

Original Article

Scale Inefficiency in Village Fund Utilization: Evidence from Data Envelopment Analysis and Benchmarking across Papua and Maluku, Indonesia

¹SEPTRIANI SEPTRIANI, ²YUSNIDA YUSNIDA, ³BARIKA BARIKA

^{1,2,3}Department of Economic Development, University of Bengkulu, Indonesia.

ABSTRACT: *This data, despite not yet being a full-fledged led type of development, has succeeded in proving that even with massive Village Fund transfers, welfare improvement is still inequitable across Indonesian regions like Papua as well as Maluku, which indicates the ineffectiveness of local governments in transforming fiscal resources into real socio-economic outcomes. Using an output-oriented Data Envelopment Analysis (DEA) (VRS), the present study investigates the efficiency of Village Fund usage in improving welfare and reducing poverty simultaneously among 61 regencies and cities located within Papua and Maluku during 2020–2022. The independent variable (Village Fund) is treated as input, and the outputs are defined as the proportion of non-poor Population; inverse Poverty Gap Index; and inverse Poverty Severity Index. Results show that most of the local governments registered a relatively high level of DMU VRSTE, indicating suitable managerial performance. Nevertheless, weaker CRSTE and SE scores indicate that inefficiency is mostly linked to imperfect operational scale rather than technical proficiency. Findings: In 2020, only 4 of the 61 DMUs (6.56%) were fully efficient, while this number rose to 8 DMUs by using VRS in only one year (2021), and decreased to 5 DMUs (8.20%) again through the years, as seen within VRS model output between two other years with similar efficiency scores, with a Q3=5; Table 2. Over the observation period, there were eight regencies/cities that were able to achieve the efficiency frontier: Ambon City, Jayapura City, North Halmahera Regency, South Halmahera Regency, Morotai Island Regency (Morotai), Taliabu Island Regency, Tidore Islands City, and Sula Islands Regency. Out of these regions, Ambon City has a position as the main benchmark in 2020 and 2022, and North Halmahera Regency and Taliabu Islands Regency served primarily as the main benchmark in which years. These results suggest that better performance with the Village Fund has two components: not only do regions need adequately sized fiscal transfers, but they also have to wisely use funds and strengthen the mechanisms for inter-regional learning and emulate efficient practices from other regions. This study contributes to the literature on fiscal decentralization by demonstrating that operational scale is a more dominant source of inefficiency than managerial capacity in underdeveloped regions. Furthermore, the DEA benchmarking framework provides practical guidance for local governments that are not yet efficient in formulating improvement strategies based on the characteristics of comparison regions with better performance. However, since DEA measures relative efficiency based on an observed sample and does not explicitly incorporate factors such as governance quality, institutional capacity, or the composition of Village Fund usage, future research is recommended to integrate governance variables and a dynamic DEA approach to provide a more comprehensive evaluation of the efficiency of Village Fund management.*

KEYWORDS: *Data Envelopment Analysis, Village Fund, Poverty Reduction, Efficiency, Percentage of the Non-Poor Population, The Inverse Poverty Gap Index, The Inverse Poverty Severity Index.*

1. INTRODUCTION

For nearly the past decade, Indonesia has made the Village Fund a key instrument in accelerating rural development through fiscal decentralization mechanisms. From its initial implementation in 2015 through 2023, the government has allocated approximately Rp539.76 trillion in Village Funds to more than 75,000 villages across Indonesia (Indonesian Ministry of Finance, 2023). The magnitude of this fiscal commitment is based on the belief that enhancing villages' financial capacity will accelerate the provision of basic infrastructure, improve public services, strengthen local economic activities, and expedite poverty reduction, as mandated by Law No. 6 of 2014 about Villages and Government Regulation No.60/Hkg/20141. Q: What are the subjects of research studies one and two, respectively, on Government Regulation of Villages? Example: View Research Studies? However, almost a decade of administration of this policy has shown development success, at least in terms of welfare indicators, is not equal across the board. Despite these relatively larger shares of allocations through Village Funds since the implementation of the program, both Papua and Maluku provinces still have a very high rate of poverty in Indonesia due to the distribution formula that takes into consideration population size, poverty level, land area, and geographical condition (Central Bureau of Statistics, 2024; Ministry of Finance Republic of Indonesia, 2023)12. This situation creates an empirical puzzle that is important to explain: why has a massive increase in fiscal transfers not been sufficient to reduce poverty in the regions most in need of development intervention?

The magnitude of this fiscal commitment indicates that the government views rural development as a key strategy for reducing inter-regional development disparities while accelerating poverty alleviation. The increased fiscal transfers to the village level should theoretically increase the responsiveness of village governments in delivering public goods, improving economic opportunities, and the general well-being of communities. Because they know the social, economic, and geographic characteristics of their regions better than the central government (Oates, 1972), local governments have a comparative advantage from a fiscal decentralization perspective as they can allocate public resources with greater precision according to community needs. Therefore, the Village Fund is expected not only to increase the volume of development spending at the local level but also to bring about tangible socioeconomic transformation, particularly in areas with high poverty rates.

However, after nearly a decade of implementation, trends in various welfare indicators show that the increase in village fiscal capacity has not yet fully resulted in equitable development. Although the national poverty rate has gradually declined since the COVID-19 pandemic, interregional disparities remain a major challenge for Indonesia's development. Papua and Maluku are still the poorest regions of Indonesia, namely in terms of the number of people who live in poverty and/or limited access to basic services (Central Bureau of Statistics, 2024). This condition is interesting as both regions have consistently received a relatively large allocation of Village Fund due to the application of a distribution formula that considers poverty, land area, population size, and geographical difficulty (Ministry of Finance of the Republic of Indonesia, 2023).

However, it leads to an important question in the development/public economics literature: why have some of the largest cash transfers not provoked a similar reduction in poverty in areas that are instead highly entitled to receive funds but do have a very low developmental requirement? This question implies that to know whether the policy of Village Fund is either a success or not, it does not merely depend upon the huge budget cut but furthermore also has to do with how those fiscal resources are exercised and then effectively converted into development outcomes. Two regions receiving relatively the same amount of Village Fund allocations may achieve different levels of well-being if they possess varying institutional capacities, governance quality, planning effectiveness, and program implementation capabilities.

The differences in poverty levels across regions in Indonesia indicate that the issue of village development is not only related to fiscal resource constraints but is also closely linked to the efficiency of public resource utilization. In other words, the main challenge is not merely how to increase the amount of fiscal transfers to villages, but rather how to ensure that every unit of the budget spent can generate optimal development benefits. Such a perspective changes the landscape for evaluating Village Fund policy from simply whether or not the Village Fund has any effect on development to what I see as a more fundamental question of how well the Village Fund is used to produce development outcomes from poverty alleviation. Figure 1 suggests the disparities in development (poverty) across regions in Indonesia during the period of 2020–2023.

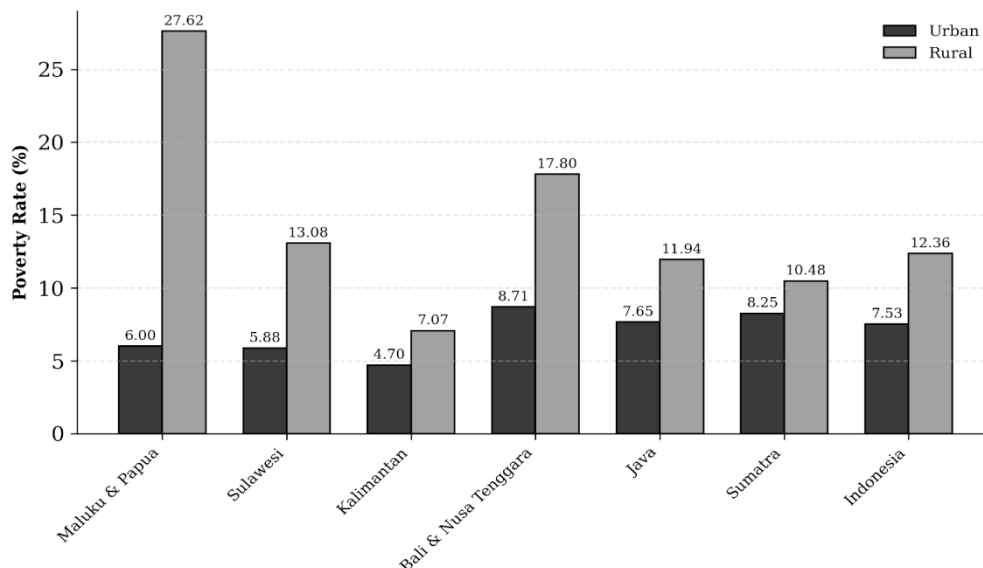


FIGURE 1 Poverty Rate by Island in Indonesia, 2020–2023 (%)

Source: Central Bureau of Statistics (BPS) 2020–2023.

The figure indicates that while most regions showed a downward trend in poverty rates, Papua and Maluku remained the poorest regions among other areas. Such results not only substantiate the case against interregional welfare convergence in response to higher fiscal transfers, but also point to why it is important to assess the efficiency of Village Fund management when seeking more inclusive development.

Fiscal decentralization has become one of the core approaches to advance regional development, especially in developing countries experiencing problems with regional disparity and a lack of both infrastructure and public services. By transferring powers and fiscal resources, it is anticipated that local administrations would be able to develop policies tailored towards meeting local needs. However, many available studies suggest that greater fiscal transfers do not always produce proportionate improvements in welfare. Because some regions have relatively less capacity to provide sound policy decisions and a favourable bureaucratic climate than others (Bardhan, 2002; Faguet, 2014), such small differences in fiscal support lead to different development outcomes.

In theory, fiscal decentralization can enhance the efficiency of public service delivery, because local governments have a comparative advantage with respect to information about local conditions and needs. This allows the allocation of resources to be better suited to the characteristics of each region (Oates, 1972; Decentralization Theorem). But the advantages of decentralization are contingent on institutional readiness and good governing processes. When local governments face constraints in managing public resources, increased fiscal transfers may boost spending without yielding optimal improvements in welfare (Bardhan, 2002). Consequently, the focus in the public policy literature has begun to shift from merely examining the size of the allocated budget (more spending) toward the government's ability to generate greater development benefits through the efficient use of resources (better spending) (Farrell, 1957; Narbón-Perpiñá & De Witte, 2018).

The amount of funding received by a region does not automatically guarantee development success if those resources cannot be converted into improved community well-being. Therefore, an evaluation of the Village Fund must consider not only the impact of the policy but also the capacity of local governments to manage fiscal resources efficiently. One appropriate approach for measuring this efficiency is Data Envelopment Analysis (DEA), a nonparametric method developed by Charnes et al. (1978) based on Farrell's (1957) concept of efficiency. DEA can measure the ability of a Decision-Making Unit (DMU) to transform inputs into outputs and identify relative efficiency levels across regions. This approach is typically employed in public sector evaluations since it can detect variations in performance, as well as the potential for greater efficiency (Worthington, 2000; De Witte & López-Torres, 2017). In the context of Papua and Maluku, these insights provide an essential platform for understanding why regions with large amounts of Village Fund are nevertheless still struggling to find a way forward from poverty, as well as how better public financial management practices can support higher impact rural development outcomes.

One type of fiscal decentralization we supported in Indonesia was the Village Fund, which aimed to boost place-based development through increased authority and fiscal capacity at the village government level. The Village Fund's policy design fundamentally accounts for regional differences in development needs through an allocation formula that considers population size, poverty levels, land area, and geographical difficulty. In addition to being directed toward basic infrastructure development, the use of the Village Fund has expanded to include community empowerment, strengthening the local economy through Village-Owned Enterprises (BUMDes), food security, and social protection through programs such as the Village Fund Direct Cash Assistance (BLT-DD) during the COVID-19 pandemic. While various studies show that the Village Fund is a contributing factor to increased infrastructure, basic services, and economic activities of local communities, the effect on regional differences remains. These differences suggest that the success of the Village Fund is not solely a function of the volume of funds received but rather of the capacity to effectively plan, allocate, and manage fiscal resources at the local government level.

