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Upstream Investment Risk and Opportunities in West Africa's Marginal Offshore Assets: Case Study of Sèmè Field's Technical Setbacks and Fiscal Revival Strategies


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CERTIFICATION PAGE

This report is certified as an original research work conducted by African Energy Research (AER) in accordance with approved research standards, methodologies, and ethical guidelines.

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DECLARATION

This research report has not been submitted to any other institution for any purpose and all sources of data and references have been duly acknowledged.

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LIST OF ACRONYMS & ABBREVIATIONS

MOPUs	Modular Mobile Offshore Production Units
FSOs	Floating Storage and Offloading
PSC	Production Sharing Contract
Q4	Fourth Quarter
FDI	Foreign Direct Investment



Executive Summary

West Africa's marginal offshore assets defined as smaller fields with recoverable reserves typically under 50-100 million barrels of oil equivalent, offers a mixed investment environment characterized by significant resource potential and persistent operational and fiscal challenges. However, risks such as technical drilling challenges, fiscal uncertainties and infrastructure gaps persists. This research uses the Sèmè field in Benin as a central study case study to illustrate these dynamics. Discovered in 1969 and shut-in since 1998 after producing approximately 22 million barrels, Sèmè is undergoing redevelopment by Akrake Petroleum(Rex International Subsidiary). The project targeting approximately 15,000 bpd initial production, encountered substantial technical setbacks in 2025, including geomechanical instability in overburdened shales leading to stuck pipe incident and re-drilling, delaying first oil from Q4 2025 to late January 2026.



CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

West Africa's offshore petroleum landscape has undergone significant transformation over the past two decades, evolving from a frontier exploration region to a mature hydrocarbon province with diverse asset portfolios. The region, encompassing the Gulf of Guinea and extending from Mauritania to Angola, hosts substantial proven reserves estimated at over 50 billion barrels of oil equivalent, with offshore fields contributing approximately 70% of total production. However, beneath the surface of mega-projects operated by international oil companies lies a critical yet underexplored segment: marginal offshore assets that represent both considerable untapped potential and significant investment challenges.

Marginal offshore fields are typically characterized by smaller reserves, aging infrastructure, technical complexity, and higher unit development costs. In West Africa, these assets are particularly prevalent along the continental shelves of Nigeria, Benin, Togo, Ghana, and Côte d'Ivoire, where mature basins contain numerous undeveloped or stranded discoveries. The economic viability of these marginal offshore assets is naturally linked to complex variables including reservoir characteristics, water depth, distance to infrastructure, fiscal terms, and operator technical capacity.

The Sèmè offshore field, located in the Republic of Benin, represents a convincing case within this context for understanding the multifaceted challenges confronting marginal field development in the region. Initially developed with expectations of modest but sustainable production, the field has experienced repeated operational disruptions, production shutdowns, and investor withdrawals due to technical setbacks and unfavorable fiscal conditions. These technical failures, compounded by unfavorable fiscal regimes and infrastructure limitations, relegated Sèmè to stranded asset status for extended periods. However, recent government-led fiscal reforms and renewed policy attention have positioned Sèmè as a test case for reviving marginal offshore assets through improved investment frameworks.

This research seeks to develop a comprehensive framework for evaluating investment decisions in similar assets across the region. Understanding the dynamics of marginal field economics, technical risk assessment, and fiscal policy effectiveness is crucial for energy firms, policymakers, and investors navigating the evolving West African upstream sector.

1.2 Problem Statement

Despite possessing commercially viable hydrocarbon resources, many marginal offshore assets in West Africa remain stranded or underperforming. The persistent challenges include reservoir uncertainty, infrastructure degradation, limited operational flexibility, and high development costs relative to recoverable reserves. These technical risks are often exacerbated by fiscal regimes that do not adequately account for the economic realities of marginal fields, leading to poor project economics and premature asset abandonment.

The Sèmè Field exemplifies this problem. Historical development efforts were undermined by production instability, reservoir management issues, and cost overruns, which were further intensified by rigid fiscal terms and limited government incentives. The resulting investment uncertainty discouraged sustained capital inflow and stalled field redevelopment. While recent fiscal adjustments signal a strategic shift toward asset revival, there is limited empirical analysis on whether such reforms sufficiently mitigate upstream investment risks or create bankable opportunities for marginal offshore developments.

This research addresses these interconnected problems by investigating how energy firms can effectively assess, mitigate, and manage upstream investment risks in West African marginal offshore assets, using Sèmè Field as a detailed case study to derive transferable insights for the broader regional portfolio.

