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Analyzing The Efficiency Rate of Local Government's Expenditure in Education and Healthcare Sectors Using The Dea Method Towards Human Capital in Madura Between 2020 and 2024

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ABSTRACT
The purpose of this study is to analyze the efficiency of government expenditure in the education and health sectors across four regencies on Madura Island, Bangkalan, Sampang, Pamekasan, and Sumenep, during the 2020–2024 period. This topic is significant because, despite the government's mandate to allocate at least 20% of the budget for education and 5% for health, the Human Development Index (HDI) achievements in Madura remain below the average of East Java Province. This disparity raises a research question: Has regional government spending in the education and health sectors on Madura Island been efficient in improving human development during the 2020–2024 period? The novelty of this study lies in its focus on analyzing inter-regional efficiency among the regencies of Madura using the Data Envelopment Analysis (DEA) approach within the post-pandemic period, which has rarely been examined at the regency level with similar socio-economic characteristics. The research employs a quantitative approach using an input-oriented Variable Return to Scale (VRS) model, with input variables consisting of education expenditure, health expenditure, and GDP per capita, and output variables including Mean Years of Schooling (MYS), Expected Years of Schooling (EYS), and Life Expectancy (LE). Secondary data were obtained from official publications of BPS (Statistics Indonesia) and DJPK (Directorate General of Fiscal Balance) for the years 2020–2024. The results indicate that the level of government spending efficiency varies between districts. Sampang District is the most efficient, with an average score of 0.94, and achieved full efficiency in the 2020–2021 period.
In contrast, Sumenep District has the lowest efficiency, with a score of 0.82. Bangkalan and Pamekasan showed fluctuating efficiency, with Pamekasan reaching increasing returns to scale in 2022–2023. This study concludes that managerial capacity and budget scale significantly influence Madura Island's fiscal efficiency, which is currently not optimal. The implication is that there is a need to improve budget management, equalize infrastructure, and optimize the scale of public spending so that regional expenditure is more effective in promoting improvements in HDI.
Keywords: *Fiscal Efficiency, Local Government's Expenditure, and HDI*

INTRODUCTION

The government's expenditure constitutes budget allocation with which

the authorities employ to fund any programs aimed at improving their citizens' welfare and stimulating economic growth. This budget allocation, additionally, is to primarily provide diverse public services, to renew or re-erect infrastructure, and to foster human resources' quality, particularly in these two fundamental aspects as follows: 1) education, and 2) healthcare. Todaro and Smith (2015, as cited in Sumiyarti & Lazuardy Pratama, 2024) argue that the government's expenditure in and for these two sectors is a productive expense, as it stimulates human capital development, which is believed to be the primary source of economic growth. Narrowing the focus to human capital, Becker (1962) and Sikayena et al. (2022) view it as the knowledge and skills acquired through individuals' participation in education, training, and healthcare services. The government's expenditure on promoting economic growth through education and healthcare has captured the attention of numerous researchers. It stems from their vital and significant roles in mitigating the overall poverty rate (Fahimi et al., 2018, cited in Sikayena et al., 2022). It thus involves such a pivotal base, i.e., human resource development, to produce sustainable competitiveness

The state expenditure for education and healthcare is fundamentally interrelated to the success of growth accomplishment (Rahmawati & Muhsyaf, 2025). In reference to the constitution year 1945, article 31, section (4), and 2003 No. 20 article 29 on National Education System, it is stated that the government has provided educational fundings by allocating at least 20% of both state and local government budget, while only 5% of state budget is used for healthcare as regulated within the constitution No. 36 year 2009. Such an amount, however, has resulted in no significant improvement in public service quality, despite this policy being primarily aimed at reducing social and economic gaps, and particularly sustaining two core areas: education and healthcare. This issue arises due to the government's excessive expenses, poor governance, inefficient management, and improper resource allocation, as well as various economic and social circumstances, which enable ineffective spending potential by the authorities (Jibir et al., 2024a). According to Mohanty and Bhanumurthy (2021), the so-called effective expenditure is achieved when the government successfully provides for its citizens.

