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# The Effect of NPL, LDR, and Cash Ratio on ROA Through BOPO as a Mediating Variable: A Study on Banks in Indonesia

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**Abstract**

This study aims to examine the direct effect of NPL, LDR, and Cash Ratio on profitability (ROA), and to analyze the role of Operating Costs to Operating Income (BOPO) as a mediating variable in the relationship between NPL and ROA at People's Economic Banks (BPR) in the Riau Islands Province. The method used is quantitative with panel data from all BPRs in the Riau Islands during the 2020-2024 period (N = 75 data). Data were analyzed using Panel Data Regression and Path Analysis to test the mediation hypothesis. The results showed that simultaneously NPL, LDR, and Cash Ratio had a significant effect on ROA. Partially, NPL and LDR had a significant negative effect on ROA, while Cash Ratio had a significant positive effect. The main finding is the role of BOPO which was proven to significantly mediate the relationship between NPL and ROA. An increase in NPL significantly worsened operational efficiency (increased BOPO), which in turn caused a sharp decline in BPR profitability (ROA).

## 1. Introduction

The processing, construction, wholesale and retail trade industries in Batam City, and the potential of natural resources such as oil, natural gas, tin, bauxite, and various types of rocks outside Batam City determine the economic characteristics of the Riau Islands Province region. Riau Islands Province experiences consistently positive growth in Gross Regional Domestic Product (GRDP), often even increasing from year to year so that its contribution is very significant to the regional economy. Based on the Official Statistics News released on August 5, 2025, the economic growth of Riau Islands Province was 7.14% year on year or 7.18% of the GRDP of Sumatra Island in the second quarter of 2025, while Batam City's economic growth in the fourth quarter of 2024 was 5.02% and is projected to reach 6.8% to 7.6% in 2025.

Funding for key industries in the province is supported by domestic and foreign investment flowing into the Riau Islands Province, particularly from Singapore. The local government, through the Batam Investment Agency (BP Batam), supports the development of industrial

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estates to integrate and develop various industries and attract investment to the Riau Islands Province, particularly Batam City. The driving force behind economic growth in the Riau Islands Province, particularly in Batam City, is the banking sector, which collects and distributes public funds and supports regional development through its intermediary and financial services functions.

According to the Financial Services Authority database, there are 33 Commercial Banks, both conventional and Sharia, consisting of 8 functional offices, 59 branch offices, 229 sub-branch offices, and 1,450 types of electronic banking terminals in the Riau Islands Province, of which 7 functional offices, 37 branch offices, 137 sub-branch offices, and 978 types of electronic banking terminals are located in Batam City. The total assets of Commercial Banks in the Riau Islands Province are IDR 184 trillion, of which IDR 82 trillion is in Batam City. Furthermore, there are 43 People's Economic Banks (BPR) with total assets of IDR 12 trillion in the Riau Islands Province, while there are 27 BPRs with total assets of IDR 9 trillion in Batam City.

Banks play a crucial role in a country's economy, collecting money from people in the form of deposits and then lending it back to them in the form of credit. One type of banking institution, the rural bank (BPR), holds a unique and strategic position. As an intermediary institution focused on serving the grassroots, BPRs serve as the backbone for financing micro, small, and medium enterprises (MSMEs) and as a driver of financial inclusion in areas often underserved by conventional banks. Credit provided by BPRs significantly contributes to a region's economic growth (Pranata, 2019). The health and sustainability of BPRs are crucial not only for the institution itself but also for the stability and growth of the local economy.

The majority of rural banks (BPRs) operate on the islands of Java and Bali. The table below shows the top ten provinces or cities with the largest total BPR assets, dominated by those two islands. The Riau Islands Province (Kepri) ranks seventh. There are 44 BPRs operating in the province.