1.3 Aim and Objectives of the Study

The primary aim of this study is to assess upstream investment risks and opportunities associated with marginal offshore assets in West Africa, using the Sèmè Field as a

case study, with particular emphasis on technical setbacks and fiscal revival strategies. With the objective of:

- Examine the technical challenges encountered in the development and operation of the Sèmè offshore field.
- Analyze the impact of technical setbacks on production performance and investment outcomes.
- Evaluate the fiscal and regulatory framework governing marginal offshore assets in Benin.

1.4 Scope of the Study

This study focuses on upstream oil and gas investment in marginal offshore assets within West Africa, with the Sèmè Field serving as the central case study. The analysis covers technical performance, investment risk factors, and fiscal policy evolution related to the field. While regional comparisons are drawn to provide broader context, the study does not extend to onshore assets, or midstream/downstream operations.

1.5 Significance of the Study

The detailed analysis of Sèmè Field's challenges and potential revival creates a valuable reference case for firms considering similar assets across the region, potentially reducing due diligence costs and improving investment outcomes. The study provides practical frameworks for evaluating investment opportunities in marginal offshore assets, and offering risk assessment methodologies. For investors and upstream operators, it highlights critical risk factors and opportunity drivers influencing capital allocation decisions. For energy researchers and policy analysts, the study contributes to the growing body of literature on marginal field economics and upstream investment resilience in emerging hydrocarbon provinces. Ultimately, the study supports evidence-based decision-making aimed at maximizing resource recovery while balancing investment risk in West Africa's evolving upstream landscape.

CHAPTER TWO: LITERATURE REVIEW

2.1 Conceptual Review

2.1.1 Overview of Marginal Offshore Assets in West Africa

West Africa's marginal offshore fields, concentrated in the Gulf of Guinea (Nigeria's Niger Delta shelf, Benin's Dahomey Basin, Ghana's Tano Basin), have historically contributed material volumes to global oil supply. They are considered commercially challenged under prevailing technical, fiscal, or market conditions. These challenges typically arise from small reserve sizes, mature reservoirs, high unit operating costs, aging infrastructure, or long production downtimes.

Opportunities stem from tie-backs to existing FPSOs and improved seismic data, while risks include volatile Brent prices and aging infrastructure. Recent policy shifts (eg. Angola's reduced royalties for marginal discoveries and Nigeria's low signature bonuses), have revived interest, substantial annual FDI to the region. However, investors continue to weigh above-ground risk (legal, fiscal, security) alongside subsurface potential when making capital allocation decisions.

2.1.2 Sèmè Field (Offshore Benin)

The Sèmè field, located in shallow water depth (approximately 20-30m) offshore Southeastern Benin (about 15km from the coast), illustrates the challenges and potential in redeveloping marginal offshore assets in West Africa. Discovered in 1969 by Union Oil and initially produced from early 1980s to 1998, the field is now being revitalized by Akrake Petroleum, a subsidiary of Lime Petroleum Holding. Akrake holds 76% interest in the project, with the Benin government retaining 15% and other partners the remainder. The redevelopment, aimed at unlocking remaining recoverable reserves, highlighting both technical obstacles in mature but under-maintained fields and the role of fiscal incentives in enabling economic revitalization.

Technical Setbacks

The Sèmè redevelopment campaign, launched in August 2025, involved a three-well program designed to bring the field back online after nearly three decades of dormancy. This included one exploration or appraisal well (AK-1P) and two horizontal production wells (AK-1H and AK-2H), targeting the primary H6 reservoirs (a production sandstone known for light crude). The campaign utilized the Borr Drilling Gerd jack-up grid, selected for its suitability in shallow waters and track record in similar West African operations. However, the effort encountered significant technical challenges that underscore the inherent risks of marginal field revivals, particularly in geologically complex environments with limited modern data.

Drilling operations were disrupted by geomechanical instability in the overburdened shale layers above the reservoirs. These shales exhibited poor borehole stability due to their reactive clay content and overpressured zones, leading to wellbore collapses and stuck pipe incidents. Specifically, during the drilling of AK-H1 and AK-H2, the team faced multiple stuck pipe events caused by the differential pressure sticking and mechanical binding, requiring time consuming fishing operations and sidetracks. As a result, sections of the wells had to be redrilled, extending the campaign timeline by several months.

