Scientific Contributions Oil & Gas, Vol. 48. No. 4, December: 507 - 517

SCIENTIFIC CONTRIBUTIONS OIL AND GAS

Testing Center for Oil and Gas
LEMIGAS

Journal Homepage:http://www.journal.lemigas.esdm.go.id
ISSN: 2089-3361, e-ISSN: 2541-0520

Application of Bailer Technique for Idle Well Reactivation in Mature Fields: Case Study of SLF Field Sumatera

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Manuscript received: November 11th, 2025; Revised: November 28th, 2025
Approved: December 29th, 2025; Available online: December 30th, 2025; Published: December 30th, 2025.

ABSTRACT - This paper presents a field trial of wireline bailer cleanout to reactivate an idle oil well (SLL-06) in the mature SLF Field, South Sumatra Basin. The well had been shut in for several years due to severe debris accumulation and scale deposition. A low-capital bailer operation was used to remove wellbore obstructions and restore fluid communication. Eight successive bailer runs were conducted, and debris volume was quantified for each run. The results show a pronounced decline in recovered debris per run and an estimated cumulative removal of approximately 80% of the original obstruction. Post-cleanup measurements indicate a significant reduction in static fluid level of about 35% and a stabilized bottom-hole pressure (SBHP) profile, suggesting partial restoration of reservoir–wellbore connectivity. Following the intervention, the well resumed production at a low oil rate. A simplified economic assessment shows that the bailer operation required only 15–20% of the capital cost of a conventional workover. Under a conservative production assumption of approximately 30 bbl/d and an oil price of USD 70/bbl, the projected first-year revenue substantially exceeds the intervention cost. These findings confirm that wireline bailer cleanout is a technically effective and economically attractive first-step strategy for reactivating marginal wells where conventional artificial lift options are not economically viable.

Keywords: idle well, bailer, wireline, mature field, well reactivation, South Sumatra Basin .

How to cite this article:

Berkah Hani and Wahyu Sutresno, 2025, Application of Bailer Technique for Idle Well Reactivation in Mature Fields: Case Study of SLF Field Sumatera, Scientific Contributions Oil and Gas, 48 (4) pp. 507-517. DOI.org/10.29017/scog.v48i4.1994.

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INTRODUCTION

Recent studies have emphasized that idle well reactivation in Indonesian mature basins increasingly relies on low-cost, rigless interventions supported by updated production evaluation and economic screening methodologies (Putra et al., 2024; Mardiana et al., 2024). Mature or marginal oil fields are commonly characterized by declining production, limited remaining reserves, and increasing operational challenges, so that economic considerations rather than technical potential ultimately govern operational feasibility. Numerous studies have emphasized that marginal fields frequently remain undeveloped or underutilized not because hydrocarbons are absent, but because their economic sensitivity makes conventional development strategies unviable unless operating costs are kept extremely low (Steele 1976; Ramírez et al., 2000). In these settings, field redevelopment decisions are driven more by cost efficiency and capital discipline than by reservoir size or original oil in place. As a result, operators increasingly prioritize reactivating existing idle wells over new drilling programs, which are often uneconomical in mature assets.

Idle wells are a significant source of deferred production and asset degradation in aging basins. Prolonged shut-in conditions commonly lead to wellbore obstruction from scale deposition, formation fines migration, corrosion products, and stagnant fluid columns. In many mature onshore fields, particularly those with long production histories, the cost of conventional re-intervention—such as rig-based workovers, coiled tubing cleanouts, or artificial lift installations—often exceeds the incremental production that can be realistically recovered. For example, installing an electric submersible pump (ESP) requires substantial capital expenditure, including downhole pumps and motors, power cables, surface electrical infrastructure, and long-term maintenance support. Steele (1976) demonstrated that although ESP systems may offer relatively low initial capital costs compared to other lift options, their high failure rates and operating expenses often result in inferior net present value (NPV) in mature fields. Similarly, Ramírez et al. (2000) reported that gas lift systems consistently outperformed ESP installations in NPV terms, as the latter suffered from higher equipment costs and reliability issues that outweighed production gains.