Literature on fiscal decentralization suggests that the effectiveness of government transfers is not only dependent on the volume of resources transferred but also upon local governments' capacity to transform fiscal inputs into real development outputs. Likewise, Indonesia has had the Village Fund as a major tool of rural development since 2015, encompassing community infrastructure investment and support for basic services to sustain the local economy and reduce poverty. Accompanied by several research studies that mention that the Village Fund has contributed to the improvement of infrastructure and community welfare in rural areas (Saragi et al., 2021; Agusta & Khoirunurrofik, 2024). Nonetheless, these impacts are heterogeneous across regions; they vary according to institutional capacity, a measure of the quality of governance, and village government's ability to manage fiscal resources.

This policy adopted the provisions within Law No. 6 of 2014 on Villages, which regards villages as development actors that are responsible for deciding priorities based on the social, economic, and geographic characteristics of their regions. The government spent about Rp539 trillion on the fund from 2015 until 2023. The Village Fund transferred IDR 76 trillion to more than 75,000 villages across Indonesia (Ministry of Finance of the Republic of Indonesia, 2023). Transfers through the Village Fund increased dramatically between 2015 and 2023, rising from IDR 20.77 trillion to around IDR 70 trillion (see Figure 2). This persistent fiscal expansion results from the view that more fiscal capacity at the village level would generate better development results. However, the scaling up itself has an uncomfortable question at its heart: Has increased fiscal space led to similarly sized improvements in welfare outcomes, even in areas that have been battling poverty for generations?

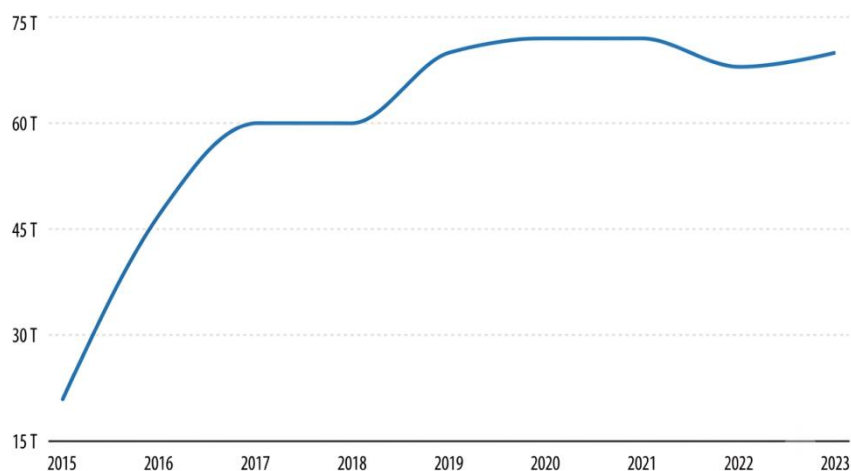


FIGURE 2 Growth Trend of Indonesia's Village Fund Allocation (2015–2023)

Source: Ministry of Finance of the Republic of Indonesia (2023).

Differences in development outcomes across regions indicate that increased Village Fund allocations do not automatically lead to greater poverty reduction. Regions with different geographic and institutional characteristics can yield different development outcomes even when receiving relatively similar levels of fiscal support. This issue becomes increasingly critical in regions such as Papua and Maluku, which face development challenges including limited connectivity, high public service costs, and uneven administrative capacity. Therefore, the evaluation of the Village Fund needs to shift from merely measuring policy effectiveness to analyzing the government's ability to use fiscal resources efficiently, policy efficiency (Lewis, 2015).

Most previous research on the Village Fund has relied on econometric approaches such as panel data regression, fixed-effects models, and difference-in-differences to identify the Village Fund's impact on poverty or other development indicators. While these approaches are important for understanding policy effectiveness, they have not been able to explain whether a particular region has utilized its fiscal resources optimally compared to other regions. From the perspective of public spending efficiency, a region may generate positive impacts but still be inefficient if the same outcomes could be achieved with fewer resources. Therefore, an approach is needed that can measure the relationship between fiscal inputs and development outcomes.

Data Envelopment Analysis (DEA), which compares various inputs and outputs to measure relative efficiency among Decision Making Units (DMUs), is a potential answer for this problem due to the fact that this methodology allows comparing DMUs with no assumption on the form of a certain production function (Charnes et al. 1978; Banker et al. 1984). DEA is a well-known method that has been extensively applied to efficiency analysis in the public sector, as it helps identify and quantify inefficient units and provides insights for further improvement of resource use (De Witte & López-Torres, 2018; Narbón-Perpiñá & De Witte, 2018). This study can provide a comprehensive understanding of how regions with available budget fiscal resources can efficiently navigate the intricacies of poverty reduction, especially in areas burdened by the heterogeneity and multifaceted development challenges such as Papua and Maluku, by utilizing DEA for handling Village Funds management. To fill this void, this research adopts the Data Envelopment Analysis (DEA) method to analyze the efficiency level in village fund management. DEA is a nonparametric method that measures relative efficiency among Decision Making Units (DMUs) by comparing various combinations of inputs and outputs without requiring assumptions about the form of the production function (Charnes et al., 1978; Banker et al., 1984). In the public sector, DEA is widely used to identify efficient units, measure levels of inefficiency, and provide benchmarks for units that still require improvement (De Witte & López-Torres, 2018; Narbón-Perpiñá & De Witte, 2018). Unlike econometric approaches that focus on causal relationships, DEA evaluates local governments' ability to convert fiscal resources into development outcomes on a relative basis.

Such an approach is particularly pertinent to the provinces of Papua and Maluku, with their history of high poverty rates, geographical remoteness and high reliance on fiscal transfers. However, little research has focused on the effectiveness of Village Fund management in these areas, as previous studies have only focused on policy impact analysis. Therefore, an efficiency analysis is crucial to provide a more comprehensive picture of the quality of Village Fund utilization, identify performance gaps between regions, and provide a stronger empirical basis for refining fiscal decentralization policies and strengthening village development governance in eastern Indonesia.

2. THEORETICAL AND LITERATURE REVIEW

Fiscal decentralization is based on the view that local governments have better information about community needs and the socioeconomic characteristics of their regions than the central government. This means that transferring fiscal powers to local governments should enhance the efficiency of the allocation of public revenues through policies tailored to local needs (Oates, 1972). Other than by the mere volume of fiscal transfers, the actual success of fiscal decentralization is contingent upon institutional capacity, governance quality, and accountability mechanisms that empower local governments to convert extra fiscal resources into better public welfare and upgraded provision of public services (Oates, 1972; Rodríguez-Pose & Gill, 2003; World Bank, 2022). In the Indonesian domain, fiscal centralization at the village level is exercised in accordance with Law No. 6 of 2014 on Villages, which puts more power into village governments to manage development and finances. The main instrument of this policy is the Village Fund, a transfer from the State Budget (APBN) through the state treasury for village governance; infrastructure development, community empowerment, and improvement of well-being in villages. This policy changes the role of villages from being development objects to institutions of development that must be placed in a position where they are entitled to determine their own priorities based on local needs.

Conceptually, the Village Fund is a fiscal policy tool for speeding up rural development as well as for enhancing local economic capacity and reducing regional disparities in development. The balanced allocation and formula-based allocation reflected in the Village Fund mechanism demonstrate that this policy not only aims to spread evenly but also considers the heterogeneous nature of villages through some indicators like population size, poverty rate, land area, and geographical problems. Hence, the Village Fund can be viewed from two dimensions: as a fiscal transfer system or institutional arrangement and certain development tools for rural community welfare improvement. However, larger fiscal transfers do not necessarily translate into enhanced well-being. Development-wise, fiscal policy is not merely about resource availability but also the ability of local institutions to productively mobilize and allocate resources. As such, measuring the Village Fund should not only be in terms of size or speed of fund absorption, but rather the potential to translate these resources into development outcomes that bring social dividends.

Empirically, therefore, the Village Fund is proven to enhance the well-being of rural communities through numerous development mechanisms. Rammohan et al. The evidence shows that the Village Fund has led to greater rural household consumption, enhanced economic activities, and higher female labor supply (Geng et al., 2023). A substantial avenue in which increased female participation plays a role is through diversified household income and economic resilience for poor communities. In addition, the Village Fund also has a role in local economic transformation as it directs economic activities from low-productivity agricultural sectors to the service sector (Rammohan et al., 2023).

Nonetheless, several studies have revealed that the effect of the Village Fund on poverty alleviation is still heterogeneous across regions. Based on Sari and Abdullah (2017), they found that the Village Fund and Allocation of Village Funds could reduce poverty in some districts of the Tulungagung Regency, but not evenly. This is partly because the money has mostly gone toward infrastructure and not community economic empowerment programs. This result is in accordance with Setianingsih (2017), who also concluded that the increased funds allocated from the Village Fund program cannot reduce poverty if these additional budgets are not allocated for activities that can improve community economic capability.

Recent studies also show that Village Funds can provide benefits through different channels of development, including basic infrastructure and access to health care, education, clean water, and productive economic activities (Noer et al., 2025). Still, a high budget execution rate does not necessarily equate with successful development. Attractive budget absorption is not worth a fig for helping shoulder national welfare unless expenditures correspond with the needs of local communities or are able to spur economic development (Ginting et al., 2023)—further illustration of the distinction between efficiency in administrative and substantive management of the Village Fund.

Administrative Efficiency is related to compliance with financial management procedures in the village government and performing budget realization. On the other hand, substantive efficiency is about operationalizing public expenditure into actual improvements in welfare and well-being within communities, like reducing poverty levels, increasing income generation, and enhancing quality of life. In the context of development, substantive efficiency is a more relevant measure because the primary objective of the Village Fund is not merely to ensure that the budget is spent, but to ensure that public resources yield optimal social benefits.

The concept of efficiency in public resource management refers to an organization's ability to produce maximum output with a given set of inputs or to produce a specific output with minimal use of resources (Farrell, 1957). In the public sector, efficiency refers to the limited resources being used for development and their relation with benefits. Mardiasmo (2009) states that a public organization can be said to be efficient if the benefit in the use of resources is optimal. Accordingly, Yuwono et al. Bhagwati et al. (2005) argue that public financial resources should only be assessed in terms of their capacity to generate outputs and outcomes which afford direct benefits to the community. This notion of efficiency also applies to the assessment of

the Village Fund, as regions with similar levels and types of fiscal transfers could reach different degrees of well-being due to differences in capacity for management, adequacy in policy/rules, approaches for budget expenditure, and institutional conditions. Thus, the evaluation focuses not only on the relationship between the Village Fund and poverty but also on the villages' ability to transform fiscal resources into development outcomes optimally.

To measure this transformation process, the Data Envelopment Analysis (DEA) approach is widely used in public sector efficiency research. DEA is a non-parametric method that measures relative efficiency among Decision Making Units (DMUs) based on a combination of various inputs and outputs without requiring assumptions about the form of a specific production function (Charnes et al., 1978; Cooper et al., 2007). In contrast to regression approaches that approximate average relationships between variables, DEA creates an efficiency frontier according to the best-performing units contained in the research sample.

DEA is particularly useful because it enables the evaluation of organizations that utilize multiple inputs and generate multiple outputs in the same period (Bogetoft & Otto, 2011). This method is appropriate for the village fund analysis because rural development phenomena are multidimensional by nature, where inputs like the village fund, demographic characteristics, and institutional capacity are converted into outputs such as poverty reduction, improved well-being, and overall quality of village development. Besides generating efficiency scores, DEA can also identify benchmark regions and locate sources of inefficiency, thus yielding more analytical policy insights (Cooper et al, 2007).

