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EVALUATING THE EFFECTIVENESS OF PERFORMANCE-BASED ROAD CONTRACTS IN EMERGING ECONOMIES: A GHANAIAN CASE STUDY

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ABSTRACT

Ghana's Transport Sector Improvement Project (TSIP) represents the country's first systematic deployment of Output and Performance-Based Road Contracts (OPBRCs), comprising six design-build-maintain contracts across 1,029.43 km of trunk and feeder roads in the Northern, Bono East, and Upper West Regions of Ghana between 2017 and 2025, at a total project financing of US$187.48 million. This study evaluates the effectiveness of OPBRCs as a road infrastructure delivery modality in an emerging economy context and identifies the principal challenges encountered during implementation. Drawing on five primary World Bank and Government of Ghana evaluation documents spanning the full project lifecycle, findings demonstrate that engineering and economic outcomes substantially exceeded targets: the International Roughness Index (IRI) improved from 7.50 to 2.955 m/km, trunk road travel time fell by 53% against a 25% target, feeder road travel time fell by 50-93% against a 20% target, and ex-post Economic Internal Rates of Return (EIRRs) of 30.4-42.7% exceeded the 26-36% appraisal benchmark. Against these gains, five systemic challenges were documented: procurement delays extending to 49 months; contractor capacity gaps producing abnormally low bids and maintenance non-compliance; macroeconomic and fiscal instability causing work stoppages and generating approximately US$659,000 in interest losses; a critical post-closing trunk road maintenance funding gap; and environmental, social, health and safety non-compliance resulting in nine fatalities and GH₵4.5 million in performance deductions. The study applies Principal-Agent Theory (PAT) as the analytical lens and benchmarks Ghana's outcomes against international evidence from Latin America, Asia, and Africa, contributing the first peer-reviewed evaluation of Ghana's complete OPBRC programme.

Keywords: *Procurement; Output and Performance-Based Road Contracts; OPBRC; Sustainability: Emerging Economies; Road Infrastructure; Performance-Based Contracting; Transport Sector Improvement Project; Principal-Agent Theory.*

LIST OF ABBREVIATIONS

ABBREVIATION	FULL MEANING
ADB	Asian Development Bank
AIT	Annual Implementation Target

ABBREVIATION	FULL MEANING
B/C	Benefit-Cost Ratio
BCR	Benefit-Cost Ratio
BoQ	Bill of Quantities
CAREC	Central Asia Regional Economic Cooperation
CREMA	Contrato de Recuperación y Mantenimiento (Contract for Recovery and Maintenance)
DBB	Design-Bid-Build
DFR	Department of Feeder Roads
ECF	Extended Credit Facility (IMF)
EIRR	Economic Internal Rate of Return
ESHS	Environmental, Social, Health and Safety
EU	European Union
GDP	Gross Domestic Product
GHA	Ghana Highway Authority
GoG	Government of Ghana
HDM-4	Highway Development and Management Model (Version 4)
ICR	Implementation Completion and Results Report
IDA	International Development Association
IMF	International Monetary Fund
IRI	International Roughness Index
MC	Monitoring Consultant
MoF	Ministry of Finance
MRH	Ministry of Roads and Highways
NPV	Net Present Value
OHS	Occupational Health and Safety
OPBRC	Output and Performance-Based Road Contract
OPRC	Output and Performance-Based Road Contract (variant usage)
PAD	Project Appraisal Document
PAT	Principal-Agent Theory
PBC	Performance-Based Contract
PBMC	Performance-Based Maintenance Contract
PBRC	Performance-Based Road Contract
PCR	Project Completion Report
PDO	Project Development Objective
PPP	Public-Private Partnership
RADMS	Road Accident Database Management System
RAP	Resettlement Action Plan
RED	Roads Economic Decision Model
SDR	Special Drawing Rights (IMF)
TSIP	Transport Sector Improvement Project
UWR	Upper West Region
VOC	Vehicle Operating Cost

INTRODUCTION

Road transport networks are the primary drivers of economic connectivity and poverty reduction across Sub-Saharan Africa, yet chronic underinvestment, misaligned contracting incentives, and fiscal constraints have left Ghana's 78,402 km network in accelerating deterioration (Tini et al., 2018; Dokyi et al., 2024; World Bank, 2026). Ghana's conventional Design-Bid-Build (DBB) contracting model has perpetuated a cycle of cost overruns, poor maintenance, and rapid re-deterioration, costing the country approximately US$1.1 billion annually in infrastructure inefficiencies (Offei-Nyako et al., 2016; Tseng & Yang, 2024). In response, the World Bank and Government of Ghana initiated the Transport

Sector Improvement Project (TSIP), deploying six Output and Performance-Based Road Contracts (OPBRCs)-the first in Ghana's history-across 1,029.43 km of trunk and feeder roads between 2017 and 2025 at a cost of US$187.48 million (World Bank, 2026; Agyekum, 2025). Despite over three decades of global OPBRC application, its effectiveness is yet to be adequately documented. Iimi & Gericke (2017) observe that "*despite the fact that OPRC are being used widely, there is little evidence showing their effectiveness*"-a gap particularly acute in Sub-Saharan African emerging economy settings (Minster et al., 2025). This article fills that gap by evaluating Ghana's OPBRC experience against two objectives: (i) to assess OPBRC effectiveness across engineering, economic, and socioeconomic dimensions; and (ii) to identify the principal implementation challenges and lessons applicable to future performance-based contracting in Ghana and comparable emerging economies.

PROJECT BACKGROUND

Ghana's road network is the economic lifeline of the country, carrying over 95% of all passenger and freight traffic across a 78,402 km system comprising 14,583 km of trunk roads managed by the Ghana Highway Authority (GHA), 48,383 km of feeder roads managed by the Department of Feeder Roads (DFR), and 15,462 km of urban roads (Dokyi et al., 2024; World Bank, 2026). Yet the sector has been structurally underfunded: Ghana's Road Fund covered only approximately 45% of maintenance needs between 2018 and 2021, against an expected 65% coverage, perpetuating rapid network deterioration (World Bank, 2026). Network condition assessments as at 2016 revealed that 41% of roads were in good condition, 33% in fair condition, and 26% in poor condition, with the 48,356 km feeder road network-serving 61.7% of the network-in the worst overall condition (World Bank, 2020). The consequences are most severe in Northern Ghana, where average travel time from rural communities to the nearest all-weather road exceeded 3.3 hours, agricultural productivity is constrained by logistics costs and post-harvest losses, and the Upper West Region records a poverty incidence of 70.7%, with Wa West District at 92.4% (World Bank, 2026; World Bank, 2020). Road improvement in this context is both a transport and a poverty reduction imperative, with agriculture contributing 22% of GDP and employing up to 50% of the regional labour force (World Bank, 2026).