Other artificial lift options, such as hydraulic and beam pumping units, face comparable economic limitations. These systems typically require extensive rig operations and mechanical modifications, making them poorly suited for low-rate marginal wells. In practice, the modest increase in oil rate from such capital-intensive solutions is often insufficient to recover the associated CAPEX and OPEX (Ariyon 2013). Operators increasingly prioritize reactivating existing idle wells over new drilling programs (Economides & Ehlig-Economides 2015). Consequently, there is a strong industry-wide motivation to identify low-capital, low-risk interventions that can rapidly test remaining well potential (Guo et al., 2017) before committing to expensive remediation strategies.

In this context, the wireline bailer technique has emerged as a practical and economically attractive alternative. A bailer is a simple mechanical tool deployed via slickline or wireline to manually remove accumulated fluids and solid debris from the tubing without circulation or pumping. Because bailer operations require only a wireline unit and basic surface equipment—without the need for a workover rig or downhole pumps—even modest production restoration can justify the intervention cost. Slickline-based unloading and cleanout methods have therefore been widely recognized as cost-effective solutions for addressing wellbore blockage in mature fields (Field 2024). Previous field applications have shown that wireline bailer and suction-based cleanout techniques can successfully remove large volumes of sand and debris, reopen perforations, and restore well productivity with minimal operational complexity (Hassan et al., 2014).

The relevance of low-capital approaches is particularly pronounced in Indonesia, where thousands of idle wells are distributed across mature basins and national energy policy increasingly emphasizes reactivation over new field development. Cost-effective, rigless interventions are critical to achieving incremental production targets while maintaining financial sustainability. Recent studies in Indonesia have highlighted that idle-well reactivation programs increasingly prioritize rigless and low-cost technologies to achieve rapid production gains while minimizing financial risk. Within this framework, bailer operations can serve as an initial screening step, enabling operators to assess whether an idle well retains sufficient reservoir connectivity to warrant further investment.

This study examines the application of a multi-run wireline bailer cleanout program to well SLL-06 in the SLF (Sungai Lilin) Field, an onshore oil field in the South Sumatra Basin. The well had been shut in for an extended period due to solid deposition and poor wellbore connectivity. The primary objective of the intervention was to remove accumulated debris, lower the static fluid level, and restore partial reservoir–wellbore communication at minimal capital cost. Unlike a full workover, the bailer operation was designed as a low-risk test of remaining well productivity. This paper presents the field methodology, operational results, and economic implications of the SLL-06 intervention, and discusses the broader applicability of bailer-assisted reactivation strategies for mature oil fields.

METHODOLOGY

Study area and well selection

This study was conducted in two mature onshore oil fields in the South Sumatra Basin, namely the Sungai Lilin and North Keluang areas within the SLF Field. The selected wells were categorized as idle due to prolonged shut-in periods caused by wellbore obstruction, scale deposition, and accumulated solids. Candidate wells were screened based on: 1). Historical production performance; 2). Duration of the idle period; 3). known or suspected type of wellbore blockage, and; 4). Surface and wireline accessibility. Wells with mechanical integrity issues or severe casing damage were excluded from this study. Figure 1 presents the historical oil and water production profile for well SLL-06 prior to the reactivation program. The production history shows a prolonged decline followed by an extended shut-in period, indicating that the well was classified as idle despite having demonstrated producibility in the past (Jonathan & Sasongko 2007).