The delay pushed the original startup target from Q4 2025 to late January 2026, impacting projected cash flows and highlighting data limitations in marginal fields. To mitigate, the project incorporated modular infrastructure upgrades, including the Mobile Offshore Production Unit (MOPU) Stella Energy 1 (a converted jack-up platform with processing capacity of 20,000bpd) and the Floating Storage and Offloading (FSO) vessel Kristina (storage for 300,000 barrels). These modular solutions allowed for phased validation and testing, enabling partial operations despite setbacks. This emphasizes the need for advanced geomechanical modelling, real-time monitoring, and contingency planning in marginal fields, where limited well control amplifies risks.

Fiscal Revival Strategies

The Benin production sharing contract (PSC) regime, governed by the 2019 Hydrocarbon Code (Law No. 2019-06) and tailored for marginal fields like Sèmè, has been instrumental in attracting Rex International's investment. The PSC framework emphasizes cost recovery, profit sharing and incentives to revive dormant assets, making it competitive within West Africa. For marginal offshore fields, Benin offers enhanced terms to offset high and low margins.

Key elements include a cost recovery cap of 70-80% of gross production (depending on water depth and field maturity, Sèmè in shallow water, qualifies for the upper end), allowing operators to reclaim exploration, development, and operating expenses before profit splits. This is higher than standard PSC caps in neighboring Nigeria and provides a safety net, where technical delay inflated capex.

2.2 Theoretical frame work

In upstream oil and gas projects, risk arises from subsurface uncertainty, technical complexity, oil price volatility, and fiscal and regulatory exposure. Marginal offshore assets, such as the Sèmè Field, inherently carry higher risk profiles due to small reserve sizes, aging infrastructure, and limited subsurface data, which magnify the probability of cost overruns and production delays. In the case of Sèmè, geomechanical instability and drilling complications increased capital intensity and delayed first oil, thereby elevating project risk and compressing net present value (NPV). According to the risk–return framework, such outcomes necessitate compensatory mechanisms—either through higher oil prices, reduced costs, or supportive fiscal terms—to restore investment attractiveness.

2.3 Empirical Review

Empirical studies on West Africa's upstream sector consistently highlight the declining attractiveness of mature offshore assets under rigid fiscal and operational frameworks. Industry reports indicate that while the region remains geologically prospective, capital has increasingly migrated toward lower-risk deepwater projects or more competitive basins globally.

Studies on marginal field development in Nigeria's Niger Delta shelf and Ghana's Tano Basin demonstrate that enhanced fiscal terms such as higher cost recovery caps and reduced government take significantly improve project economics, particularly for brownfield redevelopments. Empirical evidence also suggests that access to modern seismic reprocessing and horizontal drilling technologies can materially improve recovery factors in mature reservoirs.

However, multiple case studies report that technical setbacks such as borehole instability, stuck pipe incidents, and reservoir pressure uncertainty are unequally common in marginal offshore redevelopments due to limited historical data and long dormancy periods. These findings align with observations from the Sèmè Field redevelopment, where geomechanical challenges in overburden shales led to drilling delays and cost escalation.

2.4 Knowledge Gaps Identified

Despite a growing body of literature on marginal fields and upstream fiscal reform, several gaps remain evident. There exists a knowledge gap in systematically understanding how technical risk mitigation strategies and fiscal revival mechanisms can be optimally combined to unlock marginal offshore value in the West African context. The absence of comprehensive case studies documenting both failures and potential success pathways leaves operators, investors, and policymakers without empirical guidance for navigating these complex decisions. This study seeks to address these gaps by integrating technical, fiscal, and investment perspectives through an in-depth case study of the Sèmè offshore field.

CHAPTER THREE: METHODOLOGY

3.1 Research Design

The Sèmè offshore field is selected as a representative case of marginal offshore redevelopment in West Africa due to its long production history, extended dormancy, recent redevelopment attempt, and exposure to both technical setbacks and fiscal reform measures. While the study is not intended to generate statistically generalizable results, it aims to produce analytically transferable insights relevant to similar marginal offshore assets across the Gulf of Guinea. The research design integrates:

- Technical risk assessment,
- Fiscal regime evaluation
- Investment decision analysis

3.2 Data Sources

The Primary data used for this study comprises information obtained directly from Industry Reports and Technical Documents, Regulatory Filings, and Industry Databases. Other data sources include :

- Academic Literature
- Industry Association Publications
- News Media and Trade Publications
- Previous Case Studies and Theses

3.3 Data Collection Methods

Data were collected through documentary analysis. Relevant literature and industry materials were systematically reviewed to extract information on:

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- Technical challenges associated with marginal offshore fields,
- Drilling and production performance trends,
- Fiscal incentive structures and cost recovery mechanisms, and
- Investment outcomes and capital allocation behavior.

For the Sèmè Field case study, data collection focused on reconstructing the redevelopment timeline, identifying key technical setbacks, and evaluating the fiscal terms underpinning investment decisions.