Conventional Design-Bid-Build (DBB) contracting-Ghana's longstanding road procurement modality-has proven structurally incapable of addressing these challenges. Under the DBB model, contractors are paid on unit prices for different work items, creating the wrong incentive to maximise work volume rather than optimise quality and durability (Walumoli, 2015; Ogita et al., 2023). The documented pathologies include: cost and time escalation; poor work quality; inadequate contractor motivation; improper risk-sharing; susceptibility to political influence; and shorter road service life (Tseng & Yang, 2024). In Ghana, capital infrastructure cost deviations average 28% of estimated cost, and responsibility for maintenance ends at handover, with separate short-term maintenance contracts routinely underfunded-leaving recently rehabilitated roads without upkeep (Offei-Nyako et al., 2016; Minster et al., 2025). Bill of Quantities errors generate disputes whose consequences include cost overruns, project abandonment, and loss of contractor viability. These structurally embedded failures provided the impetus for Ghana's adoption of the OPBRC modality under the TSIP.

Output and Performance-Based Road Contracts (OPBRCs) emerged globally as a direct response to conventional contracting failures, first introduced in British Columbia, Canada in 1988 and subsequently adopted across Latin America, Australia, and New Zealand during the 1990s (Asian Development Ban (ADB), 2023; Sultana et al., 2012). Under the OPBRC framework, the road owner specifies what needs to be achieved rather than how, with contractors receiving lump-sum payments conditional on achieving specified service levels-such as International Roughness Index (IRI), travel time, and road condition ratings-rather than on input quantities (Dura, 2021; Iimi & Gericke, 2017; Ogita et al., 2023). This design fundamentally realigns contractor incentives with road user interests, incentivising investment in quality rehabilitation and sustained maintenance over the contract lifetime (Mutai & Aila, 2018). Since the 2010s, Sub-Saharan Africa has joined this global diffusion, with deployments documented in Chad, Djibouti, Niger, Madagascar, Mozambique, Nigeria, and Ghana (Minster et al., 2025; Giwa, 2019), though most documented experience derives from developed markets with competitive contractors, well-established maintenance institutions, and reliable financing-conditions fundamentally different from Ghana's context (World Bank, 2021).

Ghana's TSIP was approved by the World Bank Board on 6 June 2017, with an IDA credit of SDR

110.6 million (US$150 million equivalent), supplemented by a European Union grant of US$37.48 million on 11 June 2020, bringing total financing to US$187.48 million (World Bank, 2020). Six OPBRCs were deployed across two network types: a 168 km classified trunk road corridor (Tatale-Yendi-Tamale) in the Northern Region funded by IDA, and 861 km of feeder and farm roads across Bono East and the Upper West Region funded by both IDA and the EU Trust Fund (Agyekum, 2025; World Bank, 2026). The Ghana Highway Authority (GHA) managed trunk road contracts, and the Department of Feeder Roads (DFR) under the Ministry of Roads and Highways (MRH) managed feeder road contracts, with two independent Monitoring Consultants verifying service level compliance and certifying lump-sum payments (World Bank, 2022). This represented Ghana's first-ever OPBRC deployment-a landmark pilot independently evaluated by both the World Bank (World Bank, 2026) and the Government of Ghana (Agyekum, 2025), producing the richest empirical dataset on OPBRC implementation in West Africa to date.

Notwithstanding over three decades of global OPBRC application, systematic peer-reviewed evidence on effectiveness in Sub-Saharan African first-deployment settings remains sparse. Existing African evidence from Zambia (Iimi & Gericke, 2017; Iimi, 2020), Kenya (Mutai & Aila, 2018), and Nigeria (Giwa, 2019) is valuable but limited in scale, evaluative depth, and lifecycle completeness. Ghana's TSIP, with its six contracts, 1,029.43 km of independently evaluated road, and eight-year implementation trajectory, provides an unexamined dataset of considerable empirical value. No peer-reviewed study has synthesised this record to evaluate OPBRC effectiveness and document implementation challenges in a form accessible to the academic and practitioner communities. This study addresses that gap. It applies Principal-Agent Theory as the theoretical lens, benchmarks Ghana's outcomes against the international evidence base, and generates five evidence-based lessons applicable to future OPBRC deployments in Ghana and comparable emerging economy contexts.

LITERATURE REVIEW

Road Infrastructure and Economic Development

The relationship between road investment and socioeconomic development is well-established across multiple disciplines. Tini et al. (2018) demonstrate that road transport networks generate employment, income, and poverty alleviation while guaranteeing accessibility, mobility, and land-use efficiency. Ng et al. (2019) quantify this through cross-national analysis, establishing that growth in road length per thousand population contributes positively to GDP growth and export expansion, with road connectivity most impactful at moderate urbanisation levels. At the community level, Adugbila et al. (2023) document that the Accra-Kasoa road expansion attracted residential and commercial investment, improved access to health facilities and primary schools, and triggered water and electricity infrastructure improvements, with 87-95% of residents reporting perceived improvements. Ben (2019) extends the analysis to indirect effects-improved investment environments, optimised industrial structures, accelerated urbanisation, and the formation of economic traffic belts-which compound the direct accessibility gains. In Northern Ghana's project areas, these pathways are mediated through agriculture: roads reduce logistics costs, enable market participation, and directly raise smallholder incomes (World Bank, 2026).

Limitations of Traditional (BoQ) Road Contracting

Conventional Bill of Quantities (BoQ) contracting is structurally ill-suited to achieving sustainable road maintenance. The core flaw, identified by Ogita et al. (2023) and Walumoli (2015), is that unit-price payment incentivises contractors to maximise work volume rather than quality-creating a perverse incentive directly antithetical to asset preservation. Cost deviations for transport infrastructure in Ghana average 28% of estimated cost, with Ghana losing approximately US$1.1 billion annually to inefficiencies including overpricing (Offei-Nyako et al., 2016). Sultana et al. (2012) note that traditional methods are prone to corruption due to the volume-driven nature of decision-making, whereas PBMCs can reduce decision-making scope and promote transparency. Critically, Minster et al. (2025) establish that conventional contracts end responsibility at handover, leaving recently rehabilitated roads without sustained maintenance-perpetuating the cycle of premature deterioration and costly reconstruction that characterises Ghana's road sector.