Beyond technical factors, the success of the Village Fund is shaped by institutional quality and governance. While the Village Fund Law stipulates that the funds are to be allocated based on community needs, realities such as transparency, accountability, community participation and local leadership are significant determinants of how well it works (Permatasari et al. 2021; Lewis, 2015) Yet a poor planning capabilities, limited technical capacity, weak financial administration and regulatory complexity continue to make it difficult for the government part of Village Fund (Lewis, 2015). These conditions may imply differences in regional capacity to leverage fiscal space into development-related benefits.

In addition, community participation is also an important factor in enhancing the efficiency of Village Fund utilization. Engagement of the community in planning and oversight processes complements transparency and accountability, and helps mitigate "elite capture", where specific groups wielding social or political influence at the local level enjoy disproportionate access to benefits from public resources (Sidik et al., 2023). The effectiveness of the Village Fund, therefore, is measured not only by its technical input-output relationship but also by the extent and quality of governance as well as the inclusiveness of development.

However, there are several gaps in the literature based on these developments. Firstly, the majority of prior research centered on determining the effectiveness of the Village Fund, assessed via a regression method in regard to poverty, economic growth, and village advancement (Ernawati et al., 2021; Saragi, 2021; Andiatma et al., 2016). While this strategy could help explain the statistical correlation between variables, it has yet to establish whether villages bothered to use their fiscal resources effectively. Second, the empirical evidence on the impact of Village Fund on poverty remains mixed. Azmi et al. The Community Empowerment System of the Village Fund (2020) specifies that although the village fund has successfully sent assistance to poor communities in Aceh Province, it has not rapidly made a significant increase in poverty reduction and popular welfare, whilst Guswandi and Amelia (2023) showed a limited effectiveness on the utilization of community economic resources in West Sumatra. Conversely, Andiatma et al. (2026) and Zahara et al. (2024) Village Fund Contribution: The author found that the Village Fund could play a big role in reducing poverty and led to better village development. The contrasting results furthermore suggest that the success of the Village Fund critically hinges on local government management of available resources. Third, previous research has been limited in integrating fiscal, institutional, and development outcome dimensions into a single evaluation framework. Therefore, the DEA approach is relevant because it can identify how each region transforms fiscal resources into development outcomes in a relatively efficient manner. Thus, this study contributes by shifting the focus of research on the Village Fund from mere effectiveness to the efficiency of fiscal resource management. Through the DEA approach, this study provides insights into which regions have achieved efficient performance, which regions are experiencing inefficiencies, and the management factors necessary to enhance the capacity of village governments to improve community welfare.

3. RESEARCH METHODS

This study employs a quantitative research approach using a non-parametric efficiency analysis framework to examine the efficiency of Village Fund management in improving welfare outcomes and reducing poverty among regencies/cities in the Maluku and Papua regions of Indonesia. Unlike econometric approaches that primarily estimate causal relationships between fiscal intervention and development outcomes, this study focuses on assessing the relative efficiency of local governments in transforming fiscal resources into socioeconomic outcomes. Therefore, the Data Envelopment Analysis (DEA) approach is applied to evaluate the performance of each regency/city as a Decision-Making Unit (DMU), an approach widely adopted for assessing public sector efficiency under multiple input-output settings (Thanassoulis, 2001; Emrouznejad & Yang, 2018).

DEA is a non-parametric mathematical programming technique that measures relative efficiency based on multiple inputs and outputs without requiring a specific functional form of the production function (Charnes et al., 1978; Banker et al., 1984). Compared with parametric frontier methods, DEA is particularly advantageous when the production technology is unknown and when organizations produce multiple outputs simultaneously (Cooper et al., 2007). Because government organizations convert fiscal resources into various socio-economic outcomes rather than market-based profits (Johnes, 2006; Daraio & Simar, 2007; Emrouznejad & Yang, 2018), this approach has been widely applied to evaluate government performance (e.g., Zhang et al. This study utilizes data envelopment analysis (DEA) to address which regions are operating on the efficiency frontier, and which ones are inefficient but have scope for further utilization of Village Funds.

This study focuses on Regencies/Cities in Maluku and Papua regions in the 2020–2022 period. This area is also an area with high levels of poverty and where the use of Village Funds is an important instrument to develop small-scale rural development and increase local income. Results show that despite large regional inequities in fiscal transfers, welfare outcomes vary significantly between regions, which reflects the difference in local government's ability to convert fiscal resources into development outcomes. The work is based on secondary panel data at the regency/city level. Village Fund allocation data were taken from the Directorate General of Fiscal Balance (DJPK), Ministry of Finance, Republic of Indonesia, and poverty-related indicators were collected from the Central Bureau of Statistics (BPS). The dataset consists of allocation levels of the Village Fund, percentage of non-poor population, poverty depth index, and poverty severity index for each regency/city over the observation period.

In this study, the DEA framework is constructed with one input and three outputs. The input variable is Village Fund allocation, which is the fiscal resources available to 1 (one) regency/city in each year for supporting village development, community empowerment, and poverty reduction programs. The output variables are designed as desirable welfare outcomes. The first output is the percentage of non-poor population, calculated as: $Y_1 = 100 - PovertyRate$. This indicator shows the percentage of the population living above the poverty line a higher figure means better welfare conditions. Your second output is actually like applying an inverse transformation to the Poverty Depth Index (P1): $Y_2 = \frac{1}{P1}$. The average expenditure gap of the poor relative to the poverty line is measured by the key indicator our study uses, which is the Poverty Depth Index. Since lower values of P1 correspond to better tolerated poverty, the inverse transformation was performed to ensure that higher output values represent a more favourable welfare performance. The third output is the inverse transformation of the Poverty Severity Index (P2): $Y_3 = \frac{1}{P2}$. The Poverty Severity Index captures inequality among poor

households. Similar to P1, the inverse transformation converts this indicator into a desirable output where higher values represent better performance in reducing poverty severity. The efficiency measurement is conducted using an output-oriented Variable Returns to Scale (VRS) DEA model. The VRS specification developed by Banker et al. (1984) is selected because regencies/cities in Maluku and Papua operate under heterogeneous economic, demographic, geographic, and institutional conditions. Assuming constant returns to scale would therefore ignore differences in operational scale and potentially bias efficiency estimates. The VRS model relaxes this assumption of constant returns to scale across decision-making units, allowing for increasing, constant, or decreasing returns to scale, thus making VRS particularly suitable for assessing local government performance (Banker et al., 1984; Coelli et al., 2005; Cooper et al., 2007). In addition, an output-oriented specification is used because local governments are relatively constrained in their ability to cut Village Fund allocations fixed by the central government but expected to use available fiscal resources as efficiently as possible in terms of maximizing welfare improvements. Indeed, output orientation makes much more sense when public expenditure evaluation and performance assessment are the objectives, as in decentralized governance systems (Thanassoulis, 2001; Cook et al., 2014). The output-oriented VRS DEA model can be mathematically defined as:

$$\begin{aligned} & \text{Max } \phi \\ & \sum_{j=1}^n \lambda_j x_j \leq x_0 \\ & \sum_{j=1}^n \lambda_j Y_j \geq \phi Y_0 \\ & \sum_{j=1}^n \lambda_j = 1 \\ & \lambda_j \geq 0 \end{aligned}$$

Where ϕ is the output expansion factor, X is the input variable (Village Fund), Y are the output variables (indicators of welfare and poverty), and λ are intensity weights that will be used to construct the efficiency frontier. The constraint $\sum \lambda_j = 1$ is associated with the VRS assumption (Banker et al., 1984), allowing the DMUs to operate at different scales.

The DEA efficiency score describes the capability of each regency/city in conducting the reshaping of the Village Fund into an increase in welfare. As a reminder, a DMU with an efficiency score of one means it operates on the efficiency frontier and is the state-of-the-art benchmark for other similar regions. Conversely, a score below one indicates that the region has potential improvements in generating welfare outcomes with the available fiscal resources. The DEA results are subsequently used to compare efficiency differences among regencies/cities in Maluku and Papua and identify benchmark regions that demonstrate more effective Village Fund management practices. Based on this evidence, it shows the effect of the use of fiscal decentralization through Village Funds in overcoming poverty and encouraging sustainable rural development.

4. RESULTS AND DISCUSSIONS

4.1. VILLAGE FUNDS IN PAPUA AND MALUKU FROM 2020 TO 2022

In an effort to address poverty in Indonesia, the government has implemented numerous policies. One of these is a policy to allocate village funds to each region. The regions with the highest poverty rates in Indonesia, Papua and Maluku, receive relatively large amounts of village funds. From 2020–2022, the amount of village funds in Papua and Maluku continuously decreased. This is a result of economic recovery from the effects of COVID-19. The amount of village funds in each province in Papua and Maluku differs from regent to regent. The top one and bottom one village fund allocations during 2020 up to 2022 in West Papua Province were Maybrat Regency as the highest amount and South Manokwari Regency as the lowest amount. Papua Province, second, Tolikara Regency received the highest amount, with IDR 73.340 million, and the lowest, Jayapura City, received IDR 5 billion or only USD 318.75 million on average every month.

Furthermore, in Maluku Province, the highest village fund allocation was in Central Maluku Regency and the lowest in Tual City. In North Maluku Province, the highest village fund allocation was in South Halmahera Regency, and the lowest in Tidore Islands City. The classification of the highest and lowest village fund allocations in Papua and Maluku can be seen in the following table.

TABLE 1 Provincial Village Funds in Papua and the Maluku Islands, 2020–2022

Province	2020		2021		2022	
	Max	Min	Max	Min	Max	Min
West Papua	195.284.321 (Maybrat)	64.829.871 (South Manokwari)	198.083.334 (Maybrat)	65.445.870 (South Manokwari)	183.825.584 (Maybrat)	49.405.589 (South Manokwari)
Papua	422.326.878 (Tolikara)	27.940.274 (Jayapura City)	428.173.465 (Tolikara)	26.551.124 (Jayapura City)	427.041.775 (Yahukimo)	13.151.364 (Jayapura City)
Maluku	181.868.192 (Central Maluku)	35.860.809 (Tual City)	180.663.319 (Central Maluku)	37.438.217 (Tual City)	167.711.614 (Central Maluku)	23.536.303 (Tual City)
North Maluku	199.132.764 (South Halmahera)	48.548.292 (Tidore Island City)	196.441.821 (South Halmahera)	49.499.008 (Tidore Island City)	196.099.147 (South Halmahera)	36.823.386 (Tidore Island City)

Source: Research data, processed (2023)

Table 1 shows that Village Fund allocations in Papua and the Maluku Islands during 2020–2022 were characterized by substantial disparities both across provinces and among regencies within the same province. The distribution pattern remained relatively stable over the three-year period, with only minor changes in the nominal value of allocations and limited shifts in the districts receiving the highest allocations. It shows that structural, but not annual, regional features drive Village Fund distributions.

Papua has been home to the largest Village Fund transfers of any of the four provinces, with Tolikara receiving the largest single transfer in 2020–21 only to be displaced by Yahukimo in 2022. On the contrary, Kota Jayapura became the smallest receiver during those 4years of mediation. The other provinces, too, followed a similar pattern in which Maybrat (West Papua), Central Maluku (Maluku) and South Halmahera (North Maluku) received the biggest allocations and South Manokwari, Tual City and Tidore Islands City got the least. Such patterns are compatible with the Village Fund allocation formula, which prioritizes the number of villages, population, poverty level, land areas, and accessibility factor. As a result, larger allocations mostly result from higher fiscal needs and increased service delivery costs rather than better performance at the regional level.

Another notable finding is that Fiscal Disparity in Papua shows the widest Range in almost all Regions of this study. The lowest allocations are well below the estimate, and when comparing the highest allocation in a single province with the lowest national allocation, there is a huge gap remaining between different provinces; differences in administrative structure and territorial character reflect themselves through this gap. Districts in hilly or remote areas typically oversee greater numbers of

smaller villages, leading to higher overland costs, while urban municipalities like Kota Jayapura manage comparatively few. Such circumstances make differentiated fiscal transfer valid as a part of Indonesia's horizontal fiscal equalization policy.