Bailer equipment and configuration

The bailer operation used a conventional mechanical bailer deployed via a slickline or wireline unit (see Figure 2). The bailer tool

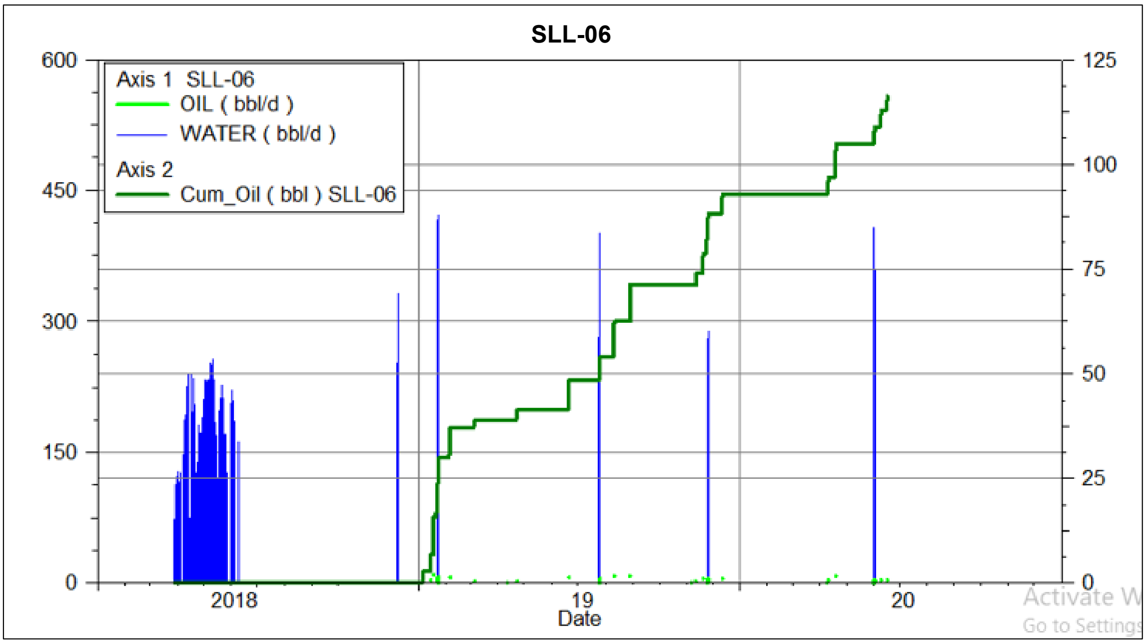

Figure 1. Production history SLL-06

Figure 2. Actual field photograph or standardized technical drawing of otobail tool.

consisted of a cylindrical barrel with a bottom check valve that allowed fluid and solid debris to enter the chamber during downward movement and prevented backflow during retrieval. The bailer capacity ranged from 1.0 to 1.5 barrels per run, depending on tool size and tubing internal diameter. Standard wireline surface equipment, including a winch, lubricator, and pressure control devices, was used to ensure safe operation.

Operational procedure

Before bailing, wellhead pressure and static fluid level were measured to establish baseline conditions. The bailer was then run into the well to the targeted depth near the suspected obstruction zone. Multiple bailer runs were performed sequentially, each consisting of descent, filling, retrieval, and surface discharge of recovered fluids and solids. The operation continued until the recovered debris volume per run declined significantly, indicating effective cleanup as shown in Figure 3 below.

The operational sequence of the Otobail system is as follows:

- Running in Hole (RIH): The wireline is driven by the winch to lower the bailer into the well until it reaches the top fluid level within the wellbore.
- Bailer Filling: After reaching the fluid surface, the bailer is lowered an additional approximately 3–5 meters, depending on the bailer length, to allow well fluids to enter the bailer chamber. The bailer is then held stationary for several minutes to ensure maximum fluid intake.
- Pulling Out of Hole (POOH): The bailer is subsequently retrieved to the surface using the winch until it is positioned inside the lubricator.
- Fluid Discharge: Once the bailer is inside the