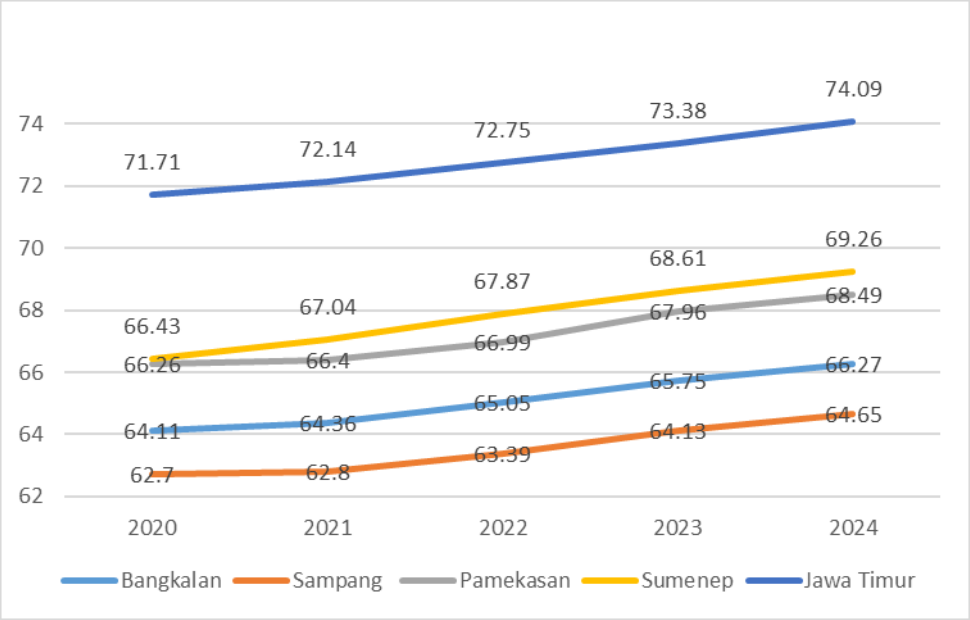
Financial efficiency is perceived as a criterion of economic stimulus — the range of efficiency escalation seized indicates fit and proper financing practice. Derived from Idialis et al. (2021), efficiency serves as a benchmark to measure the sustainability of institutions. Afonso & Fernandes (2023, in Sikayena et al., 2022) further argue that efficiency, regarding state expenditure, refers to a term that demonstrates the finesse of the government either to optimize economic activities based on the amount of spending or to reduce the amount of spending in accordance with the economic activities, vice versa. It also comprises a condition in which no resources are relocatable anew to promote public prosperity best, which briefly means that the authorities expending the budget must bring about welfare for society. Claimed by Nuryadin et al. (2020), such an achievement, if attainable, proves that the government has succeeded in achieving maximum efficiency. Following such a claim, Rahmawati & Muhsyaf (2025) believe that budget constraints, if so, play a vital role in making it. The analysis of this issue, efficiency of government's expenditure, thus becomes so critical to conduct, bearing in mind that in every region of Indonesia, especially in Madura, there appears a significant difference not only in Gross Domestic Product (GDP), but also in Human Development Index (HDI) (Mohanty &

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Bhanumurthy, 2021).

Madura Island, comprising four regencies—Bangkalan, Sampang, Pamekasan, and Sumenep —struggles to develop its human resources. The Human Development Index (HDI) in each regency still ranks below the average of East Java, and yet the worst of the four is Sampang (Badan Pusat Statistik, 2024). To measure HDI, four indicators are applied as follows: Life Expectancy (LE) for health; Expected Years of Schooling (EYS) and Average Years of Schooling (AYS) for education. The chart below illustrates the HDI of each region in Madura.



PICTURE 1. HDI GROWTH IN FOUR REGENCIES BASED IN MADURA AND EAST JAVA

TABLE 1. CLASSIFICATION OF HUMAN DEVELOPMENT STATUS

HDI Value	Human Development Status
<60	Low
≤60 IPM <70	Medium
70 ≤ IPM <80	Hight
≥80	Very High

Source: BPS, 2025

Overall, the chart above indicates that the Human Development Index (HDI) in Madura between 2020 and 2024 experienced an upward trend in Bangkalan, Sampang, Pamekasan, and Sumenep. Although it consistently climbs, this enhancement is considered relatively low compared to the average number in East Java. In 2020, East Java's HDI was 71.71, whereas Madura's was estimated at around 62.70 and 66.43. Furthermore, this gap continued to grow until 2024, with Sampang reaching 64.65%, Bangkalan 66.27%, and Pamekasan 68.49%. Moreover, Sumenep 69.26, while East Java progressed to 74.09. This condition depicts HDI in Madura as positively enhanced, but still

inappropriately.