In West Papua, Maluku and North Maluku, the maximum Village Fund declined slightly in 2022 but the district allocation pattern was little changed. This suggests that adjustments in the annual allocation did not alter the underlying distribution mechanism. More importantly, the pronounced variation in Village Fund allocations confirms that districts operate under different fiscal capacities. Therefore, evaluating policy performance solely based on the amount of Village Funds received would be insufficient. The critical issue is whether local governments are able to transform these fiscal resources into measurable welfare improvements, particularly poverty reduction, which constitutes the main focus of the efficiency analysis in this study. Thus, the results of the descriptive analysis show that the distribution of Village Funds in Papua and the Maluku Islands during the 2020–2022 period exhibited a fairly high level of heterogeneity, both across provinces and across regencies within a single province. The patterns of the highest and lowest Village Fund recipients tended to be stable, while greater variation occurred in the nominal amounts of the funds. The position of this situation is mostly influenced by the Village Fund allocation formula that considers the number of villages, population size, poverty level, land area, and geographical difficulty level, which has been confirmed in terms of government policies.

4.2. CUMULATIVE POVERTY HEADCOUNT, PAPUA AND MALUKU ISLANDS 2020–2022

This notice regarding the growing poverty rate and the assistance of a government program they will hire Philip to check on is one of the other indicators for how we will evaluate whether or not all this extra money in this case, funds under President Jokowi's Village Fund program works out well, especially as it pertains to Eastern Indonesia, where development lags and many human-services basic services are still lacking. In theory, the Village Fund focuses on improving community welfare and reducing poverty in the village; results achieved so far clearly show vast disparities by region. Therefore, an analysis of variations in poverty rates is essential to provide an overview of the socioeconomic conditions faced by each region and to serve as a basis for assessing the extent to which local governments are able to convert fiscal resources into development outcomes. Table 2 presents the highest and lowest poverty rates in each province on the islands of Papua and Maluku during the 2020–2022 period as an initial illustration of poverty disparities, which are subsequently used as output indicators in the efficiency analysis.

TABLE 2 Poverty Rate for Papua and Maluku Islands, 2020–2022

Province	2020		2021		2022	
	Max	Min	Max	Min	Max	Min
West Papua	34,70 (Pegunungan Arfak)	16,04 (Kaimana)	33,81 (Pegunungan Arfak)	15,50 (Kaimana)	33,7 (Pegunungan Arfak)	15,29 (Kaimana)
Papua	41,66 (Intan Jaya)	10,16 (Merauke)	41,76 (Deiyai)	10,03 (Merauke)	42,03 (Intan Jaya)	10,1 (Merauke)
Maluku	29,15 (Southwest Maluku)	4,51 (Ambon City)	29,55 (Southwest Maluku)	5,02 (Ambon City)	27,64 (Southwest Maluku)	4,68 (Ambon City)
North Maluku	29,15 (Pulau Taliabu)	6,64 (South Halmahera)	15,04 (East Halmahera)	5,19 (South Halmahera)	13,14 (East Halmahera)	4,58 (North Halmahera)

Source: Research data, processed (2023)

Table 2 demonstrates that poverty remains highly uneven across regencies in Papua and the Maluku Islands during 2020–2022. This gap also occurred in Papua Province, whereby the difference in the poverty rate was higher than 41% - more than the lowest range of poor persons, even only about 10%. Meanwhile, the poverty gap in Maluku and North Maluku is relatively lower, but there are still differences between regions. These results show that, among districts in eastern Indonesia, poverty is not distributed evenly through the provinces.

Papua was consistently at the top across all of the poverty measures assessed here, while there were periods during which Intan Jaya or Deiyai uniquely occupied this state in the study area. They feature rugged terrain, very little road and rail access, poor public services, and subsistence livelihoods. These structural barriers lead to slower economic growth and reduced performance of poverty alleviation initiatives. In contrast, Merauke regularly had the lowest poverty rate in Papua as a result of relatively superior physical connection and more extensive monetary opportunity; it is likewise more appropriate for horticulture and exchange compared with the central highlands district.

The same goes with West Papua, where Pegunungan Arfak has the highest poverty rate; this trend remains, and Kaimana has the lowest. Similar to this situation, Southwest Maluku reported the highest incidence of poverty in Maluku Province whilst

Ambon City had reported the lowest for many years. The highest poor districts in North Maluku experienced a shift from Pulau Taliabu in 2020 to East Halmahera in 2021–2022, while the lowest poor were located in South Halmahera and then North Halmahera. These changes invite a reorientation in perspectives on poverty dynamics across provinces, but the spatial pattern as before shows that very remote and geographically isolated districts have more connectivity-related deficits than urban or commercially integrated areas. To get some qualitative evidence from the data, one would often expect large Village Fund disbursements to correlate with lower poverty incidence across a given district. Long-lasting differences in poverty signify that regional aspects, geographical access, economic structure, and development capacity of local governance are still crucial determinants of development results. These results confirm the importance of effectiveness evaluation to assess whether local government has been successful in converting the Village Fund into real impact on, it is for poverty reduction. Poverty Severity Index of Papua and Maluku, 2020–2022

The poverty severity index (P2), which also accounts for the mean expenditure disparity of the poor and reflects the depth of poverty, is another piece of evidence on income inequality that drew close attention from researchers in India. The Poverty Severity Index differs from the poverty rate, which is nothing more than a measure of the proportion of those who live below the poverty line, as it indicates how wide the expenditure gap is between the poor and the poverty line and at once retains information on inequality among the poor. Thus, this indicator presents a more complete overview of the character of poverty and is an appropriate measure to assess whether the management of Village Fund has been effective in enhancing the welfare status by village. To give an initial depiction of the discrepancy in poverty depth by region that is used analytically, Table 3 shows the maximum and minimum values of the Poverty Severity Index at the provincial level in Papua and Maluku for the years 2020–2022.

TABLE 3 Poverty Severity Index in Papua and Maluku, 2020–2022

Province	2020		2021		2022	
	Max	Min	Max	Min	Max	Min
West Papua	3,84 (Teluk Bintuni)	0,73 (Kaimana)	4,19 (Teluk Wandama)	0,59 (Kaimana)	4,11 (Teluk Bintuni)	1 (Raja Empat)
Papua	8,12 (Lanny Jaya)	0,31 (Merauke)	6,99 (Puncak Jaya)	0,29 (Sarmi)	7,59 (Lanny Jaya)	0,37 (Sarmi)
Maluku	1,64 (West Southeast Maluku)	0,06 (Ambon City)	1,72 (Southwest Maluku)	0,14 (Ambon City)	1,77 (Western Seram)	0,09 (Ambon City)
North Maluku	0,39 (Central Halmahera)	0,08 (South Halmahera)	0,68 (East Halmahera)	0,07 (North Halmahera)	0,41 (East Halmahera)	0,11 (North Halmahera)

Source: Research data, processed (2023)

Table 3 indicates that the ranks of the Poverty Severity Index elasticity of poverty and growth divergent results exist across regions in Papua and Maluku islands for the period of 2020–2022, implying different lifestyles for the poorest percentile population. Papua Province showed the highest poverty severity, with index values that were always higher than or equal to 6.99 (the most parsimonious being within the range of 6.99 to 8.12) whereas West Papua, Maluku and North Maluku recorded consistently lower index values ($P < 0[\text{point}] 001$). This finding implies that poverty is wider than in other provinces and is moreover deeper where poor households fall short of the food poverty line by a greater degree in Papua.

Within Papua, Lanny Jaya, Puncak Jaya, and later Lanny Jaya again recorded the highest Poverty Severity Index, whereas Merauke and Sarmi consistently reported the lowest values. A similar spatial pattern was found in the other provinces. In West Papua, the highest index was recorded in Teluk Bintuni and Teluk Wondama, while Kaimana and Raja Ampat consistently showed the lowest levels. In Maluku, the highest poverty severity shifted among West Southeast Maluku; Southwest Ambon City always had the lowest index, while Maluku and Western Seram, on the other hand. East Halmahera and North Maluku had the highest poverty severity in 2021–2022, and North Halmahera was only at the lowest values.

These patterns also resonate with the historical legacy of geographical isolation, poor infrastructure, low access to public services, and a less diversified economy in remote districts mainly located in the mountainous burdens of Papua as well as outer areas and islands in Maluku province. On the contrary, areas with better connectivity and a more diversified economy such as Ambon, Merauke, and Raja Ampat have relatively lower poverty severity. The findings call for focusing poverty-reduction efforts not only on reducing the number of poor people but also on decreasing the severity of poverty.

This distinction is particularly important for the present study because an efficient use of Village Funds should contribute to improving the welfare of the poorest households, rather than merely lowering the aggregate poverty rate.

When comparing provinces, Papua consistently shows a poverty severity index that is far higher than other provinces, particularly in the Lanny Jaya and Puncak Jaya regions, where the index reaches values between 6 and 8. In contrast, the lowest values are consistently found in Ambon City, with values approaching zero. This indicates a very large disparity not only in poverty levels but also in the distribution of well-being among poor groups in eastern Indonesia. The descriptive results in Table 2 also suggest that the poverty severity index across the islands of Papua and Maluku remains very spatially heterogeneous during the 2020–2022 period. This is shown by higher values in mountainous and remote island regions such as Lanny Jaya, Puncak Jaya, Teluk Bintuni, and West Seram, while lower values are found in urban areas and growth centers such as Merauke and Ambon City. These results are only descriptive in nature, so these findings should not be interpreted as explaining causal relationships; they represent patterns of variation amongst poverty severity according to the data we were able to observe.

4.3. PAPUA AND MALUKU: POVERTY DEPTH INDEX 2020–2022

The depth of poverty index (P1) is one of the most important indicators for estimating the average level of expenditure gap between the poor and the poverty line, besides the incidence of poverty rate and the Poverty Severity Index. This indicator provides a measure of the extent to which the economic condition of the poor is below the poverty line, and thus serves as an approximation of how much effort will be required to raise them above that line. Poverty Depth Index Value is an indicator of the gap between expenditure levels of poor people and the poverty line, so a high value of the Index means that higher budget allocations should be taken to improve welfare through multi-dimensional development, be it Village Funds or even others. So, this indicator is relevant to assess the quality of Village Fund management that is aimed at improving the welfare of poor people. Table 4: Maximum Minimum of Poverty Depth Index by province of Papua and Maluku Period 2020–2022. The need for a summary variance in poverty depth across regions. Table 4 also provides an initial overview of the difference in value both between regions (provincial) as well as over time.

TABLE 4 Poverty Depth Index in Papua and Maluku, 2020–2022

Province	2020		2021		2022	
	Max	Min	Max	Min	Max	Min
West Papua	9,15 (Teluk Bintuni)	2,82 (Kaimana)	10,04 (Teluk Wandama)	2,36 (Kaimana)	9,96 (Teluk Bintuni)	3,07 (Raja Empat)
Papua	14,87 (Lanny Jaya)	1,46 (Merauke)	13,87 (Lanny Jaya)	1,53 (Merauke)	13,9 (Puncak jaya)	1,67 (Merauke)
Maluku	5,90 (West Southeast Maluku)	0,41 (Ambon City)	5,70 (Southwest Maluku)	0,64 (Ambon City)	5,09 (Western Seram)	0,55 (Ambon City)
North Maluku	1,90 (East Halmahera)	0,38 (North Halmahera)	2,62 (East Halmahera)	0,48 (North Halmahera)	1,94 (North Halmahera)	0,47 (East Halmahera)

Source: Research data, processed (2023)

The result of heterogeneity from regency in Papua and Maluku Islands during the period of 2020–2022 demonstrated the same thing as Table 4 while I beg your pardon me Papua is located in eastern Indonesia, consisting of four provinces Papuan Province, West Papua, Maluku and North Maluku from 4 the province papua consistently has the highest Poverty Gap Index with a value of 13.87 - 14.87 which is much higher than (the poverty gap index) between neighbouring province values North Maluku province (1.310), Sulteng Province(2.732). The implication of our findings is that poverty in Papua translates into a much larger expenditure shortfall below the poverty line than in other regions that have been studied.