Global Evidence on PBRC Effectiveness

Latin America: Pioneering Evidence

Latin America provides the most extensive PBRC evidence base, built around the CREMA (Contrato de Recuperación y Mantenimiento) model adopted in Argentina (1990), Uruguay (1996), Chile (1997), and Brazil (1998) (Sultana et al., 2012). In Brazil, Prasad et al. (2022) report CREMA unit costs of

works per kilometre 25-35% lower than traditional contracts, maintenance unit costs 34% lower, and road conditions rated 'Very Good' versus 'Regular' for traditional contracts. In Argentina, the system reduced roads in poor condition (IRI > 4) from 35% to 10% and roads in bad condition (IRI > 5) from 11% to 2%, with road user cost savings estimated at a minimum of US$275 million annually (Prasad et al., 2022). Walumoli (2015) confirms Argentina reduced the share of roads in poor condition from 25% to under 5% by 1999, and that Uruguay had 42% of its national network under performance-based contracts by January 2000. Bundling rehabilitation and maintenance in a single contract-as in Ghana's TSIP-increases contractor accountability and eliminates the gap between construction and routine maintenance (Prasad et al., 2022). Contracts of at least 3-10 years are recommended for comprehensive maintenance, as shorter durations reduce contractor incentive to invest in durable quality (Prasad et al., 2022).

Asia: Benefit Evaluation Frameworks

Asian evidence reinforces the effectiveness case and provides quantified benefit frameworks. Tseng & Yang (2024) applied a structured benefit evaluation framework to a Taiwan urban road PBRC pilot, finding a benefit-cost ratio (BCR) of 5.35 and cataloguing 14 PBRC benefit categories including cost reduction, improved service levels, risk transfer, multi-year financing, contractor innovation, enhanced asset management, and reduced corruption. The Indonesian experience provides direct precedent for Ghana's use of IRI as the primary performance metric: Susanti et al. (2016) demonstrated through a West Java PBRC pilot that performance-based contracts produce better road service performance than conventional input-based systems, with life-cycle cost savings of 9.4% (Prasad et al., 2022). The Philippines experience documented by Prasad et al. (2022) shows that the absence of contractor training prior to implementation significantly impacted programme success-a lesson with direct relevance to Ghana's first-time deployment context. Taiwan's experience further demonstrates that PBRC pilots can achieve 'satisfactory' qualitative outcomes and strong economic viability when the benefit evaluation framework is properly designed.

Africa: Emerging Evidence

African evidence on PBRC effectiveness is growing but fragmented. Iimi (2020) establishes in a peer-reviewed Zambian study that OPRC arrangements are effective at increasing agricultural production, with small-scale farmers benefiting from improved market connectivity. Roads under OPRC arrangements in Zambia showed an 18% point higher probability of receiving required maintenance works than roads under traditional contracts (Prasad et al., 2022; Iimi & Gericke, 2017). In Kenya, Mutai & Aila (2018) demonstrate that PBRC elements collectively explain 83.2% of road agency performance variance (R^2 = 0.832)-constituting strong empirical support for the model in a Sub-Saharan institutional context. Nigeria's Kaduna State OPRC-the only such pilot in Nigeria-covered 460 km of rural roads over five years, opening communities, enabling market access, and improving health and education access, though the modality has not been continued (Giwa, 2019).

Challenges of PBRC in Emerging Economies

Despite the documented benefits, the literature consistently identifies implementation challenges constraining PBRC effectiveness in developing country contexts. Sultana et al. (2012) catalogue the main barriers as: lack of government support; dependency on external funding; political influence and corruption; lack of PBMC experience; inadequate planning; fear of job loss; loss of competition; and challenges in cost estimation. Ogita et al. (2023) characterise the implementation complexity: PBRCs are more complex, requiring extensive training for practitioners and contractors, greater flexibility from governments and international financing institutions, and imposing long-term budgetary obligations. Risk allocation requires careful calibration: Walumoli (2015) notes that while OPBRCs allocate higher risk to contractors, this simultaneously opens opportunities for margin through improved efficiency and innovation. Prasad et al. (2022) establish that penalty values must be balanced-too low and contractors may not comply; too high and contractors inflate tender prices. Jangali (2021) advises that when initial rehabilitation works exceed 40-50% of contract value, risks may warrant a separate initial contract-a threshold directly relevant to Ghana's trunk road OPBRCs, where rehabilitation constituted 52-60% of contract values (Agyekum, 2025).

Theoretical Framework: Principal-Agent Theory

Principal-Agent Theory (PAT) provides the most coherent theoretical framework for understanding OPBRC incentive design and contractor behaviour. Braun and Guston (2003) define the Principal-Agent relationship as a delegation relationship in which an agent acts on the principal's behalf in exchange for remuneration, with the agent expected to further the principal's interests. Gauld (2023) applies this to public contracting: incentive-

based contracts improve public sector performance by aligning agent goals with principal desired outcomes. PAT centres on two problems: adverse selection-where the principal cannot verify agent capability at award-and moral hazard-where the agent exploits information asymmetry to minimise effort or compromise quality in unobservable ways (Shrestha et al., 2019). Rees (1984) formalises the moral hazard problem: when neither agent effort nor the state of the world is observable to the principal, the agent maximises their own utility rather than the principal's desired outcome, producing a genuine second-best result. In conventional road contracting, adverse selection manifests as abnormally low bids and moral hazard as ad hoc repairs-both documented in Ghana's TSIP. OPBRCs address these problems through: (i) performance-based payment schedules tied to jointly observable service levels; (ii) long contract durations internalising lifecycle incentives; and (iii) independent Monitoring Consultants reducing the information asymmetry that enables moral hazard (Rees, 1984; Dura, 2021).