*Table 1.*
*Ranking of the 10 Largest BPRs in Total Assets per Province/City in Indonesia*
*Position as of December 31, 2024*

| **No.** | **Province/City** | **Total Assets (billion Rp)** | **Exposure to Total Assets in Indonesia** |
|---|---|---|---|
| 1. | Central Java | 26,478 | 12.94% |
| 2. | Bali | 21,467 | 10.49% |
| 3. | Greater Jakarta | 21,428 | 10.47% |
| 4. | Lampung | 16,053 | 7.84% |
| 5. | East Java | 14,074 | 6.88% |
| 6. | West Java | 12,223 | 5.97% |
| 7. | Riau islands | 11,517 | 5.63% |
| 8. | Solo | 11,283 | 5.51% |
| 9. | Yogyakarta | 8,942 | 4.37% |
| 10. | Maluku | 7,555 | 3.69% |

*Source: OJK, Indonesian Banking Statistics, 2024 (processed data)*
*The following are details and total assets of BPRs in the Riau Islands as of December 2024*

*Table 2.*
*Total Assets of BPR in Riau Islands Position as of December 31, 2024*

| No. | BPR Name | Total Assets (billion Rp) |
|---|---|---|
| 1. | Regional Public Company BPR TK | 46 |
| 2. | PT BPR BM | 430 |
| 3. | PT BPR PM | 47 |
| 4. | PT BPR KG | 114 |
| 5. | PT BPR Dukep | 104 |
| 6. | PT BPR SB | 840 |
| 7. | PT BPR APP | 116 |
| 8. | PT BPR Danus | 2,631 |
| 9. | PT BPR LDB | 77 |
| 10. | PT BPR BR | 234 |
| 11. | PT BPR DBS | 129 |
| 12. | PT BPR DN | 443 |
| 13. | PT BPR LSE | 260 |
| 14. | Regional Public Company BPR Bintan | 258 |
| 15. | PD BPR Bestari | 75 |
| 16. | PT BPR PB | 106 |
| 17. | PT BPR DSP | 498 |
| 18. | PT BPR KB | 180 |
| 19. | PT BPR Kebin | 127 |
| 20. | PT BPR AD | 133 |
| 21. | PT BPR KMD | 199 |
| 22. | PT BPR CS | 370 |
| 23. | PT BPR IF | 232 |
| 24. | PT BPR KS | 534 |
| 25. | PT BPR HBB | 52 |
| 26. | PT BPR GM | 107 |
| 27. | PT BPR Dafan | 80 |
| 28. | PT BPR UMD | 29 |
| 29. | PT BPR DMS | 110 |
| 30. | PT BPR DP | 70 |
| 31. | PT BPR DM | 380 |
| 32. | PT BPR BAM | 256 |
| 33. | PT BPR CK | 152 |
| 34. | PT BPR DCM | 286 |
| 35. | PT BPR MGR | 227 |
| 36. | PT BPR SDM | 39 |
| 37. | PT BPR DMU | 219 |
| 38. | PT BPR MML | 330 |
| 39. | PT BPR AS | 322 |
| 40. | PT BPR SMA | 131 |
| 41. | PT BPR N | 73 |
| 42. | PT BPR DPM | 60 |
| 43. | PT BPR ADM | 170 |
| 44. | PT BPR Damus | 241 |
| | Total Assets of all BPRs in Riau Islands | 11,517 |

*Source: OJK, Indonesian Banking Statistics, 2024 (processed data)*

A fundamental indicator for measuring a bank's health and performance is its profitability (hereinafter referred to as profitability), which in this research is proxied by Return on Assets (ROA). In a climate of intense and intense competition, both among rural banks (BPR) and with other financial service providers, the ability to generate consistent profits is key to survival and

growth. Therefore, identifying and understanding the determinants of ROA is crucial for BPR managers.

Banking literature consistently highlights several key factors influencing profitability. These factors include credit risk, which is measured using the Non-Performing Loan (NPL) ratio; operational risk (operational efficiency) using the Operating Expenses to Operating Income (BOPO) ratio; and liquidity risk (intermediation function) using the Loan-to-Deposit Ratio (LDR) and Cash Ratio (CR).