At the level of regency in Papua, Lanny Jaya and Puncak Jaya have always been ranked the highest in the Poverty Gap Index, while Merauke was ranked the lowest (Figure 3). This pattern was also seen in the other provinces. The highest index in Phase 1 was observed in Teluk Bintuni and Teluk Wondama, whereas Kaimana and Raja Ampat consistently scored the lowest. In Maluku, the least good poverty gap index moved from West Southeast Maluku to Southwest Maluku but later to Western Seram, while Ambon City remained the best District. In North Maluku, East Halmahera had the highest average poverty gap, and North Halmahera had the lowest values.

These disparities across regions originate from distance and differential mobility levels, accessibility issues, economic opportunities, lack of infrastructure availability, along with the cost of public service delivery, particularly in remote and geographically isolated districts. On the other hand, more economically active and connected areas like Merauke and Ambon City turn out to have a smaller poverty gap. Overall, the findings indicate that poverty in eastern Indonesia is characterized not only by differences in the incidence of poverty but also by substantial variation in its depth. Consequently, assessing the

effectiveness of Village Fund management requires evaluating whether fiscal resources are able to reduce the expenditure gap of poor households, rather than focusing solely on reducing the number of people living below the poverty line.

5. DISCUSSION

5.1. RESULTS AND DATA ENVELOPMENT ANALYSIS

Based on the results of data analysis using the DEAP application, the efficiency levels of each province in Papua and Maluku were determined. The efficiency results for each province in Papua and Maluku are shown in Figure 3. Figure 3 presents the distribution of Data Envelopment Analysis (DEA) efficiency scores for regencies and cities on the islands of Papua and Maluku during the 2020–2022 period, using two production technology assumptions: Variable Returns to Scale (VRS) and Constant Returns to Scale (CRS). In this study, the Village Fund is treated as an input, while the percentage of the non-poor population, the inverse of the poverty depth index, and the inverse of the poverty severity index are used as outputs. Therefore, the resulting efficiency scores reflect the relative ability of each local government to convert the Village Fund into development outcomes related to poverty reduction.

In general, the DEA results show a very wide gap between Pure Technical Efficiency (VRSTE) and Overall Technical Efficiency (CRSTE) across all provinces during the three-year observation period. The average VRSTE values range from 0.977 to 0.999, while the average CRSTE values range only from 0.132 to 0.346. Similarly, Scale Efficiency (SE) values ranged only from 0.135 to 0.349. This discrepancy is a key finding of this study because it indicates that most regency and city governments actually possess relatively good managerial capabilities in managing Village Funds according to their respective operational conditions, but have not yet been able to operate at the most productive scale.

In DEA theory, a situation where the VRSTE value is significantly higher than the CRSTE is a classic indication that the primary source of inefficiency stems from scale inefficiency, not from pure technical inefficiency (Banker et al., 1984; Cooper et al., 2011). In other words, most local governments have been able to manage available resources relatively efficiently, but the combination of the amount of Village Funds received, regional characteristics, population size, geographic conditions, and development needs has not yet resulted in an optimal operational scale. This finding is important because it shows that improving the efficiency of Village Fund management cannot be achieved solely by enhancing the capacity of village officials but also requires adjustments to the structural characteristics of each region.

Regencies and cities on the islands of Papua and Maluku have highly diverse regional characteristics, in terms of land area, number of villages, population density, accessibility, and geographic conditions. The results of a descriptive analysis show that the distribution of Village Funds also varies significantly across regions. As cited in 2019, for example, Yahukimo Regency received a Village Fund of more than Rp427 billion in the same year Jayapura City earned around Rp13.15 billion. This pattern can also be observed in West Papua, Maluku, and North Maluku, with a large gap between the regencies/cities with the biggest and smallest allocation of Village Fund. These variations can be traced from the regional characteristics that have been used as the basis for calculating Village Fund allocations, namely (1) the number and area of villages; (2) rural population size; (3) poverty rate; (4) land area; and (5) geographical difficulty level. Consequently, each region operates with different fiscal capacities and service scales, so the potential to achieve the Most Productive Scale Size (MPSS) also tends to vary.

The DEA results show that the Variable Returns to Scale Technical Efficiency (VRSTE) values are relatively high in almost all regions, while the Constant Returns to Scale Technical Efficiency (CRSTE) values remain relatively low. The prevalence of this pattern suggests that while local governments have been able to make reasonable use of the resources available to them at their current scales of operation, not all are holding out for that maximum productivity level. This indicates that the inefficiencies identified in this study relate more closely to scale efficiency as opposed to technical efficiency. This finding is consistent with the DEA theory, which states that the difference between VRSTE and CRSTE generally indicates scale inefficiency—that is, a situation when a unit still does not operate at an optimal size (Bogetoft & Otto 2011). Various studies on public sector efficiency indicate that local governments serving areas with challenging geographical conditions, low population density, and high costs of providing public services tend to face challenges in achieving scale efficiency, even though their managerial capacity is relatively adequate (Afonso et al., 2005; Halkos & Petrou, 2019). Therefore, the low CRSTE values in several regencies and cities in Papua and Maluku cannot be interpreted solely as a sign of weak governance of the Village Fund, but rather reflect differences in operational characteristics that affect local governments' ability to achieve an optimal scale of service delivery.

These findings are also consistent with previous studies on local government efficiency in Indonesia. Rambe et al. In their evaluation of local government efficiency in the various regencies across Sumatra, Agustian et al. (2020) concluded that differences in efficiency were not significantly determined by fiscal resources alone but also accounted for managers-level performance, institutional capacity, and regional characteristics. This implies that public resource management matters: local governments with similar fiscal capacities will achieve different development outcomes depending on their capacity to manage public resources. This paper adds to the existing evidence by showing that inefficiency within Village Funds in Papua and

Maluku is most closely related to scale inefficiency rather than technical inefficiency. Therefore, to increase the efficiency of Village Fund utilization, not only absorb, but it must also strengthen its implementing capacity, and at the same time attach importance to adjusting optimal scale based on local geographical, demographic, and socio-economic conditions in individual areas.

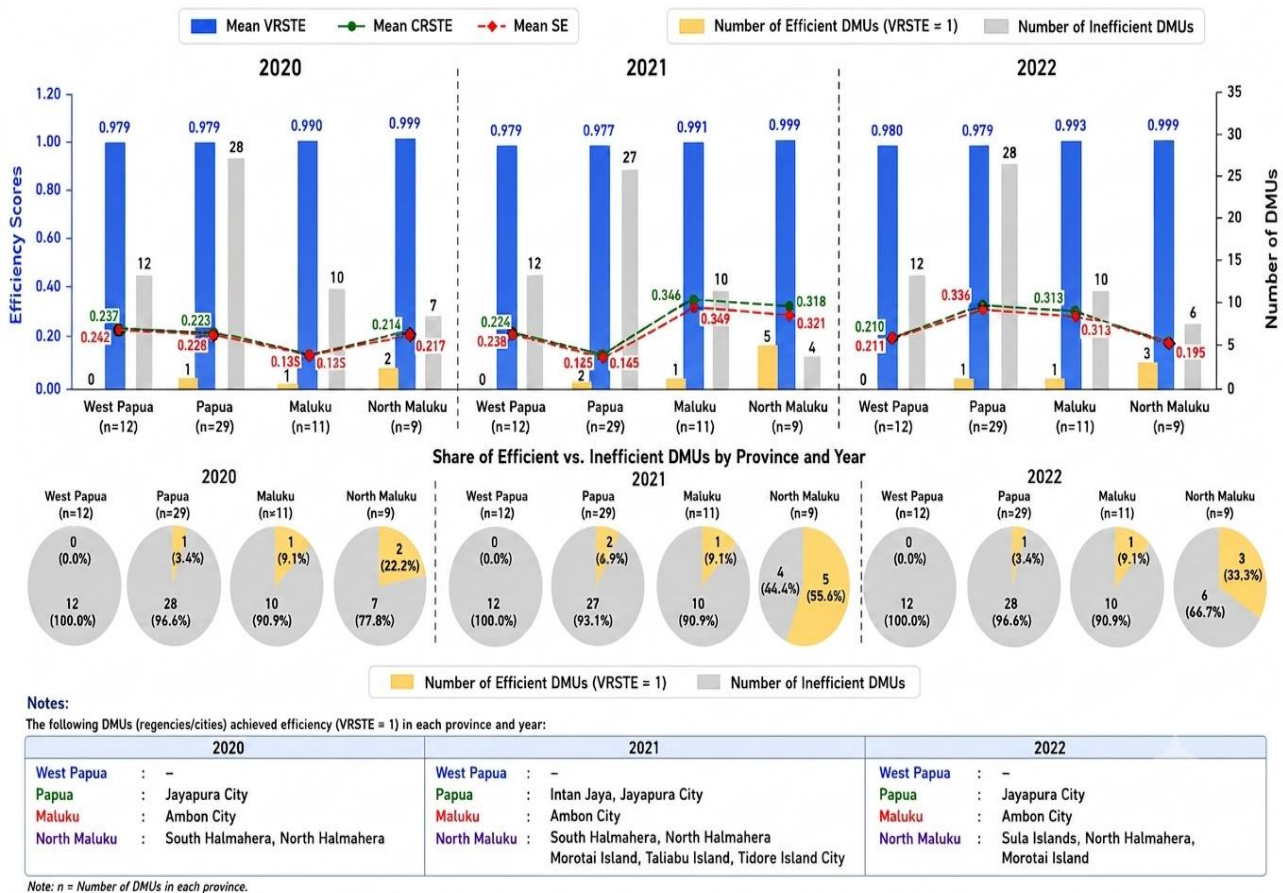


FIGURE 3 Distribution of DEA Efficiency Scores by Province (2020-2022)

Source: Research data, processed (2023)

Going province-by-province, the data shows some interesting trends in efficiency. West Papua (0.237), Papua (0.223), North Maluku (0.214) and Maluku (0.132) had the highest average CRSTE in 2020. However, West Papua does not yet have any regencies or cities that have reached the efficiency frontier, whereas Papua has one efficient area: Jayapura City, Maluku has Ambon City, and North Maluku has two efficient areas: South Halmahera and North Halmahera. These findings indicate that a province's average efficiency does not always align with the number of decision-making units (DMUs) located on the efficiency frontier. The average CRSTE reflects the relative performance of all DMUs within a province, whereas the number of efficient DMUs merely indicates the number of units that have achieved perfect efficiency. Thus, a province can have a higher average efficiency even if it does not have many DMUs on the frontier, provided that most of its districts exhibit relatively uniform levels of efficiency.

These findings reinforce the view that the size of the Village Fund allocation does not automatically result in more efficient development performance. Various studies show that the effectiveness of the Village Fund is greatly influenced by the quality of governance, the capacity of village officials, and the ability of local governments to direct spending toward productive activities that benefit people with low incomes. Thus, regions receiving larger Village Fund allocations do not necessarily achieve higher levels of efficiency if these resources cannot be optimally converted into poverty reduction and improved community well-being (Lewis, 2015; Rammohan et al., 2023; Ginting et al., 2025).

So these results corroborate with what they have found in earlier empirical studies concerning their investigation of government spending and that on poverty reduction as well. Septriani et al. In Indonesia, Indonesian government expenditure shows that tax transfers could reduce poverty, whilst the implementation of fiscal spending relies upon allocation and application (Putnam et al.). In effect, it suggests that larger fiscal resources do not lead to higher welfare outcomes unless combined with appropriate targeting and adequate institutional capacities. Likewise, Septriani (2023) shows that Village Fund

distribution encourages regional economic growth through increasing rural economic activity. However, the previous literature has mainly examined the effect of fiscal expenditure on welfare outcomes, while the current study delivers a new perspective into this literature by investigating its efficiency dimension. This study shows that although Village Funds allocations were equal among regions, the poverty reduction impact varies in accordance with management capacity, institutional quality, and expenditure prioritization paired with regional characteristics because of differences in local government ability to convert fiscal resources into welfare improvement outcomes — using Data Envelopment Analysis (DEA). Consequently, Village Funds can not only be evaluated from the perspective of fiscal transfers or macroeconomic effects and their development impacts but also in terms of resource efficiency. In other words, how many resources does it need to cut down poverty incidence, depth, and severity?