3.4 Analytical Tools and Models

The analytical tools and models employed in this study are concepts commonly used in upstream decision-making, they are:

- Risk–Return Analysis: To assess how technical setbacks and fiscal incentives influence project risk profiles and expected returns.
- Comparative Fiscal Analysis: To benchmark Benin's PSC terms against neighboring West African jurisdictions, particularly Nigeria and Angola.
- Case Study Analysis: To integrate technical, fiscal, and operational factors into a coherent narrative explaining investment outcomes.

3.5 Assumptions and Limitations

This study operates under several necessary assumptions and acknowledges inherent limitations:

3.5.1 Key Assumptions

- Published technical and fiscal information accurately reflects field-level realities.
- Fiscal terms and regulatory frameworks remain stable over the analysis period.
- Technical challenges observed at Sèmè are broadly representative of shallow-water marginal offshore assets in West Africa.

3.5.2 Key Limitations

- Limited access to proprietary reservoir data, detailed cost structures, and confidential PSC terms restricts the depth of quantitative analysis.
- The single-case study approach limits broad generalization, although analytical insights remain transferable.
- Rapid changes in fiscal policy or geopolitical conditions may affect the long-term relevance of some findings.

3.6 Ethical Considerations

This study adheres to standard ethical research principles. All data used are obtained from publicly available, credible, and verifiable sources. Sources are appropriately acknowledged, and interpretations are presented objectively, without political or institutional bias. The research maintains analytical independence, ensuring that conclusions are driven by evidence rather than advocacy, in line with best practices for policy and industry research.

CHAPTER FOUR: DATA PRESENTATION & ANALYSIS

4.1 Data Description

The data used in this study are primarily qualitative and descriptive, supported by analytical perspective drawn from publicly available technical, fiscal, and industry sources. The dataset covers three core dimensions:

1. information on the geological setting, drilling activities, well performance, operational challenges, and redevelopment timeline of the Sèmè offshore field.
2. Fiscal data comprising Benin's Production Sharing Contract (PSC) terms under the 2019 Hydrocarbon Code, including cost recovery limits, profit-sharing mechanisms, and incentive structures for marginal fields.
3. data that support the evaluation of how technical and fiscal factors influence investment outcomes.

4.2 Analysis and Interpretation

4.2.1 Upstream Investment Risks of Sèmè Field

Technical risks are prominent, as seen in the field's 2025 campaign, where geological complexities led to borehole instability, stuck pipes and the need for re-drilling. Common issues in similar shallow water environments. These challenges inflated and delayed startup, underscoring the dry-hole risk in underexplored margins.

Security and operational risks remain a persistent threat, with piracy in the Gulf of Guinea and sabotage inflating insurance premiums and raising operational expenses. For Sèmè, aging infrastructure gaps such as reliance on Modular Mobile Offshore Production Units (MOPUs) and Floating Storage and Offloading (FSOs) heightened these issues, mirroring broader regional challenges.

4.2.2 Upstream Investment Opportunities of Sèmè Field

Despite these risks, the Sèmè field revival demonstrates substantial opportunities for upstream investment in West Africa's marginal offshore assets, offering attractive return on investment through targeted strategies.

Fiscal incentives play a central role, as evidenced by the Benin framework providing 70-80% cost recovery, combined with negotiated royalties and profit sharing terms can support viable redeployment economics. Scenario-based modelling suggests that marginal offshore projects such as Sèmè could attract mid-teen post-tax returns at Brent price, subject to execution efficiency and fiscal stability.

The deployment of modular production systems reduces development complexity and flexibility relative to permanent facilities, while phased execution helps manage technical risks. Although project-specific economics and investment levels have not been publicly disclosed, analyst estimates indicate capital requirements broadly consistent with other shallow-water redevelopment in the region.

4.3 Key Findings

based on the data presentation and analysis, the following key findings emerge:

1. Geomechanical instability in overburden formations represents the dominant technical risk for Sèmè Field and comparable shallow-water marginal fields in the Gulf of Guinea. Reactive shale sequences with overpressure, poor consolidation, and swelling clays create wellbore stability challenges that substantially increase drilling costs and timelines.
2. Fiscal flexibility is a critical determinant of investment viability, with higher cost recovery limits and tailored PSC terms significantly improving the resilience of marginal offshore projects to cost overruns and schedule delays.

Despite material technical setbacks, the project remained economically viable and proceeded to completion, demonstrating that well-designed fiscal regimes can absorb significant adverse technical outcomes without rendering marginal fields uneconomic.