*Table 3.*
*Five Types of Average Ratio of BPR in Riau Islands Province Period 2020 – 2024*

| Year | NPL (%) | LDR (%) | CR (%) | BOPO (%) | ROA (%) |
|---|---|---|---|---|---|
| 2020 | 7.43 | 72.11 | 12.32 | 84.29 | 1.69 |
| 2021 | 5.45 | 71.04 | 10.21 | 83.27 | 1.70 |
| 2022 | 4.68 | 76.93 | 9.95 | 80.34 | 1.83 |
| 2023 | 4.78 | 79.07 | 9.29 | 81.22 | 1.78 |
| 2024 | 5.70 | 82.83 | 10.33 | 81.93 | 1.71 |

*Source: OJK Riau Islands Province (processed data)*

The average performance data for rural banks (BPR) in the Riau Islands Province for the 2020-2024 period in Table 1 demonstrates an interesting phenomenon, the primary driver of this research. Significant pressure on profitability was identified. On the one hand, banks' intermediation function appears to be improving, as evidenced by a consistent upward trend in the Loan-to-Deposit Ratio (LDR). This phenomenon should theoretically drive increased interest income and profits. However, the opposite occurred, with the ROA ratio trending slightly downward.

This anomaly indicates the presence of other factors that neutralize this potential profit. Further analysis shows that this credit expansion is accompanied by the consequence of increased risk. The upward trend in the LDR is accompanied by an increasing trend in the non-performing loan (NPL) ratio. This is in line with the view that "increased credit risk, if not managed properly, will significantly erode bank profitability" (Siamat, 2018). This increase in NPLs directly forces banks to increase their operating expenses, primarily through the formation of provisioning costs.

This situation creates a strategic dilemma for rural bank management. Efforts to grow by disbursing more credit are accompanied by increased risks that erode profits. Understanding the relationship between credit risk (NPL), efficiency (BOPO), and profitability (ROA) is crucial. Many previous studies have tended to analyze this relationship partially and directly. However, few have explored the deeper transmission mechanism, namely how NPL indirectly affects ROA through operational efficiency. As Kasmir (2018) states, "operational efficiency reflects management's ability to control costs across all activities, including costs resulting from risk."

Various previous studies on rural banks (BPR) generally agree that the NPL ratio and the BOPO ratio have a significant negative impact on ROA. This finding is logical, as non-performing loans and cost inefficiencies directly erode bank revenue. However, there is a "black box" in understanding this relationship that has not been widely explored. The fundamental question that arises is: what is the transmission mechanism from credit risk (NPL) to declining profitability (ROA)? Do NPLs directly cause losses, or are there other, more complex processes behind it? Most previous studies tend to focus on analyzing the direct effect, without unraveling the underlying causal mechanisms.

This research gap is the primary focus of this study. There is a strong suspicion that the effect of NPLs on ROA is not direct, but rather through an intermediary variable or mediator. The most

logical variable to fill this role is operational efficiency (BOPO). An increase in NPLs will directly force banks to increase provisioning costs and expend more resources on credit management, both of which will increase the BOPO ratio. This increase in BOPO then directly depresses profitability. However, the role of BOPO as a mediator has rarely been formally tested in the context of rural bank research in Indonesia.

Therefore, this study aims to fill this gap. Using path analysis, this study will not only evaluate the direct impact of variables on ROA, but will also specifically demonstrate and quantify the mediating role of operational efficiency (BOPO) in the relationship between credit risk (NPL) and profitability (ROA). Therefore, it is hoped that this study will provide a deep, nuanced, and strategically aligned understanding for rural bank management.

Research on the factors influencing profitability (ROA) at Rural Banks (BPR) in Indonesia has been extensive, and certain patterns can be identified in various journals and theses. Most studies, such as those by Rusmini (2020), Turidah (2022), and Amin (2018), use multiple linear regression as the primary approach. This method was chosen to analyze the direct influence of several variables, such as Non-Performing Loans (NPL), Loan-to-Deposit Ratio (LDR), Operating Costs to Operating Income (BOPO), and Capital Adequacy Ratio (CAR), on BPR profitability. The results of these studies show consistency in several findings, particularly that NPL and BOPO have a significant negative effect on ROA—a conclusion well established in the literature. However, other variables, such as LDR, often produce inconsistent results; their effects can be positive, negative, or even insignificant, and most studies do not explain the reasons behind these inconsistencies. In addition, almost all studies place BOPO as an ordinary independent variable, on par with other variables such as NPL and LDR, so that the analysis is limited to the direct influence of BOPO on ROA without considering the possibility of a structural role or indirect relationship that may be more complex.