The second was a fairly big change in efficiency patterns in 2021. Maluku recorded the highest average CRSTE (0.346), followed by North Maluku (0.318), West Papua (0.234), and Papua (0.143). Interestingly, North Maluku had five efficient DMUs: South Halmahera, North Halmahera, Morotai Island, Taliabu Island, and Tidore Islands City, accounting for more than half of the regencies and cities in that province. The increase in the number of efficient DMUs indicates that, in that year, more regions in North Maluku succeeded in reaching the relative efficiency frontier compared to the other two provinces. Conversely, West Papua once again had not a single efficient region. This difference points to the fact that distributions of efficiency across regions are extremely heterogeneous and not uniformly distributed. The heterogeneity lies in accordance with various studies revealing that the effect of Village Fund is highly region-specific, determined by local characteristics. Regions with fairly similar funding levels can have adverse development outcomes arising from differences in geographical conditions, institutional capacity, planning sophistication, and community participation. Thus, Village Fund Management is more determined by policy implementation (Permatasari et al., 2021; Sutikno et al., 2025; Yusuf & Khoirunurrofik, 2022) instead of only the amount of fiscal transfers it receives.

The province of Papua had the highest CRSTE average (0.335), with Maluku coming in second (0.313), followed by West Papua (0.210) and North Maluku (0.195). However, in the province of Papua, Grey et al (2022) found that only Jayapura City was located on the efficiency frontier. In contrast, Maluku only had one efficient region, with Ambon City and North Maluku having three DMUs that were indicated as efficiency points, which are the Sula Islands, North Halmahera, and Morotai Island. This behavior suggests that variations in the average efficiencies are not ensuring corresponding changes between efficient DMUs. This is a common characteristic of DEA, as the position of the frontier is determined by the relative performance of the entire sample in the same year.

Based on year-over-year trends, the VRSTE values across all provinces remained relatively stable and consistently above 0.97. This stability indicates that local governments' technical capacity to manage Village Funds did not undergo significant changes during the study period. In contrast, the CRSTE and Scale Efficiency values show greater fluctuations. This reinforces the indication that changes in efficiency are influenced more by changes in the scale of operations than by changes in the quality of Village Fund management. In other words, the managerial capacity of local governments has remained relatively stable, while the ability to operate at the most productive scale still varies across regions.

The prevalence of scale efficiency over technical efficiency confirms that, on the whole, most local governments are relatively competent managers of Village Fund, but not all are at the right scale in which to operate. These findings add to the body of research on how increasing administrative capacity alone does not reduce poverty without adequate program scale, targeting of beneficiaries, and an expenditure composition that is responsive to local needs (Agusta & Khoirunurrofik, 2024).

Another interesting pattern can be observed from the distribution of the regions that achieve the efficiency frontier as well. For three ensuing years, West Papua had no efficient DMUs. Conversely, at the regency/city level, Jayapura City was always an efficient region in Papua (except for the addition of Intan Jaya province in 2021), whereas Ambon City has consistently remained an efficient city throughout the study period. The highest number of frontiers in regions that are efficient at the same time is especially in North Maluku province, where in 2021 there were five districts/cities that successfully reached the frontier. This finding shows that there are greater opportunities in North Maluku for inter-regional learning because good practices of efficient management can be observed to a tune that is fundamentally lower than that compared to any other province.

It shows that many regencies and cities in North Maluku are on the efficiency frontier/ 'best practice frontier', which potentially means there is potential for inter-regional learning. A body of literature related to the governance of Village Fund suggests that transparency, participation, and representative management tailored to community needs can be important in improving various aspects of efficient use of a substantive proportion of Village Funds. Thus, the experience of regions that have reached the efficiency frontier can be a reference for other regions that are still struggling with inefficiencies in managing village fiscal resources (Permatasari et al., 2021; Humaedi et al., 2025; Alvin, 2025).

As far as regional development is concerned, these results carry important implications. Until now, evaluations of the Village Fund have generally focused more on the size of fiscal transfers or budget absorption rates. However, the DEA results indicate that the size of the Village Fund does not automatically lead to higher efficiency. Efficiency is more determined by a region's ability to convert fiscal resources into social outcomes, such as an increase in the proportion of the population living above the poverty line and a reduction in the depth and severity of poverty. Thus, policies to enhance the effectiveness of the Village Fund should not only focus on increasing budget allocations but also on optimizing the scale of services in accordance with the geographical, demographic, and development capacity characteristics of each region.

TABLE 5 Summary of DEA Benchmark Structure, Peer Frequency, and Lambda Weight (2020–2022)

Year	Efficient DMUs (VRSTE = 1)	Benchmark DMU	Benchmark Role	Peer Count	Percentage of DMUs (%)	Total Benchmark Relationships	Lambda Weight (λ) Pattern
2020	4	Kota Ambon	Global Benchmark	58	95.08	59	Most DMUs have $\lambda = 1.000$ relative to Ambon City. Only DMU 52 uses a combination of Ambon City ($\lambda = 0.834$) and Jayapura City ($\lambda = 0.166$).
		Jayapura City	Supporting Benchmark	1	1.64		It appears only as an additional benchmark for DMU 52.
2021	8	North Halmahera	Primary Benchmark	51	83.61	94	The primary benchmark has λ values ranging from 0.040 to 1.000.
		Taliabu Island	Secondary Benchmark	35	57.38		It is often combined with North Halmahera, with varying λ values.
		Ambon City	Supporting Benchmark	7	11.48		It is used by a small number of DMUs with λ values ranging from 0.083 to 0.960.
		Jayapura City	Local Benchmark	1	1.64		It appears only in a few reference set combinations.
2022	5	Ambon City	Global Benchmark	58	95.08	59	Most DMUs have $\lambda = 1.000$ relative to Ambon City. Only DMU 52 uses a combination of Ambon City ($\lambda = 0.739$) and Jayapura City ($\lambda = 0.261$).
		Jayapura City	Supporting Benchmark	1	1.64		Used only as an additional benchmark in DMU 52.

Source: Research data, processed (2023)

Table 5 summarizes the benchmarking structure derived from the results of the Data Envelopment Analysis (DEA) for the 2020–2022 period by integrating the number of efficient Decision Making Units (DMUs), the frequency with which a region serves as a benchmark, the intensity of peer relationships, and the pattern of lambda (λ) weights that form the efficient frontier. Unlike Table 4, which only identifies regencies/cities that achieved a full efficiency score (VRSTE = 1), this table explains how these efficient regions serve as sources of peer learning for regencies/cities that are not yet efficient. The ability of a DMU to act as a benchmark has more significance when viewed from the perspective of DEA than simply achieving an efficiency score = 1, as blueprints are based on efficient DMUs that are defining the efficient frontier, which offers the reference set against which inefficient units are projected and therefore represent best practice production possibilities (Cooper et al 2007; Bogetoft & Otto 2011).

In general, the research results show that the structure of the efficient frontier in the Papua and Maluku regions is highly concentrated in a few specific areas. During the study period, only four regencies/cities: Ambon City, North Halmahera, Taliabu Island, and Jayapura City consistently emerged as members of the reference set. Hypothesis Testing & Results: The above results reveal that although several DMUs have an efficiency score of unity, not all of them support (or are able to influence) the efficiency frontier equally well. Although a DMU may get an efficiency score which is equal to one in DEA, it

does not always represent the benchmark for comparison with many other regions in the input-output context. Conversely, a good benchmark is a DMU that possesses the most representative combination of inputs and outputs, thereby serving as a reference for the majority of units that are not yet efficient (Bogetoft & Otto, 2011).

In 2020, only four DMUs achieved full efficiency, but the structure of the efficient frontier was almost entirely dominated by Ambon City. This region served as a benchmark for 58 of the 61 DMUs, or approximately 95.08% of all regencies and cities analyzed. In contrast, Jayapura City served as an additional reference for only one DMU, while North Halmahera, which was also efficient, was not used as a benchmark. Ambon City's dominance was further reinforced by the λ weighting pattern, which showed that nearly all DMUs used $\lambda = 1.000$ relative to Ambon City. In DEA theory, a λ value of one indicates that a non-efficient DMU can achieve the efficiency target simply by emulating the input-output combination of a single benchmark without needing to combine it with other benchmarks (Cooper et al., 2007). Thus, nearly the entire efficiency frontier in 2020 was essentially shaped by Ambon City's performance characteristics.

Based on data from the Central Statistics Agency, during the 2020–2022 period, Ambon City consistently recorded the lowest poverty rate in Maluku Province: 4.51% in 2020, 5.02% in 2021, and a further decline to 4.68% in 2022. In addition, Ambon City also has the lowest poverty depth index and poverty severity index compared to other regencies in Maluku Province. These conditions indicate that development success is demonstrated not only by a low proportion of the poor population but also by a narrowing gap between the expenditure of the poor and the poverty line, as well as a more equitable distribution of expenditure among poor groups. With this combination of outcomes, the use of Village Funds in Ambon City has produced an input-output relationship that most closely approximates the efficiency frontier, making it a primary reference for the majority of other regions. Ambon City's status as the capital of Maluku Province provides advantages in terms of infrastructure provision, access to public services, bureaucratic capacity, and development coordination. Various government evaluations indicate that development in Ambon City has been relatively successful in integrating the Village Fund program with local and central government programs, thereby yielding better welfare outcomes. Although this study does not directly measure the quality of governance, these empirical findings provide a consistent explanation for Ambon City's dominance as a global benchmark. These results are in line with the observations made by the public administration literature, stressing that differences in public sector efficiency result to a greater degree from institutional quality regarding capacity or governance as well as managerial capability and intergovernmental coordination than simply from the volume of fiscal resources available (Narbón-Perpiñá & De Witte, 2018; OECD, 2022; Andrews et al., 2017).

The one exception in 2020 was, however, observed by DMU 52 with a combination of Ambon City ($\lambda = 0.834$) and Jayapura City ($\lambda = 0.166$). This phenomenon indicates that the input-output characteristics of this DMU are not entirely identical to those of Ambon City, thus requiring a combination of two benchmarks to establish an efficiency target. According to the DEA-VRS model, the use of more than one benchmark is a consequence of the convex combination principle, namely the formation of an efficiency target through a combination of several efficient DMUs (Banker et al., 1984). However, because Ambon City's λ weight is much larger than that of Jayapura City, Ambon City's contribution remains the dominant factor.

The benchmarking structure changed significantly in 2021. Thus, the number of efficient DMUs expanded to 8, and the total number of peer relationships increased from 59 to 94. The increase indicates that the efficient frontier has become more convoluted because a growing number of reference combinations are used by non-efficient regions. The primary benchmark became North Halmahera with 51 reference relationships (83.61), and the secondary benchmark was Taliabu Island with 35 reference relationships (57.38). Meanwhile, Ambon City still utilized 7 units of DMU, and Jayapura City remained the reference at the local level.

This is evident from these changes because the DEA efficient frontier is not a static phenomenon but rather is time-dependent on the relative proximity of all DMUs in any given evaluation period. The λ values also have more diversity in 2021, with the lowest value being 0.040 and the highest one as high as 1.000, indicating that most of the regions can no longer reach the frontier by just imitating one model or benchmark, but a mix of multiple benchmarks in different proportions is required. The value of λ (or the degree of variation in data) shows that heterogeneity between Village Fund management characteristics across regencies in Java through the COVID-19 pandemic is increasing.