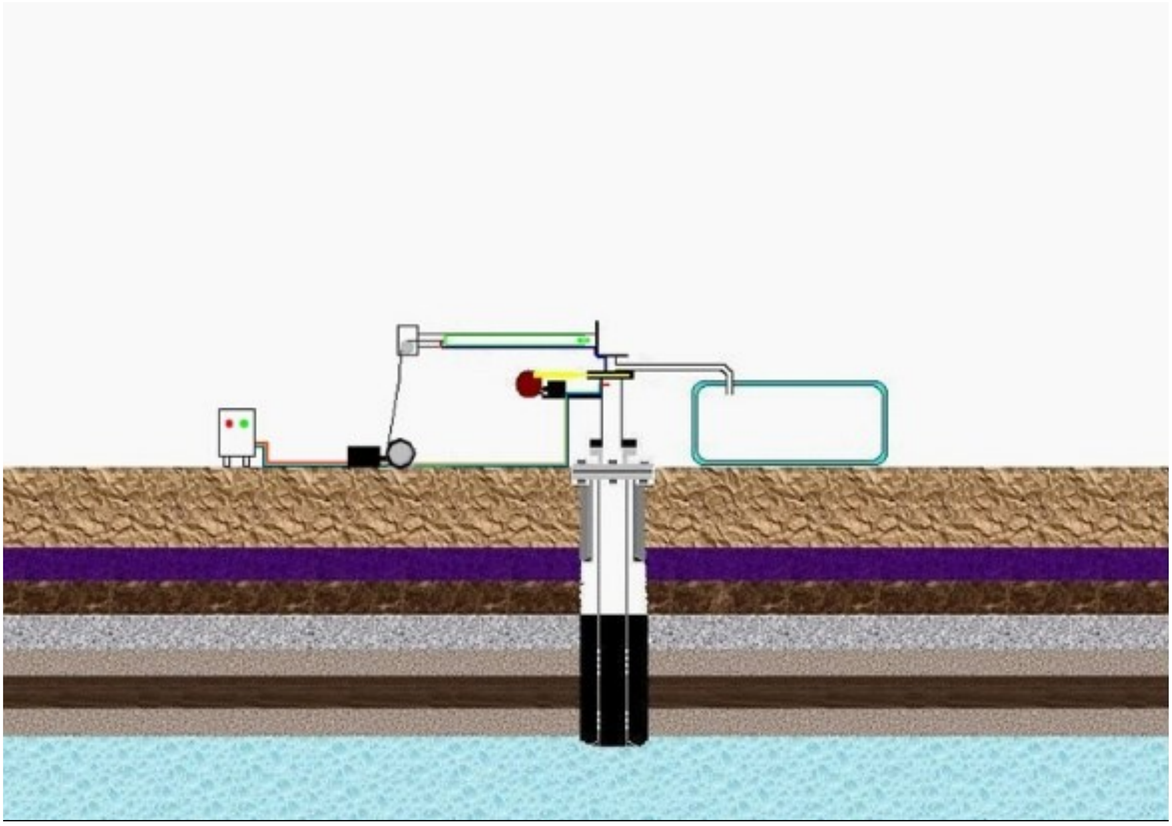

Figure 3. Otobail system

lubricator, the gate valve is closed. The bailer is then placed on top of the gate valve plate to discharge the collected well fluids.

- Fluid Transfer to Storage: The discharged fluids are routed through a hose line to the oil storage tank (TOS) or designated surface containment system.

Operational data recorded for each run included: (1) recovered fluid and solid volumes, (2) run duration, (3) total number of runs, and (4) total operation time. After the bailer job was completed, the static fluid level was re-measured, and the well was monitored for flow response.

Data analysis and economic evaluation

The effectiveness of the bailer operation was evaluated by comparing pre- and post-operation fluid levels, the total volume of debris removed, and the qualitative improvement in wellbore communication. A simple economic analysis was conducted by comparing the total cost of bailer operations with the estimated costs of conventional workover or coiled tubing interventions for similar wells. Cost metrics were normalized to per-well values to enable direct comparison.