Table 1: Principal-Agent Theory applied to the Ghana TSIP OPBRC context

PAT Concept	Manifestation in Conventional Contracting	OPBRC Design Response	Ghanaian Evidence
Adverse Selection	Client cannot verify contractor capability; lowest-price bidding selects underqualified contractors	Two-envelope procurement with rated criteria; pre-qualification requirements	GHA Lot 1 bid: 42.7% below estimate; quality and cash flow constrained (Agyekum, 2025)
Moral Hazard	Contractor maximises quantity, minimises quality; no maintenance incentive beyond handover	Lump-sum tied to service levels; long contract duration; maintenance embedded	Maintenance started after 31-121 km instead of required 5 km (World Bank, 2026)
Information Asymmetry	Client cannot monitor daily activity; contractor exploits knowledge gap on road condition	Monitoring Consultants verify service levels; IRI measured every 6 months	Two MCs appointed; GH₵4.5M deducted for non-compliance (Agyekum, 2025)
Conflict of Interest	Contractor profit maximised through volume; client interest requires quality and durability	Payment conditional on IRI and travel time outcomes; deductions for non-compliance	PDO-1 Exceeded; PDO-2 Negligible-9 fatalities (World Bank, 2026)
Participation Constraint	Contractors price below cost to win, then claim variations to recover margin	Lump-sum with price adjustment formula; advance payment for mobilisation	Average cost growth: 32.8%; UWR Lot 2: 95.6% (Agyekum, 2025)

Sources: Rees (1984); Braun & Guston (2003); Shrestha et al. (2019); Gauld (2023); World Bank (2026); Agyekum (2025).

Research Gap

While the theoretical foundations of PBRCs is grounded in PAT, the comparative advantages over conventional contracting, and the Latin American evidence base are well-established, empirical evidence on PBRC effectiveness from Sub-Saharan African first-deployment settings remains sparse and fragmented. Existing African evidence from Zambia, Kenya, and Nigeria is valuable but limited in evaluative depth and lifecycle completeness. Ghana's TSIP-with six contracts, 1,029.43 km of road, dual independent evaluations, and an eight-year lifecycle-provides an unprecedented empirical dataset for a region-specific assessment of OPBRC effectiveness. No peer-reviewed study has synthesised this record in a form that generates transferable lessons for practitioners and policymakers. This article addresses that gap, applying PAT and the international PBRC comparative evidence base to produce a comprehensive evaluation of Ghana's OPBRC experience.

RESEARCH METHODOLOGY

This study is situated within an interpretivist epistemological framework and adopts a qualitative, documentary case study design. Case study research is appropriate for contextually embedded, multi-dimensional phenomena that require rich description and process tracing rather than decontextualised measurement (Yin, 2018). The bounded case is Ghana's TSIP-comprising six OPBRCs deployed across three regions between 2017 and 2025-examined through its full project documentation cycle. A documentary approach was adopted because the primary evaluation documents-generated by the World Bank and Government of Ghana as part of the official TSIP project cycle-provide comprehensive, systematically collected, and institutionally authoritative data on all dimensions relevant to the study's two research objectives. The case enables detailed examination of mechanisms, incentive structures, and contextual moderators that make Ghana's experience both unique and transferable to comparable emerging economy contexts.

The analytical corpus comprises five primary documentary sources: (i) the World Bank Project Appraisal Document (PAD, 2017)-providing baseline conditions, original OPBRC targets, and appraisal-stage economic analysis; (ii) the Additional Financing Project Paper (PAD3483, 2020)-documenting the EU-funded UWR feeder road scale-up, revised results framework, and poverty data; (iii) the Restructuring Paper (RES50974, 2022)-providing mid-implementation performance ratings and macroeconomic risk data; (iv) the Implementation Completion and Results Report (ICR00379, 2026)-the definitive outcome assessment with ex-post HDM-4 and RED economic models, all PDO indicator actuals, and formal lessons; and (v) the Project Completion Report (PCR, Agyekum, 2025)-the Government of Ghana's independent evaluation corroborating and extending the ICR. These sources were selected on criteria of official authority, systematic data collection, lifecycle coverage, and capacity for triangulation across independent evaluators.

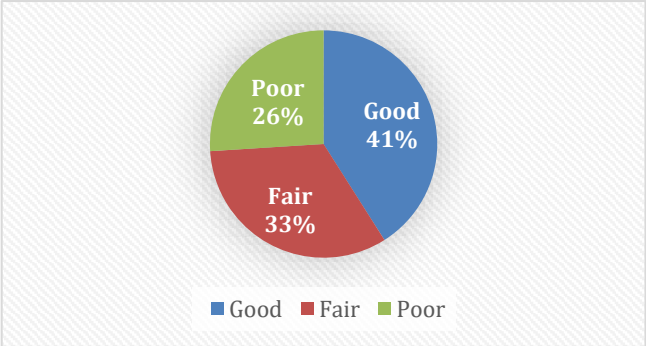
A systematic data extraction protocol was applied across all five sources, organised around five thematic categories: OPBRC contract structure; engineering performance; economic performance; socioeconomic impacts; and implementation challenges. Triangulation was achieved by comparing ICR and PCR figures-noting and explaining discrepancies, such as the divergence between the ICR ex-post EIRR of 30.4% and the PCR EIRR of 42.7% on the trunk road, attributable to different traffic growth assumptions (World Bank, 2026); cross-referencing appraisal targets from the PAD and PAD3483 against completion actuals; and checking administrative data from the Ministry of Finance Programme-Based Budget Estimates and the World Bank Implementation Status Report against project-cycle documentation. Material findings are reported only were corroborated by at least two independent sources. The analytical framework integrates PAT-providing theoretical language for interpreting incentive design and contractor behaviour-with the international PBRC comparative evidence base (Minster et al., 2025; Dura, 2021; Iimi & Gericke, 2017; Prasad et al., 2022), which provides the benchmarks against which Ghana's outcomes are evaluated.

FINDINGS

Ghana Road Infrastructure Baseline at Project Inception

At project appraisal in 2017, Ghana's road network comprised 78,401 km, of which only 26% was paved. Network condition assessments indicated 41% good, 33% fair, and 26% poor (Figure 1), with feeder roads-comprising 61.7% of the network-in the worst overall condition (World Bank, 2020). The Road Fund covered only approximately 45% of maintenance needs (target: 65%), and average travel time from rural centres to the nearest all-weather road in Northern Ghana exceeded 3.3 hours (World Bank, 2026). Upper West Region poverty stood at 70.7%-the highest in Ghana-with Wa West District at 92.4% (World Bank, 2020). The trunk road IRI baseline was 7.50 m/km (classified Poor under World Bank standards), against a project target of 3.50 m/km (World Bank, 2017).