CHAPTER FIVE: DISCUSSION OF RESULTS

5.1 Interpretation of Findings

One of the core objectives of this study was to examine the technical challenges encountered in the development and operation of the Sèmè offshore field. The findings confirm that geomechanical instability in overburden formations represents the most significant technical risk affecting marginal offshore redevelopments. Borehole collapse, stuck pipe incidents, and the need for redrilling during the 2025 campaign materially increased development costs and delayed first oil. These outcomes directly support the objective of assessing how technical setbacks influence production performance and investment outcomes.

Another key objective was to evaluate the fiscal and regulatory framework governing marginal offshore assets in Benin. The results indicate that fiscal flexibility under Benin's PSC regime played a decisive role in sustaining project viability, even in the face of substantial technical challenges. The high cost recovery cap (70–80% of gross production) effectively cushioned the financial impact of drilling delays and cost overruns, allowing the operator to recover sunk costs before profit sharing. This outcome demonstrates that fiscal terms can function as a risk-sharing mechanism, reallocating a portion of downside risk from investors to the host government in order to attract and retain capital.

The findings of this study are broadly consistent with existing literature on marginal field development and upstream investment risk in West Africa. Previous empirical studies emphasize that technical uncertainty and rigid fiscal regimes are primary causes of marginal asset underperformance, particularly in mature offshore basins. The Sèmè case reinforces these conclusions by demonstrating how limited subsurface data and long dormancy periods amplify drilling risk. Furthermore, literature on marginal field economics highlights the importance of enhanced fiscal terms such as higher cost recovery limits and reduced government take in improving project bankability. The results from Sèmè provide empirical support for this argument, showing that fiscal incentives can materially offset technical risk and preserve investment attractiveness.

From an industry perspective, the results have important implications for upstream capital allocation in West Africa. Energy firms increasingly prioritize projects that offer flexibility, rapid payback, and resilience to operational disruption. The Sèmè redevelopment demonstrates that marginal offshore assets can still attract investment when supported by adaptive development strategies and competitive fiscal regimes, even in challenging operating environments.

Overall, the research reveals that the revival of marginal offshore assets in West Africa is neither purely a technical challenge nor solely a fiscal one. Instead, successful investment outcomes depend on the alignment of technical feasibility, fiscal flexibility, and strategic execution. The Sèmè Field serves as a practical demonstration that marginal assets can transition from stranded to investable under the right conditions, offering valuable lessons for energy firms, policymakers, and investors across the region.

CHAPTER SIX: CONCLUSIONS & RECOMMENDATIONS

6.1 Conclusion

Investing in West Africa's marginal offshore assets requires balancing technical, fiscal, and policy considerations. The Sèmè field illustrates both the challenges and opportunities of redeveloping mature, underexplored offshore assets. Technical setbacks, including wellbore instability and geomechanical uncertainties, emphasizes the importance of updated subsurface models, advanced drilling techniques, and robust contingency planning to manage schedule cost risks.

Fiscal frameworks are central to unlocking investments in marginal fields. Cost recovery mechanisms, profit-sharing arrangements and performance-linked incentives can make previously uneconomic assets commercially viable, attracting foreign capital despite operational risks. Transparent and predictable regulatory regimes further enhance investor confidence, with modular production infrastructure and phased commissioning reducing capital expenditure.

Aligning development strategies with market demand, sustainable production practices, and ESG considerations ensures long-term viability. The Sèmè field demonstrates the successful marginal offshore investment in West Africa depends on the integration of engineering excellence, fiscal clarity and proactive regulatory engagement, offering a scalable model for unlocking dormant assets across the region.

6.2 Recommendations

To navigate risks and unlock opportunities, investors should:

- Integrate detailed subsurface risk analysis including updated geomechanical models.
- Align fiscal planning with performance incentives, ensuring compliance with cost benchmarking regimes where applicable.
- Engage proactively with regulators to clarify fiscal and environmental obligations.

- Deploy cost-efficient drilling and production technologies to enhance forward economics.
- Maintain contingency plans for schedules and cost overruns due to geological surprises.

6.3 Areas for Further Research

While this study provides integrated insights into technical risks and fiscal revival strategies affecting marginal offshore assets in West Africa, several areas warrant further investigation to deepen understanding and enhance decision-making frameworks. Future research could undertake comparative multi-field case studies across different West African jurisdictions, such as Nigeria, Ghana, Angola, and Côte d'Ivoire. Expanding beyond a single case would enable more robust cross-country analysis of how variations in fiscal regimes, regulatory stability, and security environments influence marginal offshore investment outcomes.

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