RESULT AND DISCUSSION

The reactivation of well SLL-06 illustrates the technical and economic effectiveness of bailer-assisted wellbore cleanup in a mature oil field. Before intervention, the well had remained idle for an extended period, with production suspended due to suspected wellbore obstruction and fluid stagnation. Initial diagnostic activities included a static bottom-hole pressure (SBHP) survey, which served as a baseline for evaluating wellbore condition.

Operational results.

The bailer operations were successfully executed on well SLL-06 without requiring rig-based intervention, thereby minimizing operational

Figure 4. Otobail unit

complexity and execution cost. The field setup and deployment of the Otobail unit at the SLL-06 wellsite are shown in Figure 4, illustrating the rigless wireline configuration used during the cleanout operation.

Following multiple slickline bailer runs, a repeat static pressure gradient survey was conducted to evaluate the subsurface response to the cleanup operation. As presented in Figure 5, the post-intervention pressure profile indicates a stabilized hydrostatic gradient, with a recorded static pressure of approximately 438.8 psia at a depth of 808 m. This stabilized pressure response suggests that accumulated solids and trapped fluids had been effectively removed, allowing re-establishment of fluid continuity within the wellbore. Such a pressure response provides direct physical evidence that the bailer operation successfully mitigated wellbore blockage rather than merely redistributing fluids temporarily (Susilo et al., 2001).

The number of bailer runs performed on well SLL-06 ranged from 6 to 15 runs, depending on the severity of the obstruction encountered during each stage of the operation. The recovered materials consisted primarily of formation fines, scale fragments, rust particles, and stagnant wellbore fluids. Operational data showed that up to 80% of the estimated obstruction volume was removed through repeated bailer runs. As reflected by the declining debris volume recovered per run, a consistent trend of progressive wellbore cleanup was observed (Yoliandri et al., 2002). Post-operation measurements further revealed an average reduction in static fluid level of approximately 35%, indicating partial restoration of fluid communication between the reservoir and the wellbore.

Impact on well reactivation

Following bailer operations, several wells exhibited improved flow behavior during short-term monitoring, including faster fluid-level recovery and reduced wellbore loading. Although not all wells immediately returned to sustained production, the bailer intervention clearly indicated remaining well potential at minimal cost. Wells that responded positively were identified as suitable candidates for further low- to moderate-investment interventions, such as chemical cleaning or light