Figure 1: Road network condition mix at baseline (2016)

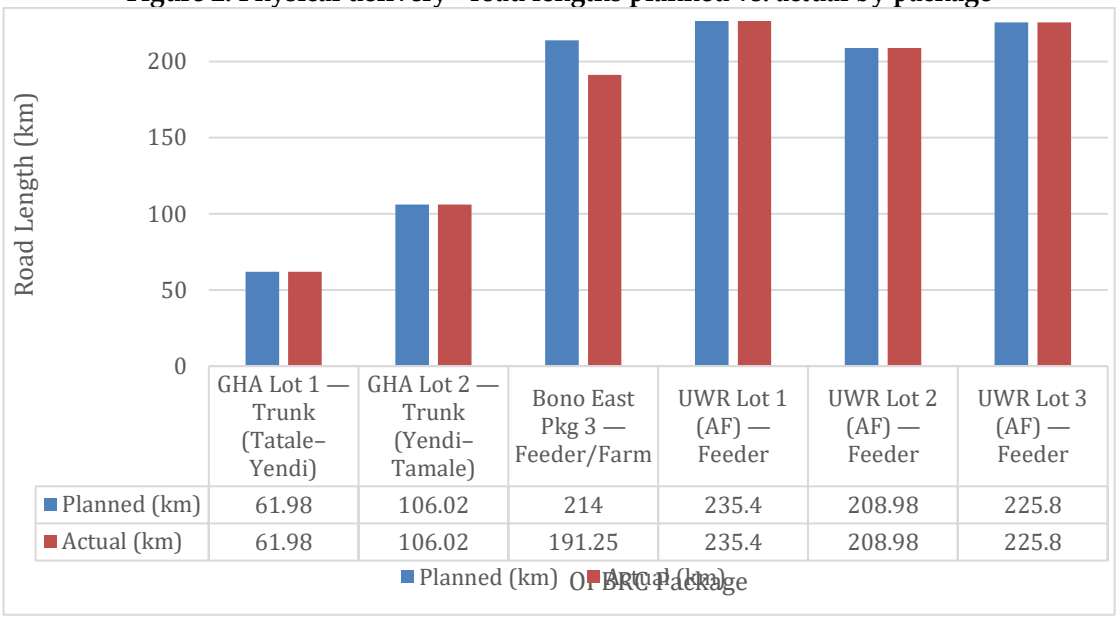


Research Objective 1-Effectiveness of OPBRC Delivery

Physical Delivery

The TSIP deployed six OPBRCs across 1,029.43 km-97.8% of the 1,052.18 km planned target (Agyekum, 2025). The shortfall is attributable to the Bono East package, where 191.25 km was delivered against a 214 km plan following reclassification of some sections (World Bank, 2026). Disaggregated by type: 167.40 km of trunk roads (target 166 km-100.8% achieved); 861.35 km of feeder roads (target 877 km-98.2%); and 7 km of farm roads (100%). Completion rates at project closing were 100% for the three EU-funded UWR contracts, 99% for the IDA trunk road contracts, and 98% for the Bono East feeder contract (Agyekum, 2025).

Figure 2: Physical delivery - road lengths planned vs. actual by package



Road Surface Quality-International Roughness Index

The trunk road IRI improved from 7.50 m/km (Poor) at baseline to 2.955 m/km (Good) at project closing-a 60.6% improvement, surpassing the 3.50 target by 15.7% (World Bank, 2026; Agyekum, 2025). The PCR documents the trajectory: IRI declined from 7.20 in June 2022 (on-site measurement) to 5.1 in May 2025, reaching 2.955 in June 2025. Lot 1 recorded 2.95 m/km and Lot 2 recorded 2.96 m/km. This improvement reflects the combined effect of rehabilitation works and the maintenance service level compliance embedded in the OPBRC contract structure.

Figure 3: IRI progression-trunk Road (168 km), baseline to closing

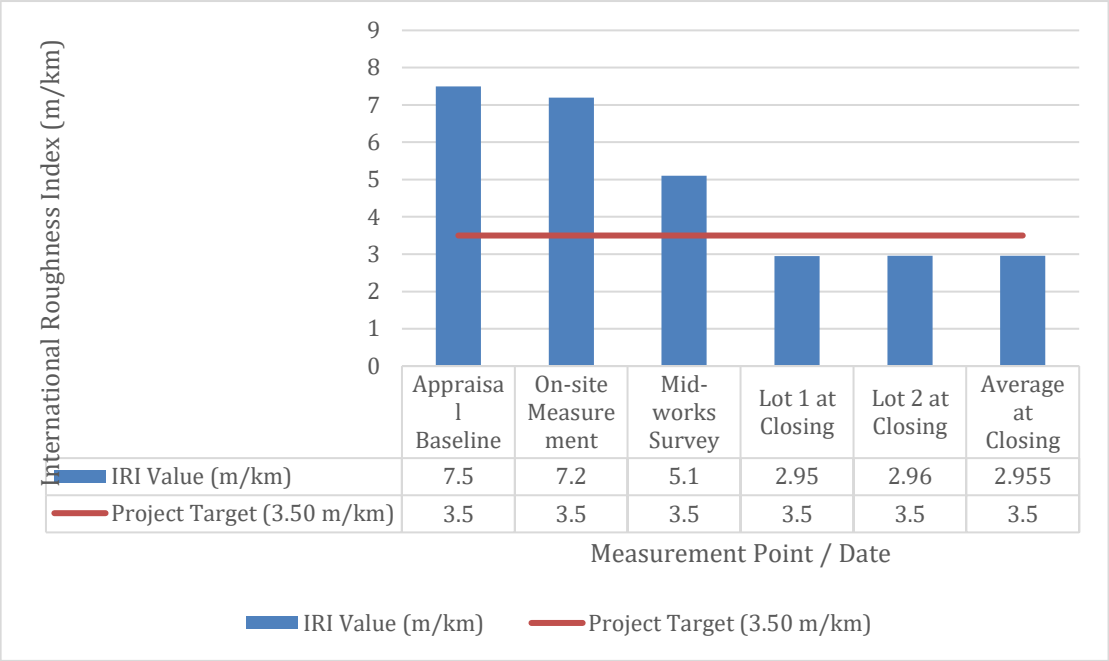
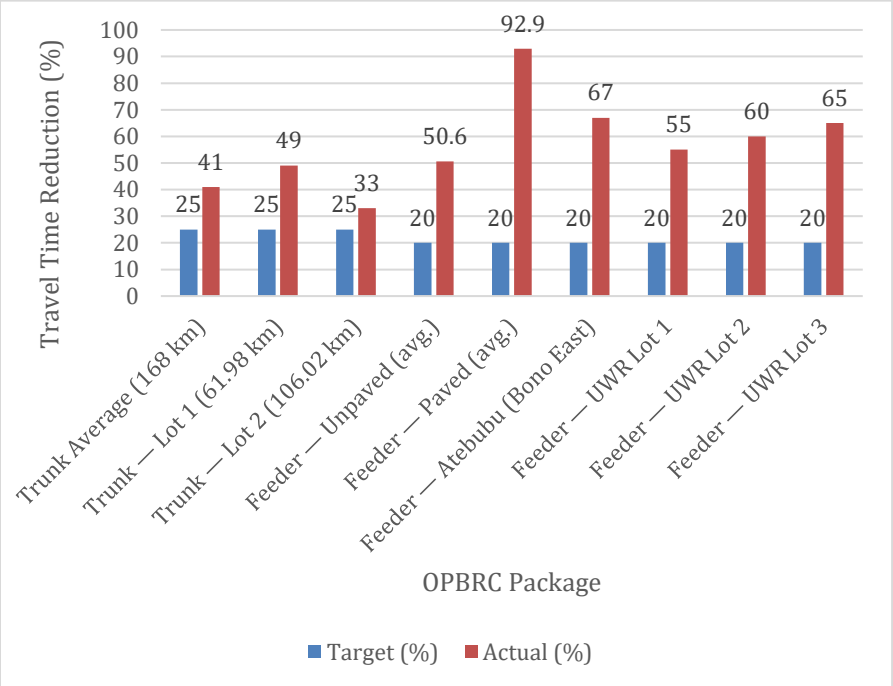