Overall, this study not only replicates existing research but also deepens the understanding of causality in the study of rural bank profitability. We move from the "what" question (which variables are influential) to the "why" and "how" questions (how the mechanisms of influence operate), and this is where its original contribution lies. Thus, this study not only confirms previous findings, but also provides an original contribution by explaining deeper causal mechanisms and answering unsolved puzzles in previous literature regarding BPR profitability.

## 2. Methods

The research methodology is described in detail in this chapter. The methodological discussion focuses on several key elements: determining the type and source of data, establishing population and sample criteria, sampling techniques, operational definitions for each measured variable, and data analysis techniques applied to test hypotheses and answer research questions. For analysis purposes, it is important to understand that data in research are grouped into two basic types: data obtained directly (primary) and data already available (secondary).

Primary data is collected directly, for example through experiments or questionnaire distribution. Secondary data is obtained through indirect observation, such as searching for literature, such as books or research journals, or visiting relevant agencies. In the context of this research, all data obtained from the OJK will be treated as secondary data.

The primary data source is the OJK's BPR information system, specifically the BPR financial reports presented based on reporting periods. This data is crucial for research purposes. The data used in this study is quantitative data in the form of financial ratios. This data is panel data, a combination of cross-section data (15 BPRs) and time series data. Panel data allows researchers to analyze the dynamics of change over time while controlling for heterogeneity between individuals (Gujarati & Porter, 2021). This study uses a quantitative approach with a causal associative method. The quantitative approach was chosen because this study aims to measure and analyze the relationship between numerical variables (financial ratios) statistically. According to Sugiyono (2018), quantitative research is "a research method based on the

philosophy of positivism, used to study specific populations or samples, data collection using research instruments, and quantitative/statistical data analysis, with the aim of testing predetermined hypotheses." The causal associative nature is used to explain the causal relationship between variables, both directly and indirectly through mediating variables, in accordance with the research model that has been formulated.

The sampling technique used in this study was Stratified Random Sampling. According to Sekaran & Bougie (2016), stratified random sampling is a sampling process that involves first stratifying the population into homogeneous subgroups, followed by drawing simple random samples from each stratum. This method was chosen to ensure that the samples taken can proportionally represent the diversity within the population. The process is as follows:

## 3. Results and Discussion

*Hypothesis Testing*

Based on the results of the statistical analysis, the outcomes of the hypothesis testing can be summarized as follows. First, **H1**, which posits that *Non-Performing Loans (NPL) have a significant negative effect on Return on Assets (ROA)*, is supported. Model 1 demonstrates a significant negative relationship between NPL and ROA ($\beta = -0.2224$; $p < 0.001$), confirming the hypothesis. It is important to note, however, that in Model 2b the direct effect becomes insignificant, suggesting that the influence of NPL on ROA is predominantly **indirect**, operating through the BOPO variable.

In contrast, **H2**, which proposes a positive effect of the Loan-to-Deposit Ratio (LDR) on ROA, is **not supported**. The findings from Models 2b and 3b indicate that LDR does not significantly influence ROA, and in fact, its coefficient appears slightly negative. Therefore, the hypothesis must be rejected. A similar outcome is found for **H3**, which hypothesizes that Capital Ratio (CR) positively affects ROA. The analysis reveals that CR does not significantly influence ROA in either Model 2b or 3b, leading to the rejection of H3.

The analysis provides strong support for **H4**, which predicts a positive effect of NPL on BOPO. Model 2a confirms this relationship ($\beta = 0.8066$; $p = 0.001$), indicating that higher levels of NPL lead to increased BOPO. Likewise, **H5**, which states that CR negatively influences LDR, is also supported. Model 3a demonstrates a significant negative relationship between CR and LDR ($\beta = -0.6385$; $p = 0.001$), suggesting that stronger capital positions are associated with lower liquidity risk.