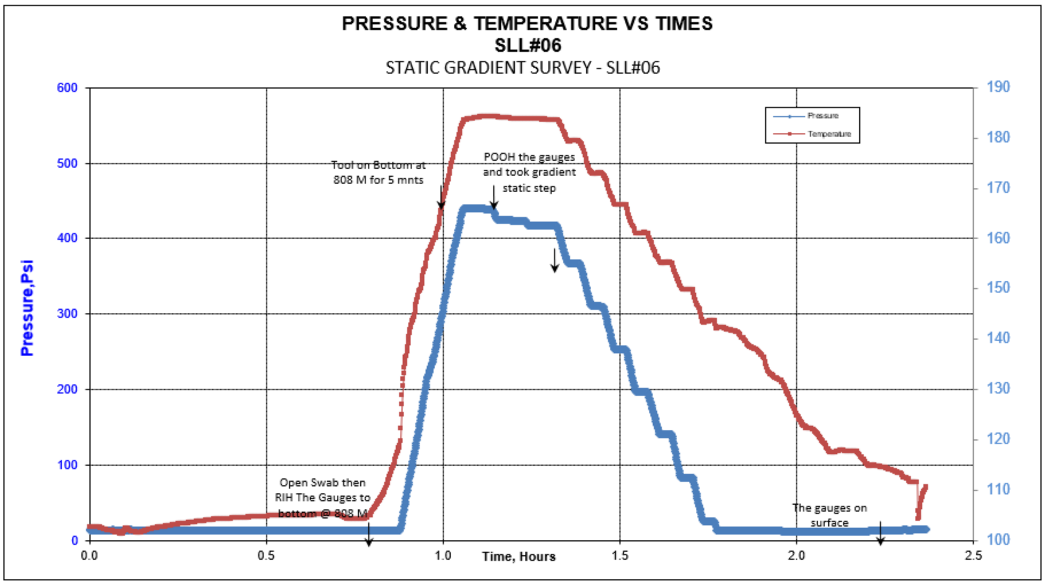

Figure 5. Static gradient survey

artificial lift. From an operational safety perspective, wireline bailer intervention presents significantly lower HSE exposure compared to rig-based workovers, as heavy lifting, high-pressure pumping, and prolonged personnel exposure are avoided. Recent developments in automated bailer and digital slickline systems further enhance operational control and repeatability, enabling scalable deployment across multiple idle wells within a field-wide reactivation program (Cavins Corporation 2024).

Economic discussion

Operationally, the bailer intervention was completed without rig-based workover, significantly reducing execution time and capital exposure. The well was subsequently returned to production on 27 September 2024 and continued to produce through June 2025, demonstrating sustained post-intervention performance. Based on a conservative production target of 20 BOPD, the well was forecast to deliver approximately 34,800 barrels of oil over a 58-month production horizon. The production forecast was derived using decline curve analysis (DCA) based on historical oil production data before shut-in, as shown in Figure 6.

The analysis employed an exponential decline model, which is commonly applied to mature oil wells with stabilized flow regimes. The forecast parameters indicate a gradual decline trend with a low terminal production rate, reflecting the marginal nature of the reservoir and supporting conservative production assumptions.

Notably, the post-reactivation field performance during the initial production period exceeded the conservative expectations implied by the forecast. Actual healthy response showed stable oil production and sustained flow continuity, indicating that the wellbore obstruction, rather than reservoir depletion, had been the primary cause of production loss before shut-in. This discrepancy between forecasted decline behavior and early post -intervention performance highlights the positive impact of wellbore cleanup on restoring effective reservoir–wellbore communication. The results suggest that traditional decline-based forecasts derived from pre-intervention data may underestimate short- to medium-term production potential when wellbore damage dominates production decline. In this context, the bailer-assisted cleanup not only restored production but also bolstered confidence in the remaining recoverable reserves, thereby enhancing the well's economic outlook. Overall, the favorable comparison between forecasted performance and actual field results reinforces the role of bailer operations as a low-risk, high-value enabling step in mature field reactivation programs.