Figure 4: Travel time reduction - target vs. actual



Travel Time Reduction

Travel time reduction was the principal PDO-1 outcome indicator. On the 168 km Tatale-Tamale trunk corridor, travel time fell from approximately four hours to two hours and 43 minutes-a 53% reduction against a 25% target (Agyekum, 2025; World Bank, 2026). Average travel speed rose from 42 km/h to 61.8 km/h (World Bank, 2026). Lot 1 achieved 49% and Lot 2 achieved 33% reduction. On feeder roads, unpaved sections recorded a 50.6% reduction (22 to 11 minutes) and paved sections a 92.9% reduction (19 to approximately 2 minutes), all against a 20% target (Agyekum, 2025). Package-level results: Atebubu 67%; UWR Lot 1 55%; UWR Lot 2 60%; UWR Lot 3 65% (World Bank, 2026).

Economic Viability

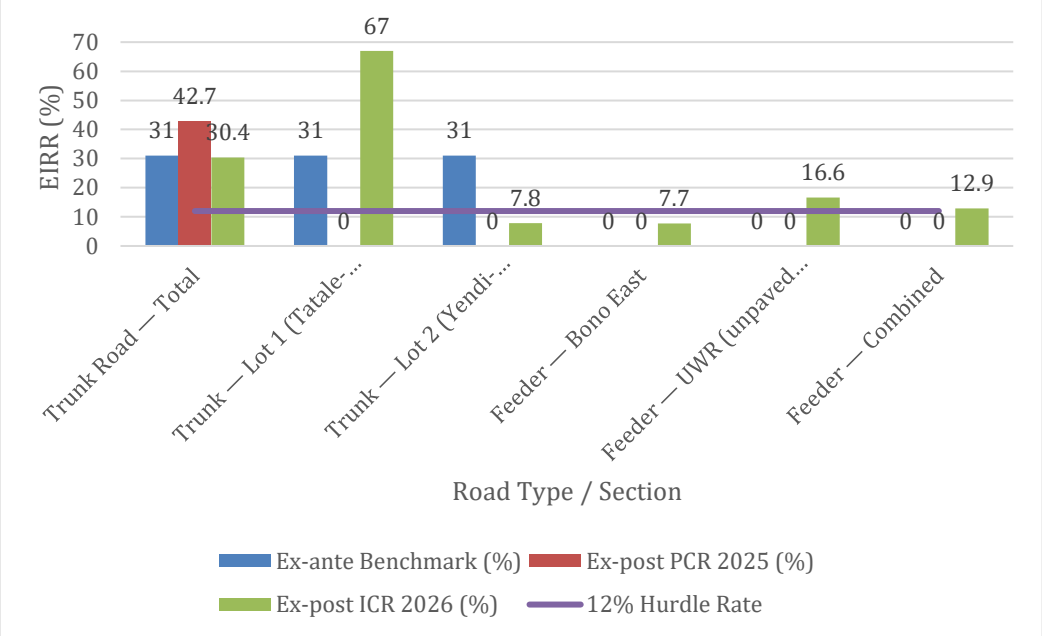
Ex-post economic analysis used HDM-4 for trunk roads and the RED model for feeder roads, both at a 12% discount rate over 20 years. The appraisal EIRR benchmark was 26-36% (World Bank, 2017). The PCR reported an ex-post EIRR of 42.7% and NPV of US$282.20 million, with VOC savings of US$166.95 million and travel time savings of US$58.70 million (Agyekum, 2025). The ICR independently produced an EIRR of 30.4%, NPV of

US$174 million, and B/C ratio of 4.1 (World Bank, 2026). Both exceed the appraisal benchmark. Lot 1 (Tatale-Yendi-upgrading an entirely unsealed road) returned 67% EIRR; Lot 2 (Yendi-Tamale) returned 7.8% in isolation but is economically dependent on Lot 1 traffic generation (World Bank, 2026). Feeder road EIRRs of 15-32% on unpaved sections exceeded the 12% hurdle rate; paved sections returned 3-11%, reflecting high unit costs relative to low traffic volumes (Agyekum, 2025). The combined feeder EIRR of 12.9% (World Bank, 2026) sits at the minimum acceptable threshold.

PDO Achievement and Outcome Ratings

The World Bank's formal outcome ratings reveal a differential pattern. PDO-1 (reduce travel time)-directly tied to OPBRC civil works-was rated Substantial, with IRI, trunk travel time, and feeder travel time all exceeding targets. PDO-2 (promote road safety) was rated Negligible, driven by the failure to operationalise the Road Accident Database Management System (RADMS) and integrate Private Vehicle Test Stations-activities outside the OPBRC scope. PDO-3 (strengthen institutions) was rated Modest, reflecting dropped activities and the 2025 reversal of the National Road Authority Act. The overall project outcome was rated Moderately Unsatisfactory (World Bank, 2026). This pattern confirms that the OPBRC modality was highly effective within its technical remit, while broader project objectives attached to it were less consistently achieved.