There is also more extensive empirical evidence supporting North Halmahera as the main reference point. North Halmahera has the lowest percentage of poor people, poverty depth, and severity in North Maluku Province, which is based on BPS data. Moreover, the 2021 Village Fund has also been instructed to be focused on support for Village Direct Cash Assistance (BLT), cash-for-work programs, and community economic empowerment as a national priority. The ability to sustain welfare outcomes amid the pressures of the pandemic makes North Halmahera's input-output structure the most representative for the majority of other regions, leading it to be more frequently selected as a benchmark. This situation underscores the importance of local governments' adaptive capacity in maintaining efficiency as the external environment changes (Andrews et al., 2017).

Taliabu Island also plays a crucial role as a second benchmark. Although its economy is relatively small, this regency serves as a reference for more than half of the DMUs in the sample. This indicates that benchmarks in DEA need not come from regions with the largest fiscal capacity, but rather from regions whose input-output combinations best align with the characteristics of a specific group of DMUs. These findings show that practices in managing Village Funds in archipelagic regions with limited accessibility can also serve as a relevant learning model for other regions with similar characteristics.

Curiously, after socioeconomic conditions started to get better from 2022 onwards, the frontier structure went back to being of the same type as in 2020. An additional five efficient DMUs were decreased, while Ambon City again had the world-class ranking for 58 DMUs (95.08%). Nearly all regions reverted to using $\lambda = 1.000$ relative to Ambon City, except for DMU 52, which used a combination of Ambon City ($\lambda = 0.739$) and Jayapura City ($\lambda = 0.261$). This recurring pattern indicates that Ambon City's advantage is not a temporary phenomenon but reflects the consistency of efficient input-output relationships throughout the study period. When these results are integrated with Table 4 and Table 5, it becomes evident that a larger number of efficient DMUs does not necessarily result in a more centralized frontier. The year 2021 had the highest number of efficient DMUs, yet the benchmarks were actually spread across several regions. Conversely, the years 2020 and 2022 had only a few efficient DMUs, yet the frontier was almost entirely defined by a single primary benchmark. These findings confirm that a region's influence in DEA is determined more by the representativeness of its input-output combination than by its efficiency status alone.

Based on these findings, the results of this study suggest that efforts to improve the efficiency of Village Fund management should not only focus on increasing the number of regions achieving full efficiency scores but also on strengthening practices proven to serve as benchmarks for other regions. The cities of Ambon, North Halmahera, and Taliabu Island exhibit management characteristics that can serve as models for inter-regional learning, while the city of Jayapura illustrates that efficiency can also be highly contextual and relevant only to regions with similar characteristics. Thus, DEA serves not only as a tool for measuring efficiency but also as an instrument for evidence-based policy learning that enables the government to identify best practices worthy of replication according to the characteristics of each region (Bogetoft & Otto, 2011; Cooper et al., 2011). The benchmarking structure analysis enriches the interpretation of DEA results because it shows that a region's success is not only measured by achieving an efficiency score of one but also by its ability to serve as a model that can be replicated by other regions. These findings underscore that inter-regional learning is one of the most promising mechanisms for improving the effectiveness of Village Fund utilization, particularly in the Papua and Maluku regions, which exhibit highly diverse geographical, social, and institutional characteristics.

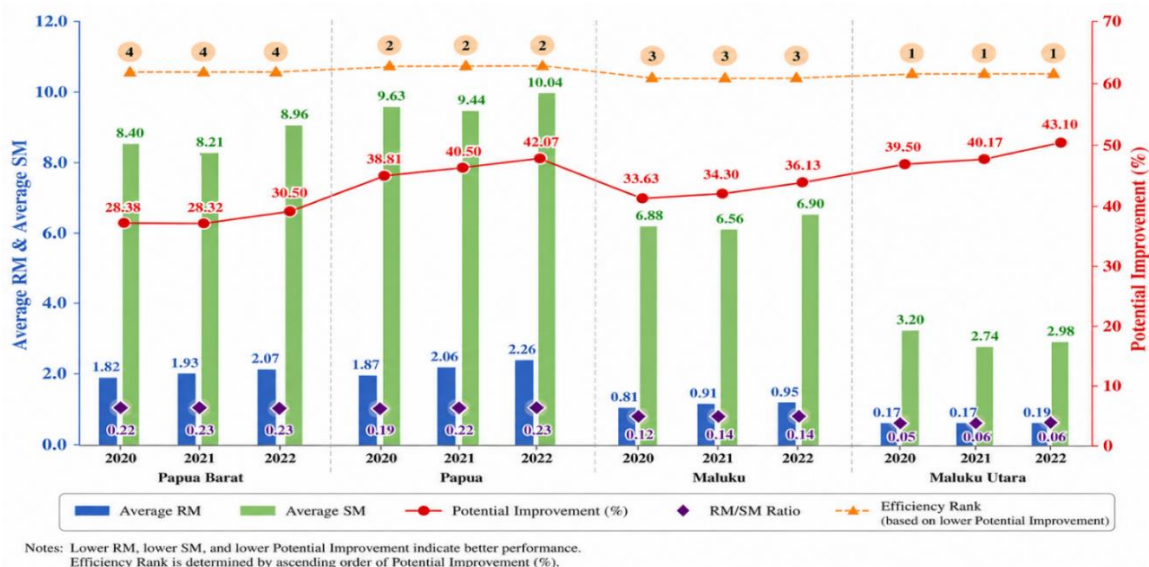


FIGURE 4 Average of DEA Improvement Indicators by Province (2020–2022)

Source: Research data, processed (2023)

Figure 4 presents the results of the potential improvement and output slack analysis based on the Data Envelopment Analysis (DEA) approach for all regencies and cities in West Papua, Papua, Maluku, and North Maluku during the 2020–2022 period. Unlike the efficiency scores in Table 2, which only indicate the relative efficiency level of each Decision Making Unit (DMU), the analysis in this table provides more operational information regarding the magnitude of output increases that can still be achieved if each DMU were able to operate on the efficient frontier. Therefore, the potential improvement results not only identify inefficiencies but also indicate the necessary directions for improvement to enhance the effectiveness of Village Fund utilization.

In this study, the outputs analyzed consist of the percentage of the non-poor population, the inverse of the poverty depth index, and the inverse of the poverty severity index. The use of inverse values for the latter two indicators was done so that all outputs share the same orientation: the higher the value, the better the welfare conditions. Thus, an increase in all outputs reflects the success of Village Fund utilization in improving the social conditions of the community.

In general, the research results show that all provinces still have room for improvement (improvement potential) across these three welfare indicators. The significant potential for improvement that remains indicates that most regencies and cities have not yet been able to optimally convert the Village Fund into welfare outcomes. These results are in line with the findings reported in Table 2, where it can be observed that VRSTE values are almost all close to one and CRSTE and Scale Efficiency values are low. This means that the primary source of inefficiency does not stem from weak technical capacity on the part of local governments in managing Village Funds, but rather because the use of these resources has not yet reached the most productive scale of operation (Banker et al., 1984; Cooper et al., 2011).

Meanwhile, when viewed through the indicator of the percentage of the non-poor population, all provinces still showed a significant need for improvement during the study period. Papua always had the biggest need for progress, which was 31.40% in 2020, then 33.80% in 2021, and it slightly increased to reach the highest rate —35.10% in 2022 (See Table above on "Percentage of poor households by provinces (%)"). In West Papua, the call for improvement also increased from 19.84% to 22.80% in the same time period. In the same period, Maluku had a slow rise from 28,70% to 31,50%, and North Maluku increased from 34.10% to 39.10%.

These results suggest that there is a gap between actual performance and potential maximum performance, which can be predicted from the best input-output combination evident in our sample. These results conform to the DEA concept, which indicates that potential improvement value is the level of outputs that can still be produced without using more inputs but improving in relative efficiency (Bogetoft & Otto, 2011; Tone, 2001). Therefore, these results do not imply that the Village Fund has failed to reduce poverty, but rather indicate that the effectiveness of its use can still be improved if management practices in regions that are currently inefficient are brought closer to the characteristics of benchmark regions.

The improvement analysis further strengthens previous evidence regarding the effectiveness of public expenditure in poverty reduction. Septriani et al. Government spending is considered to be pro-poor when the public resources are allocated properly towards social welfare programs (Smit et al.). While the above findings shed some light, much room exists to move beyond a simple linkage of increased Village Fund spending and poverty outcomes. Local governments can garner greater welfare benefits from simply using current resources more efficiently. Therefore, the issue is not merely the adequacy of fiscal transfers but the effectiveness with which these transfers are transformed into reductions in poverty incidence, poverty depth, and poverty severity. This finding redirects the policy discussion from a focus on increasing fiscal allocations to improving the efficiency of expenditure and making public financial management more results-oriented.

However, for the average inverse poverty depth index indicator, the requirement to improve is relatively high in all provinces. Papua again recorded the highest potential improvement value, at 30.10% in 2020, rising to 32.10% in 2021, and 33.90% in 2022. West Papua requires an improvement of between 18.76–21.10%, Maluku between 27.40–30.00%, while North Maluku increased from 31.80% to 36.80%. Since the indicator used is the inverse of the poverty gap index, an increase in this output value indicates a narrowing of the average gap between the expenditure of the poor and the poverty line. Thus, the DEA results indicate that the use of Village Funds still has room to narrow further the average gap between the expenditure of poor households and the poverty line. This is significant because the effectiveness of poverty alleviation interventions cannot only be assessed on the count of people who have moved out of poverty but also by how well outcomes are improving for those still living below the median (Foster et al., 1984; World Bank, 2022). Thus, regencies and cities that have not functioned well still have a space to be able to reduce the bad condition of people with low incomes through Village Funds, especially by improving the use of this fund.

Need for improvement in the inverse of the poverty severity index was most characteristic among the three previous indicators. Papua had an increase of 54.92% in 2020, followed by an increase to 55.60% in 2021, and then eventually up to a rate of 57.20% down the track (in 2022). West Papua saw an increase from 46.55% to 47.60%, Maluku from 44.80% to 46.90%, while North Maluku ranged between 50.90% and 53.40%. The magnitude of these figures indicates that the dimension of poverty severity is the most challenging aspect to address compared to other welfare indicators. Given that the indicator used is the inverse of the poverty severity index, an increase in the output signifies a more equitable distribution of expenditure among poor population groups. In other words, these results indicate that most regions still have significant room to reduce welfare disparities within poor communities. This high potential for improvement suggests that the main challenge in managing the Village Fund is not only to increase the number of people lifted out of poverty but also to ensure that the benefits of development are distributed more evenly among people experiencing poverty.

In addition to radial movement, the DEA results also reveal the presence of output slack across several indicators. The highest slack values were consistently found in the inverse of the poverty severity index, whereas for the inverse of the poverty depth index, nearly all provinces showed a slack value of zero. This slack represents the remaining output shortfall after making proportional improvements towards the efficiency frontier (Tone & Tsutsui, 2014). The value of slack, which is relatively large in this case, for the inverse of the poverty severity index indicates that it cannot reach a solution via only proportional improvements. There are still further improvements to be made in equitable welfare distribution among people experiencing poverty, representative of moving towards the frontier across these regions. Conversely, the absence of slack in the inverse of the poverty depth index indicates that improvements in this indicator can generally be achieved through proportional efficiency gains without requiring additional adjustments. This pattern shows that the greatest challenge in managing the Village Fund in eastern Indonesia is not merely narrowing the average gap in the poor's expenditure relative to the poverty line, but rather focusing on reducing welfare disparities among poor groups.

The low efficiency in the management of Village Funds is largely due to diseconomies of scale, not solely to technical inefficiencies. Local governments essentially possess relatively strong managerial capabilities, but have not yet been able to achieve the most productive input-output combination in line with their regional characteristics. Therefore, improving efficiency requires not only additional Village Funds but also a learning process from pilot regions on how the same resources can generate higher levels of well-being.