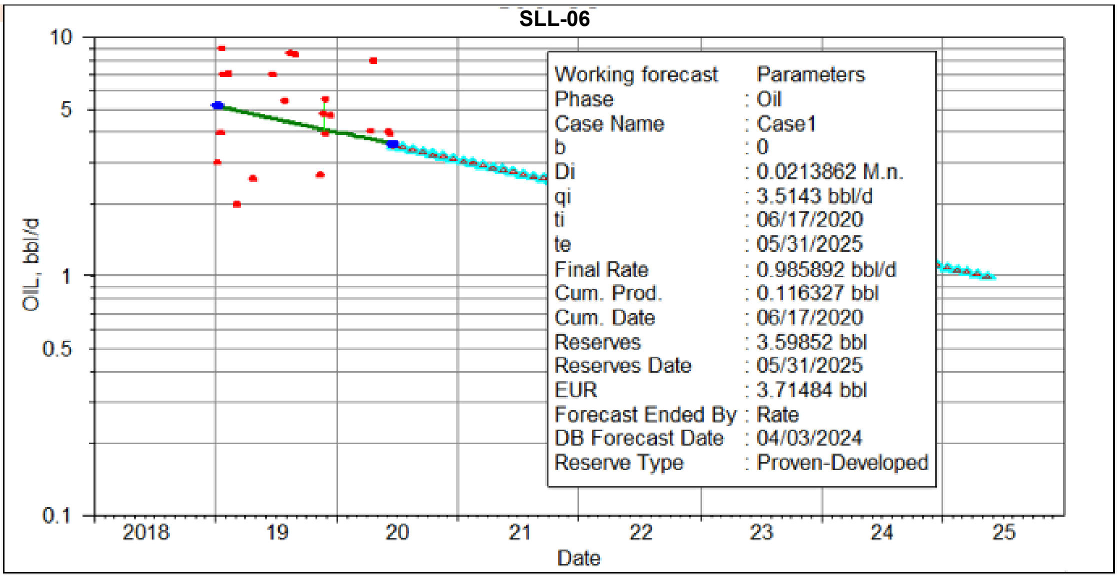

Figure 6. Decline curve analysis (DCA) and production forecast for well SLL-06 based on historical oil production data.

To further substantiate the favorable comparison between forecasted performance and actual field results, a quantitative economic assessment was performed using the cost and production assumptions summarized in Table 1. The table provides a simplified but representative economic snapshot of the bailer intervention, capturing the one-time capital expenditure (CAPEX), annual operating expenditure (OPEX), and projected revenue based on post-cleanup production performance. This preliminary assessment illustrates how even modest oil production rates can generate substantial economic returns when intervention costs are kept low(Ariyon et al. 2022), thereby supporting the interpretation that bailer-assisted cleanup functions as a low-risk, high-value enabling step in mature field reactivation programs.

Although simplified, this economic snapshot is sufficient to demonstrate that the bailer intervention achieves a rapid payout period and favorable cash flow compared to conventional workover-based reactivation, particularly for marginal wells.

From an economic perspective, the bailer technique offered a substantial cost advantage (Casdira & Fikri 2010). The total cost of a bailer cleanup operation was estimated at only 15–20% of the price of a conventional workover. Given the marginal nature of the studied wells (Daniel, 2017), this low-capital approach significantly reduced financial risk and enabled informed decision-making for subsequent interventions. These findings confirm that the bailer technique is well aligned with cost-efficiency strategies in mature field management. A detailed economic evaluation was conducted for one representative well (SLL-06) to quantify the financial impact of the reactivation program following wellbore cleanup and stimulation. The analysis incorporates capital expenditure (CAPEX), operating expenditure (OPEX), and projected production revenue over a 58-month evaluation period.

The total operational and development cost for well SLL-06 amounted to approximately IDR 1,05 billion, consisting of CAPEX of IDR 750 million and OPEX of IDR 300 million. The CAPEX component covered procurement of surface and subsurface equipment, as well as installation of tubing and pumps. At the same time, OPEX included production costs, consumables, accommodation and office expenses, social costs, well treatment, and well restoration activities. Among these components, production-related operating costs dominated the expenditure, reflecting the long production period assumed in the economic forecast.

Following stimulation and well reactivation, the well was assumed to achieve a conservative target production rate of 20 barrels of oil per day

Table 1. Economic metrics for SLL-06 bailer cleanup

Parameter	**Value (IDR)**	**Notes**
CAPEX	IDR 750,000,000	One-time cost for wireline bailer operation
OPEX / year	IDR 300,000,000	Estimated well servicing and operating overhead
Post-cleanup oil rate	20 BOPD	Assumed stabilized production rate
Oil price	IDR 1,125,000 / bbl	Equivalent to USD 75/bbl
Annual revenue	IDR 821,250,000	20 BOPD × 365 × IDR 1,125,000
Net cash flow (Years Up to 5)	IDR 1,250,000,000	Revenue – (CAPEX + OPEX)

(BOPD). Over the 58-month production horizon, this corresponds to approximately 34,800 barrels of oil. Based on the prevailing oil price assumptions used in the study, the total projected revenue from well SLL-06 was approximately IDR 23.34 billion.

Comparison of total revenue with combined CAPEX–OPEX (Danastri et al 2024) shows that the healthy reactivation program yields a positive gross margin, with revenues exceeding total expenditures by a measurable margin. Although the economic gain per well remains modest, this result is highly significant in marginal and mature fields, where conventional workovers or artificial-lift installations often fail to reach economic breakeven.