Figure 5: Economic viability-EIRR comparison by road type/section



Socioeconomic Effectiveness

By project closing, 219,143 people had gained improved transport access-13.7% above the 192,720 target-with 214,143 gaining all-season road access (World Bank, 2026). The Upper West Region accounted for 130,785 beneficiaries, the Northern Region for 59,717, and Bono East for 28,641. On feeder roads, 50% of users reported increased market access, 16.7% reported reduced produce loss, and 10% reported lower freight charges (Agyekum, 2025). Average monthly income increased by US$178.77 (males) and US$129.92 (females) on feeder road corridors. Female school attendance increased by 13% and 86% of students reported positive impacts on education access (World Bank, 2026). Direct employment reached 5,207 persons, with 1,532 (29.4 %) female-substantially exceeding the 10% female employment target (Agyekum, 2025). The OPBRC construction phase generated over 49,122 job opportunities in total.

Research Objective 2-Implementation challenges

Challenge 1-Procurement Delays and Mobilisation

The most pervasive challenge was the accumulated delay between approval and mobilisation. The project became effective on 31 August 2018-13 months after Board approval-owing to Restructuring No. 1 and delayed AIT appointments (World Bank, 2026). The two trunk road OPBRCs were not signed until July 2021-

nearly five years after approval-following protracted design reviews, procurement bottlenecks, and a 29-month RAP finalisation delay (World Bank, 2026). UWR design phases extended to 20-27 months against a planned nine months, driven by concept design inadequacy and limited contractor capacity (Agyekum, 2025). Only 69% of procurement activities were completed within planned timelines, with 27% delayed (Agyekum, 2025).

Challenge 2-Contractor Capacity Gaps

Ghana's first OPBRC deployment encountered significant contractor capacity deficits. Three pre-commencement workshops were held but deemed insufficient regarding lifecycle cost risks, self-regulation obligations, and long-term contractual risk profiles (Agyekum, 2025). Bidding produced prices cumulatively 42% below engineer's estimates, with GHA Lot 1 priced 42.7% below-an abnormally low bid that constrained cash flow and quality throughout (Agyekum, 2025). Maintenance obligations to begin after every 5 km of rehabilitation were not met: UWR Lot 1 began after 121.2 km, Lot 2 after 60.1 km, and Lot 3 after 31.2 km (World Bank, 2026). Average cost increase across all six contracts was 32.8% (Agyekum, 2025).

Challenge 3-Macroeconomic and Fiscal Instability

Ghana's fiscal environment created structural constraints incompatible with OPBRC long-term cash flow requirements. The country entered its eighth IMF Extended Credit Facility (ECF) programme since 1987 in 2023, resulting in the Ministry of Finance capping disbursements from October 2024 (World Bank, 2026). This halted civil works and caused contractors' key staff to leave sites. Interest on delayed invoice payments for the two trunk road contracts accrued to approximately US$659,000 by May 2025 (World Bank, 2026). At project closing, US$11.4 million in payment certificates remained pending and US$12 million in IDA credit remained undisbursed (World Bank, 2026). Ghana's public debt had reached 78% of GDP in 2020 (World Bank, 2022), making the OPBRC model's reliance on steady predictable cash flows a structurally problematic fit for this fiscal context.

Challenge 4-Maintenance Sustainability Post-Project

The post-closing maintenance gap on trunk roads is the most consequential long-term risk. The 7-year trunk road contracts extend to August 2028-three years beyond project closing-but no Government of Ghana budget was allocated for this maintenance period by December 2025 (World Bank, 2026). The Monitoring Consultant contract was terminated at project closing, leaving GHA to supervise with one person reported on site in September 2025 (World Bank, 2026). Remedial works on Lot 1-including 3.2 km of second seal and five clinics-were completed only in December 2025, six months post-closing. Outstanding Lot 2 issues included missing contractor key staff, defective speed humps, hazardous materials, and incomplete signage (World Bank, 2026). This sustainability risk is acute because the OPBRC replaced the conventional defect liability period with an integrated maintenance obligation-leaving no post-construction liability protection at closure.

Challenge 5-ESHS Non-Compliance

Safety and environmental compliance was persistently inadequate across all six contracts. Nine contractor fatalities and 49 safety incidents were recorded, of which only seven were formally reported per World Bank procedures (World Bank, 2026). Total ESHS payment deductions reached GH₵4,498,105.64 across all contracts (Agyekum, 2025), confirming that the contractual penalty mechanism functioned but was insufficient to prevent harm. The ICR recommends integrating OHS requirements into feasibility studies and bidding documents, and enforcing zero-tolerance for ESHS non-compliance linked to payment certification (World Bank, 2026).

Table 2: Challenge severity and impact matrix-Ghana TSIP OPBRC

Challenge	Key Evidence	Severity	Reversibility	Long-term Risk
Procurement & signing delays	~49 months to trunk road signing; 29-month RAP delay	High	Mitigable	Moderate
Contractor capacity gaps	42% underpricing; 20-27 month design delays; OPBRC novice	High	Trainable	Moderate
Macroeconomic/fiscal instability	IMF ECF cap; US$659K interest; US$12M undisbursed	Very High	External/systemic	High
Maintenance sustainability	No GoG budget; 3-yr gap; 1 supervisor post-closing	Critical	Budget-dependent	Very High
ESHS non-compliance	49 incidents; 9 fatalities; GH₵4.5M deductions	High	Preventable	Moderate

Severity: **Critical** = threatens long-term viability; **Very High** = materially impaired; **High** = significantly impacted but managed. Sources: World Bank (2026); Agyekum (2025).

Comparative Effectiveness: Trunk vs. Feeder Road OPBRCs

A key finding is the differential performance between road types. Feeder road OPBRCs consistently outperformed trunk road OPBRCs on process compliance and maintenance adherence, while trunk road OPBRCs returned higher absolute economic EIRRs. The three EU-funded UWR feeder packages reached 100% completion; the IDA trunk road contracts were 99% complete with outstanding remedial works (Agyekum, 2025). Feeder OPBRCs signed contracts 10-37 months post-approval versus 49 months for trunk roads, and maintained within contract frameworks. Jangali (2021) confirms that when initial rehabilitation represents over 40-50% of contract value, risks may be too high for pure OPBRC delivery-a threshold exceeded by Ghana's trunk road contracts at 52-60% (Agyekum, 2025). This cross-sectional asymmetry confirms the ICR's conclusion (World Bank, 2026) that feeder OPBRCs reflect better alignment between contract complexity and local contractor capacity, and that trunk corridors requiring heavy reconstruction should adopt hybrid arrangements-completing rehabilitation under conventional contracts before transitioning to performance-based maintenance.