TABLE 6 Best Practice DMUs and Reference Set Based on DEA Peer Analysis (2020–2022)

Year	Best Practice DMU	Province	Peer Count	Reference Intensity (λ)	Role in DEA Frontier	Interpretation
2020	Ambon City	Maluku	58	1.000	Global benchmark	Serves as a benchmark for nearly all regencies that are not yet efficient.
	Jayapura City	Papua	1	1.000	Local benchmark	Serves as a reference only for one specific DMU.
	North Halmahera	North Maluku	0	1.000	Efficient frontier	Efficient frontier. Efficient but not used as a benchmark.
2021	North Halmahera	North Maluku	51	1.000	Primary benchmark	The primary frontier during the pandemic.
	Taliabu Island	North Maluku	35	1.000	Secondary benchmark	An alternative benchmark representing the characteristics of a specific region.
	Ambon City	Maluku	7	1.000	Supporting benchmark	Still serves as a reference for a small portion of DMUs.
	Jayapura City	Papua	1	1.000	Local benchmark	Benchmark lokal.
2022	Ambon City	Maluku	58	1.000	Global benchmark	Returned to being the dominant frontier after the pandemic.
	Jayapura City	Papua	1	1.000	Local benchmark	Limited benchmark.
	North Halmahera	North Maluku	0	1.000	Efficient frontier	Efficient frontier. Efficient but not a reference.

Source: Research data, processed (2023)

Table 4 presents the results of the peer and reference set analyses that identified the regencies and cities forming the efficient frontier during the study period. In the Data Envelopment Analysis (DEA) approach, a DMU is said to serve as a benchmark if it is a member of the reference set for inefficient DMUs through a combination of λ (lambda) weights that define the efficiency target. Therefore, benchmark status not only indicates that a region has achieved an efficiency score of one but also suggests that its combination of input use and output achievement represents the most relevant model for other regions to replicate (Banker et al., 1984; Cooper et al., 2011; Bogetoft & Otto, 2011).

The results of this study show that not all efficient DMUs play the same role in forming the efficient frontier. Thus, some regions act as global benchmarks for almost all inefficient DMUs, others serve as local benchmarks, and still other regions are at the efficient frontier but are never referenced by any DMU. These findings indicate that in DEA, efficiency is a relative concept. A region may achieve a perfect efficiency score but does not necessarily hold a representative position to serve as a model for performance improvement for other regions. In other words, the quality of a benchmark is determined by the level of representativeness of its input-output relationships relative to the majority of DMUs, not solely by its efficiency score.

In 2020, Ambon City emerged as a global benchmark with a peer count of 58 out of a total of 61 DMUs (95.08%). Nearly all regencies and cities that were not yet efficient used Ambon City as a reference in setting their efficiency targets, and in most

cases, they assigned a λ weight of 1.000. This dominance indicates that the combination of Ambon City's use of Village Funds and its welfare indicator achievements represents the closest approximation to the efficient frontier. In other words, the majority of regencies and cities in the Papua and Maluku regions have input-output characteristics that are closer to those of Ambon City than to those of other efficient DMUs, making this region the primary reference in the benchmarking process.

Ambon City's dominance as a benchmark is also supported by its relatively better socioeconomic conditions compared to other regions in Maluku Province. Based on data from the Central Statistics Agency for the 2020–2022 period, Ambon City has consistently been the region with the lowest poverty rate in Maluku Province, standing at 4.51% in 2020, 5.02% in 2021, and declining again to 4.68% in 2022. Ambon City also recorded the lowest poverty depth index and poverty severity index for three consecutive years. This indicates that the region's success is reflected not only in the low proportion of the poor population but also in the narrowing average gap between the expenditures of the poor and the poverty line, as well as the increasingly equitable distribution of expenditures among poor communities. Consequently, the development outcomes achieved by Ambon City are more balanced compared to most other regencies and cities.

These characteristics converge with the notion of multidimensional poverty reduction, which indicates that public policy success should not be limited to a mere decrease in poverty headcount ratio, as it must also sufficiently reduce both the depth and severity of pauperism (Sen 1999; Alkire & Foster, 2011). In the DEA framework, these three indicators explain why Ambon City is located on the efficient frontier, but also became the most representative area of other regions to best practices in order to improve efficiency.

For this reason, the combination of the Village Fund, APBD, and various central government programs allows all public resources to be collectively used for maximum welfare. While this study does not measure the quality of governance, these empirical results consistently explain why Ambon City occupies the efficiency front line literally. This phenomenon is in line with international studies showing that public sector performance is more driven by inter-institutional coordination, administrative capacity, and synergies between external funding sources than simply the size of the development budget (OECD, 2021; Andrews et al., 2017).

On the other hand, North Halmahera has an interesting dynamic in contrast to Ambon City. Based on the 2020 data, it was already located at an efficient frontier; however, no other DMU in this study compared to the performance of that regency. This situation indicates that achieving efficiency does not always lead to the ability to serve as a reference. In DEA, a DMU can achieve an efficiency score of one, but if its position is in a relatively isolated part of the frontier, that DMU will not be selected as a member of the reference set. Thus, efficient status and benchmark status are two distinct concepts. However, in 2021, North Halmahera was the main reference with 51 reference relations, and Taliabu Island became a second comparison with 35 reference relationships. This change suggests that the composition of the efficient frontier changed during COVID-19.

As the external environment changed and priorities for the use of Village Funds shifted toward social protection and community economic recovery, the input-output combinations that previously dominated the frontier were no longer the sole reference. The DEA frontier came to be shaped more by regions within North Maluku Province.

This result illustrates that the efficient frontier is not static, but can respond to changes in the environment. BPS also records that North Halmahera had the lowest incidence of poverty by regency in 2022 (4.58%) in North Maluku Province, and the lowest depth index and severity index are found in this regency. These achievements indicate that this region was relatively successful in maintaining community well-being during the post-pandemic recovery period. Various reports from the Ministry of Villages, Development of Disadvantaged Regions, and Transmigration (Kemendes PDTT) also show that the implementation of the Village Fund in North Halmahera during the pandemic was directed toward supporting the Village Direct Cash Assistance (BLT) program, cash-for-work programs, and economic empowerment based on local potential in line with national priorities. Although this study does not directly evaluate the composition of expenditures, this information provides an empirical context that reinforces North Halmahera's position as the primary benchmark in 2021.

In theory, this condition indicates the presence of adaptive efficiency, that is, an organization's ability to maintain its position on the efficient frontier when the external environment changes significantly. The public administration literature shows that local governments with high adaptive capacity tend to be better able to maintain efficiency during times of crisis compared to regions with less flexible governance (Pollitt & Bouckaert, 2017; Andrews et al., 2017). Meanwhile, Taliabu Island exhibits distinct characteristics. Although it is not the primary benchmark, this regency serves as a reference for 35 DMUs, indicating that there is more than one pattern of best practices that shaped the efficient frontier during the pandemic. The very existence of this second benchmark shows that the efficiency enhancement does not need to follow a simple approach, as it can be adapted to the different characteristics of each region. In terms of archipelagic regions and limited accessibility areas, Taliabu Island is an efficient alternative input-output combination for more relevant replicable forms by similar cluster regions.

Unlike these three regions, Jayapura City is recorded only as a local reference with the number of peers equal to one in 2020, 2021, and 2022 consistently. This suggests that although Jayapura City achieved technical efficiency, its input-output characteristics are relevant only to a single DMU with similar conditions. The descriptive findings of this study show that Jayapura City has the lowest allocation of Village Funds in Papua Province but a relatively low poverty rate compared to most regencies in the region. As an urban area, Jayapura City's economic structure, level of urbanization, fiscal capacity, and public service characteristics differ significantly from those of the inland regencies in Papua. Therefore, the input-output combination possessed by Jayapura City is difficult for most other regions to replicate. This condition aligns with the concept of context-specific efficiency, that is, efficiency that is optimal within a local context but has limited potential for replication (Cooper et al., 2011).

Interestingly, in 2022, the benchmark structure returned to pre-pandemic conditions. Ambon City once again became the global benchmark with 58 reference relationships, while North Halmahera remained on the efficient frontier but was no longer used as a reference. This shift indicates that North Halmahera's dominance in 2021 was a temporary response to environmental changes during the pandemic, while Ambon City demonstrated consistency as the primary benchmark both before and after the pandemic. This consistency reinforces the hypothesis that the relationship between Village Fund usage and welfare outcomes in Ambon City is more representative of the majority of regencies and cities in eastern Indonesia than the patterns observed in other benchmarks.

The inclusion of benchmarks in DEA provides a more operational direction regarding where the learning process should begin. Regions that are not yet efficient do not need to seek abstract improvement targets but can adopt management practices demonstrated by the benchmark with characteristics that most closely match their own conditions. Thus, the primary function of benchmarks in DEA is not merely to identify who is most efficient but to provide a learning pathway toward the efficient frontier (Bogetoft & Otto, 2011). The results of this study make an important conceptual contribution to the DEA literature in the public sector. Unlike most previous studies, which stopped at identifying efficient DMUs, this study shows that efficient status is not always synonymous with the ability to serve as a benchmark. The distinctions between global benchmarks, primary benchmarks, secondary benchmarks, local benchmarks, and "efficient but isolated" DMUs indicate that the quality of a benchmark is determined by its level of representativeness of other regions' characteristics. These findings expand the role of DEA from merely a tool for measuring efficiency to an instrument for evidence-based policy learning, so that the results of the analysis not only answer the question of who is efficient but also who is most suitable to serve as a reference and why that region is worthy of being a benchmark for improving the effectiveness of Village Fund management in eastern Indonesia.

6. CONCLUSION

This study evaluates the efficiency of Village Fund utilization in improving welfare outcomes and reducing poverty in regencies and cities in the Papua and Maluku regions during the 2020–2022 period using the Data Envelopment Analysis (DEA) approach. The results show that most local governments have a high level of Pure Technical Efficiency (VRSTE), indicating that their managerial capacity in managing the Village Fund is relatively adequate. Nevertheless, the lower CRSTE and SE results indicate that much of the inefficiency was due to scalability problems rather than bad management performance. Hence, improving the effectiveness of the Village Fund must be complemented by strengthening administrative capacity and also optimizing resource allocation according to the characteristics of each region, geographical conditions, and development needs. From the analysis, it can be seen that only a very small percentage of regions have reached the efficiency frontier. Response: 4 DMUs had efficiency in 2020, representing 6.56% of the total ($N = 61$), whereas this number increased to 8 DMUs (13.11%) in both 2021 and decreased to five DMUs (8.20%) in Group no answers was supplied for each year with group supply chain management were analyzed these explanations must be able to explain theoretical conceptions; nevertheless, some years it higher than other because its characteristics e took into account aggregates without any distinction persons who are member the same organisation or authority.). The regions that were efficient are Ambon City, Jayapura City, North Halmahera Regency (North Maluku), South Halmahera Regency, Morotai Island, Taliabu Island, Tidore Islands City, and the Sula Islands. From these areas, the most stable are Ambon City, which became the main benchmark in 2020 and 2022, while North Halmahera Regency and Taliabu Island became a challenging factor as a benchmark area in 2021. The results of this study suggest that the Village Fund policies will be better not only by allocating more fiscal transfers but also by ensuring the quality of resource usage and strengthening inter-regional learning, through best practices from big tree states. The DEA benchmarking analysis provides a practical reference for regions that are not yet efficient to identify improvement strategies based on the characteristics of regions with similar traits. This study has several limitations. Firstly, DEA is a relative efficiency measurement, which means that due to the same sample and indicator at one specific time, what you get as efficiency could be different if you change either one. Secondly, the institutional factors or quality of governance, the ability/capacity of government, and the expenditure composition of Village Fund utilization have not been integrated explicitly within this study. Eventually, further studies could be conducted by incorporating governance variables, utilizing a dynamic DEA model or panel data analysis in order to understand the determinants of efficiency in managing Village Fund more comprehensively.

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