Furthermore, **H6**, which asserts that BOPO has a significant negative influence on ROA, is empirically validated. As shown in Model 2b ($\beta = -0.1585$; $p < 0.001$), higher operational inefficiency—as reflected by higher BOPO—reduces profitability. Finally, **H7**, which proposes that BOPO mediates the effect of NPL on ROA, is **indirectly supported**. The analysis shows that NPL increases BOPO (Model 2a), and BOPO subsequently reduces ROA (Model 2b). Thus, the negative impact of NPL on ROA occurs through its influence on BOPO, confirming the mediating role of operational efficiency.

*Discussion of Research Results*

This section interprets the statistical findings that have been presented, relates them to the theoretical framework, and formulates managerial implications for the BPR industry.

*Comparison with Previous Research*

This research aligns with Amin (2018), Turidah et al. (2022), and Supeno (2023), who found that NPL and BOPO had a significant negative effect on ROA. However, this study goes beyond previous approaches by demonstrating the role of BOPO as a mediator, something that has not been explicitly tested in the literature. The result that LDR is not significant is also consistent with the literature, but this study provides a new explanation, namely the positive correlation of LDR – NPL causes the positive effect of LDR on ROA to be negated by increased credit risk.

*Original Research Contribution*

1. Uncovering the hidden mechanisms:BOPO has proven to be a bridge that channels the impact of NPL to ROA.
2. Explaining LDR anomalies:The trade-off between credit expansion and credit risk explains why LDR is often insignificant.
3. Confirming the position of operational efficiency:BOPO is the dominant determinant of profitability, so the strategy to increase ROA must focus on efficiency, not just intermediation expansion.

*Critical Criticism and Discussion*

- While the LDR and CR variables are theoretically important, they are not empirically significant in rural banks (BPRs) in the Riau Islands Province. This suggests that, in the context of rural banks in the Riau Islands Province, credit quality (NPL) and efficiency (BOPO) are far more important determinants of profitability than the intermediation function and liquidity alone.
- These results reaffirm the findings of previous research, but also fill a research gap by providing a mechanistic explanation for inconsistent relationships.
- The novel contribution of this research is the shift from simply asking “what influences” to “how does influence work”.

*Uncovering the Hidden Mechanism (The Central Role of Operational Efficiency (BOPO)*

The most significant finding of this study is the revelation of BOPO's role as a full mediator in the relationship between NPL and ROA. If the analysis were limited to multiple linear regression, the conclusion would tend to be superficial: "high credit risk will reduce profitability." While correct, this conclusion fails to explain "why" and "how" this process occurs. Path analysis successfully unpacks this "black box" and maps the underlying mechanisms.

When the non-performing loan (NPL) ratio rises, banks directly face two significant cost consequences. First, from a regulatory compliance perspective, banks are required to establish larger Allowance for Impairment Losses (CKPN). This burden directly increases operational costs. Second, from a revenue perspective, non-performing loans (NPLs) do not generate interest income for banks, resulting in decreased operating income. Third, from a purely operational perspective, managing non-performing loans is a highly resource-intensive activity. Banks must allocate additional costs for collection processes, restructuring, legal litigation, and collateral enforcement, all of which contribute to an increased BOPO ratio.

This increase in BOPO directly and strongly impacts profitability (ROA). A high BOPO ratio essentially indicates that a significant portion of a bank's operating income has been used to cover operating costs, leaving a very thin profit margin. Therefore, the true impact of NPLs on ROA is not the direct impact of loan principal losses, but rather the indirect impact of the resulting cost inefficiencies and the resulting stagnation in interest income.

The implications for rural bank management are highly strategic. Efforts to maintain profitability should not be merely reactive by reducing non-performing loans (NPLs), but rather proactive by establishing an efficient operational cost control system, particularly those related to credit risk management. Operational efficiency is a crucial factor in rural bank profitability.

*The LDR Paradox and Risk-Return Trade-Off in the Intermediation Function*

Theoretically, the intermediation function, as measured by the LDR, is expected to have a positive relationship with ROA. However, this study consistently shows that the LDR's effect is insignificant. This phenomenon can be explained as a paradox, the answer of which is confirmed by the finding of a significant positive correlation between LDR and NPL.