DISCUSSION

The findings both affirm and qualify the international PBRC evidence base. On engineering and economic metrics, Ghana's TSIP substantially exceeded its targets, mirroring the Latin American experience documented by Prasad et al. (2022)-where CREMA contracts in Brazil achieved unit costs 25-35% lower and road conditions substantially superior to traditional contracts-and the Kenyan evidence of Mutai & Aila (2018), who demonstrate PBC as a significant predictor of road agency performance. The 219,143 beneficiaries who gained improved access and the 50% increase in feeder road market access parallel Iimi's (2020) Zambian findings on OPRC agricultural productivity impacts, establishing a consistent Sub-Saharan African evidence trail. The B/C ratio of 4.1 and EIRRs of 30-43% on the trunk road are consistent with Tseng & Yang's (2024) BCR of 5.35 in Taiwan and the benefit categories documented in the international literature.

The finding that feeder road OPBRCs consistently outperformed trunk road OPBRCs is a novel contribution to the literature, which has not previously distinguished between these sub-types systematically in an African context. This asymmetry is precisely predicted by PAT's adverse selection framework (Shrestha et al., 2019; Rees, 1984): trunk road contracts involved higher reconstruction intensity (52-60% of contract value), longer durations, more complex design reviews, and higher contract values-all conditions that amplify principal-agent problems when institutional capacity is limited. Minster et al. (2025) note that OPBRC case studies differ widely across political context, governance, and stakeholder capacity-the dimensions that differentiated trunk and feeder performance in Ghana's TSIP. The practical implication-that heavy reconstruction should be separated from performance-based maintenance in first-deployment settings-extends Jangali's (2021) 40-50% threshold guidance and provides operationalised design criteria for future deployments.

The macroeconomic dimension-Ghana's IMF ECF-driven disbursement cap and the resulting US$659,000 in interest accruals-has not been documented in previous African OPBRC case studies and constitutes a significant contribution. Sultana et al. (2012) identified external funding dependency as a barrier in developing countries, but Ghana's experience shows the specific mechanism: fiscal consolidation-induced payment interruption, not merely funding dependency. This finding directly validates PAT's participation constraint prediction (Rees, 1984): OPBRC lump-sum structures require continuous cash flow to sustain maintenance obligations, making them structurally incompatible with discretionary government disbursement capping under IMF fiscal frameworks. The implication-pre-funded payment security mechanisms as a contractual prerequisite-advances the literature beyond general capacity warnings (Ogita et al., 2023) toward specific structural design prescriptions.

RECOMMENDATIONS AND IMPLICATIONS FOR PRACTICE

This study generates five evidence-based recommendations for policymakers, road agencies, and development partners designing future OPBRC programmes in Ghana and comparable emerging economies.

First, the Ministry of Roads and Highways and Ministry of Finance should institutionalise ring-fenced, pre-funded payment mechanisms-such as OPBRC-specific escrow accounts or Road Fund sub-accounts-that protect contractor cash flow from broader fiscal consolidation measures. Ghana's experience demonstrates that the long-term lump-sum OPBRC payment structure is incompatible with ad hoc disbursement capping under IMF fiscal frameworks (World Bank, 2026).

Second, GHA and DFR should apply the hybrid contracting principle for future trunk road programmes: conventional BoQ contracts for the rehabilitation phase where reconstruction intensity exceeds 40-50% of contract value, transitioning to performance-based maintenance thereafter (World Bank, 2026).

Third, the World Bank and MRH should design multi-year, phased capacity building programmes beginning at least 18 months before OPBRC contract award, covering not only technical design and tendering but long-term risk management, self-regulation obligations, and ESHS requirements (Agyekum, 2025).

Fourth, procurement regulations for OPBRC awards should be updated to mandate two-envelope evaluation with rated technical criteria, eliminating the lowest-price bidding that produced abnormally low bids in Ghana's TSIP (World Bank, 2026).

Fifth, all future OPBRC bidding documents should embed ESHS compliance standards as minimum eligibility criteria-not post-award penalties-including mandatory OHS certification, incident reporting obligations, and linkage of safety performance to payment certification (World Bank, 2026). These five recommendations constitute a structured institutional reform agenda for OPBRC mainstreaming in Ghana's road sector.

CONCLUSION

This study evaluated Ghana's inaugural Output and Performance-Based Road Contract programme under the TSIP-the most comprehensive OPBRC deployment documented in West Africa-and identified five principal implementation challenges with transferable lessons for emerging economies. The empirical evidence is largely affirmative of OPBRC effectiveness within its technical remit: IRI improved from 7.50 to 2.955 m/km, trunk road travel time fell by 53% against a 25% target, feeder travel time fell by 50-93%, ex-post EIRRs of 30.4-42.7% exceeded the appraisal benchmark, 219,143 beneficiaries gained improved access, and female employment substantially exceeded targets. These outcomes affirm the OPBRC modality's value as a road infrastructure contracting instrument in the Sub-Saharan African context and extend the international evidence base from Latin America and Asia into a first-deployment West African setting.

The study simultaneously documents significant implementation challenges that reveal the structural preconditions required for OPBRC success: reliable long-term payment security compatible with fiscal constraints; graduated contract design that limits reconstruction intensity in first-deployment settings; sustained multi-year capacity building for all parties; risk-calibrated procurement that prevents abnormally low bids; and proactive ESHS integration in bid qualification rather than post-award penalties. The consistent superiority of feeder road over trunk road OPBRCs-documented here for the first time in a systematic peer-reviewed analysis-provides actionable design guidance for contract scoping in low-capacity settings. The macroeconomic finding that IMF ECF disbursement capping structurally

disrupts OPBRC cash flows opens a new dimension of the emerging economy OPBRC effectiveness debate that warrants attention from both researchers and development finance practitioners.

This study is limited to the six OPBRC packages under the TSIP (2017-2026) and to primary documentary sources; future research should complement these findings with contractor and community field interviews to triangulate the institutional and behavioural dimensions of OPBRC implementation. Comparative studies across Ghana's subsequent OPBRC deployments-as the modality transitions from pilot to mainstreamed procurement instrument-will further test and refine the lessons extracted here. The study contributes the first peer-reviewed synthesis of Ghana's complete OPBRC experience, grounded in Principal-Agent Theory, and offers a replicable analytical framework for evaluating performance-based road contracting in comparable emerging economy contexts.

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