Importantly, the economic performance of SLL-06 shows that low-cost wellbore cleanup and stimulation strategies can materially reduce financial risk. By limiting upfront CAPEX and relying primarily on operational expenditures that scale with production, the intervention offers a flexible, economically resilient approach. This finding underscores the role of bailer-based cleanup as a cost-effective screening and enabling step, helping operators identify wells with sufficient remaining potential before committing to higher-cost remediation or artificial lift solutions.

From a portfolio perspective, replicating similar reactivation outcomes across multiple idle wells (Mardiana et al. 2024) could cumulatively contribute meaningful incremental production while maintaining capital discipline. Therefore, the economic results from SLL-06 support the broader applicability of the bailer-assisted reactivation strategy as part of a systematic idle-well redevelopment program in mature oil fields.

CONCLUSION

This study confirms that the wireline bailer technique is a technically sound and economically viable first-step intervention for reactivating idle wells in mature oil fields. Field implementation in the SLF Field, South Sumatra, showed that repeated bailer runs could remove up to 80% of wellbore obstruction, resulting in an average 35% reduction in static fluid level and partial restoration of reservoir–wellbore communication.

From an economic perspective, the reactivation of well SLL-06 illustrates the value of a low-capital approach. With a total investment of approximately IDR 1.05 billion (CAPEX IDR 705 million and OPEX IDR 300 million), the well achieved a conservative post-stimulation production target of 20 BOPD, yielding cumulative production of 34,800 barrels over 58 months. This corresponds to an estimated total revenue of IDR 3.056 billion after 5 years.

Although the economic return per well remains modest, the results are highly significant for marginal and mature fields where conventional workover or artificial lift installations often fail to reach breakeven. By minimizing upfront capital exposure and using bailer operations as a rapid screening tool, operators can effectively identify wells with remaining production potential before committing to higher-cost remediation. Overall, the findings support the integration of bailer-based wellbore cleanup into systematic idle-well reactivation programs as a cost-efficient, low-risk strategy to unlock incremental production and extend the economic life of mature oil fields..

GLOSSARY OF TERMS

Symbol	Definition	Unit
Idle Well	Well that has been shut-in for an extended period with no sustained production	–
Bailer	Mechanical wireline tool used to remove fluids and solid debris from the wellbore	–
Wireline	Cable-based system used to deploy and retrieve downhole tools	–
Slickline	Non-electric wireline used for mechanical well interventions	–
OTOBAIL	Automated bailer system used for repeated fluid removal operations	–
RIH	Running in Hole; lowering the bailer into the well	–
POOH	Pulling Out of Hole; retrieving the bailer to surface	–
V_β	Volume of fluid and debris recovered per bailer run	bbl or L
N_r	Total number of bailer runs performed	–
t_r	*Duration of a single bailer run*	*min*
T_{op}	Total operational time of bailer intervention	hr
SFL	Static Fluid Level measured in the wellbore	m or ft
ΔSFL	Change in static fluid level before and after bailer operation	m or ft
SBHP	Static Bottom-Hole Pressure measured after shut-in	psi
Q_o	Oil production rate after reactivation	bbl/d
Qw	Water production rate	bbl/d
Cum. Prod	Cumulative oil production	bbl
DCA	Decline Curve Analysis used to forecast production performance	–
Di	Nominal decline rate from DCA	1/time
qi	Initial oil production rate from DCA	bbl/d
EUR	Estimated Ultimate Recovery	bbl
CAPEX	Capital expenditure for bailer operation	IDR
OPEX	Annual operating expenditure after reactivation	IDR/year
TOS	Tank Oil Storage for surface fluid handling	–

ACKNOWLEDGEMENTS

The authors thank the Department of Petroleum Engineering, Bhayangkara University, for their support and guidance during the preparation of this paper.

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