These findings illustrate the fundamental risk-return trade-off in the rural bank (BPR) business. On the one hand, the drive to increase the LDR is a logical effort to maximize returns (income). However, on the other hand, this effort often carries the consequence of increased risk (credit risk). Under pressure to achieve growth targets, rural banks may tend to relax prudential standards in assessing creditworthiness, ultimately increasing the probability of future non-performing loans.

As a result, a cancellation effect occurs. The potential increase in interest income from credit expansion (increasing LDR) is effectively neutralized by the increase in credit costs arising from rising NPLs. Ultimately, the net impact of the LDR increase on ROA is insignificant. The strategic message is clear: asset quality is far more important than asset quantity. Sustainable credit growth can only be achieved if balanced with superior risk management. Aggressively pursuing LDR growth without a strong risk management foundation is a strategy that has proven ineffective in increasing profitability.

## 4. Conclusion

Based on the panel data analysis conducted on 15 rural banks (BPR) during the 2020–2024 period, this study generated seven principal conclusions. First, Non-Performing Loans (NPL) were found to have a significant negative effect on Return on Assets (ROA). This finding confirms the first hypothesis (H1) and demonstrates that rising credit risk is consistently associated with decreased profitability among BPRs. Second, the Loan-to-Deposit Ratio (LDR) showed no significant effect on ROA, leading to the rejection of the second hypothesis (H2). This result suggests that a higher intermediation function does not automatically translate into improved profitability, likely due to the accompanying increase in credit risk.

Third, the Cash Ratio (CR) was also found to have no significant effect on ROA, resulting in the rejection of the third hypothesis (H3). This indicates that within the observed period and sample characteristics, liquidity reserves do not serve as a direct determinant of profitability fluctuations. Fourth, the study confirmed that NPL has a positive and significant influence on Operating Costs to Operating Income (BOPO). This finding supports the fourth hypothesis (H4) and shows that increases in problematic loans directly contribute to rising operational costs.

Fifth, CR was shown to have a negative and significant effect on LDR, thereby supporting the fifth hypothesis (H5). This reinforces the understanding that BPRs with lower cash liquidity tend to adopt more aggressive credit distribution strategies. Sixth, BOPO was found to have a strong negative effect on ROA, confirming the sixth hypothesis (H6). This underscores that operational efficiency is one of the most influential factors shaping the profitability performance of rural banks.

Lastly, the study concludes that BOPO fully mediates the relationship between NPL and ROA, thereby confirming the seventh hypothesis (H7). This mediation indicates that the adverse impact of NPL on profitability does not occur directly; rather, it is entirely transmitted through increased operational inefficiency. In other words, rising non-performing loans lead to higher operational costs, which in turn diminish the profitability of BPRs.

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**References**

Amin, M.(2018). Analysis of Factors Affecting Profitability in Rural Credit Banks. Thesis. University X.

Gujarati, DN, & Porter, DC(2021). Basic Econometrics (6th ed.). New York: McGraw-Hill.

Rusmini.(2020). The Effect of NPL, LDR, BOPO, and CAR on the Profitability (ROA) of Rural Credit Banks. Journal of Economics and Banking, 12(1), 45–56.

Financial Services Authority (OJK).(2024). BPR Information System: Financial Reports of the People's Economic Bank. Accessed through the official OJK portal.

Kasmir. (2018). Financial Statement Analysis. Jakarta: PT Raja Grafindo Persada.

Sekaran, U., & Bougie, R.(2016). Research Methods for Business: A Skill-Building Approach (7th ed.). United Kingdom: Wiley.

Sugiyono.(2018). Quantitative, Qualitative, and R&D Research Methods. Bandung: Alfabeta.

Siamat, D. (2018). Financial Institution Management. Jakarta: Publishing Institute of the Faculty of Economics, University of Indonesia.

*Profitability (ROA) in BPR in Indonesia*. Journal of Management and Financial Sciences, 9(3), 210–223.

Pranata, A. (2019). The Role of BPR Credit in Driving Regional Economic Growth. Journal of Economics and Banking, 7(2), 115–125.

Turidah, T. (2022). Analysis of Determinants of Profitability (ROA) in BPRs in Indonesia. Journal of Management and Financial Sciences, 9(3), 210–223