A previous study carried out by Kurniawan and Murtala (2022) presents that most provinces across Indonesia were unable to manage the government's expenditure efficiently, thereby hindering the development of quality human resources. This phenomenon, in fact, resulted from inadequate budget expenditure in several pivotal sectors, including healthcare, education, the economy, and social security.

According to Sriningsih et al. (2024), their research findings, which investigated the efficiency of budget expenses in education and healthcare in West Nusa Tenggara (NTB) from 2012 to 2021 using DEA and Tobit methods, indicate that budget expenses in healthcare were relatively more efficient than those in education. The factors that led to efficiency in each sector were the government's capacity, population density, income inequality, the ratio of teachers to students, and the quantity of the health workforce in each area.

Another study, undertaken by Nurvita et al. (2022), reveals that economic growth, education, and healthcare funding have significantly contributed to improvements in the HDI. This finding demonstrates that Jambi's government successfully implemented a policy that gained effectiveness in budgeting for education and healthcare, driving human capital empowerment as reflected in the HDI achievement.

Madura has so far grappled with the challenge of human resource development. Referring to the data issued by Badan Pusat Statistik, HDI achievement in Bangkalan, Sampang, Pamekasan, and Sumenep is below the average in East Java. Particularly, Sampang remains at the bottom perpetually. Despite the HDI trend in Madura showing an escalation from 2020 to 2024, a significant gap remains compared to the achievements East Java has reached. This fact then concludes that an efficiency-related issue of local government budget utility, spent particularly on education and healthcare, vividly affects HDI indicators such as Expected Years of Schooling (EYS) and Average Years of School (AYS) for education, Life Expectancy (LE)

Hence, research on the efficiency of state expenditure in the education and healthcare sectors in Madura is a necessary procedure to initiate, as it aims to assess the quantity of local government budget expenditure in four regencies based in Madura from 2020 to 2024 – a significant contribution to HDI improvement. This research applied Data Envelopment Analysis (DEA). This research is also expected to identify areas that have achieved efficiency and those that have not, and to propose solutions for local policymakers. As a result, the budget allocation for education and healthcare is appropriately managed, stimulating human resource development in Madura.

HUMAN CAPITAL THEORY

Etymologically, the term "human capital" consists of two words, namely 1) human, and 2) capital. "Capital" is seen as one of the production factors to fabricate goods and services with no end stocks during the production process. In relation to "human", it is an asset or form of capital, similar to other forms of capital, such as property, buildings, and machines. The amount of knowledge, skill, and intelligence particular citizens own is regarded as human capital.

Schultz (1961) opines that human capital is one of the chief factors that increase the country's economic productivity. This concept was first introduced in 1776 in a classic economics study. Human capital is acquired through two

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approaches. First, humans emerge as labor from a quantitative perspective, which constitutes the fact that the more labor, the higher the productivity. Second, investment becomes a primary vehicle to foster human capital.

Human capital, from Todaro's perspective (2000), is evaluated through two key aspects: education and healthcare. Education enables each individual to earn more value, as it is clear that the higher the education men and women receive, the more skillful and proficient they become. At the same time, healthcare is inextricably linked to education. Productivity is likely to decrease given that there is no single support from the healthcare sector, as it primarily functions to provide for individuals' physical well-being. So, the better the healthcare is, the more progressive the education will be.

The healthcare indicator in the human capital concept is assessed through life expectancy (LE). It illustrates the average number of years each individual can expect to live. The higher the LE, the better the health quality they obtain (Kurnia et al., 2023).

Education indicator is measured with two major components, namely 1) literacy rate, and 2) the average years of schooling (Indriani & Muhsyaf, 2025). The literacy rate provides a clear picture of the number of people aged 15 and above who can read and write either Latin or other alphabetic scripts. Meanwhile, the average years of schooling represent the years of formal education that individuals aged 15 and above undertake. These two indicators, as conveyed by Rahim et al. (2021), are relevant for assessing the quality of an individual's education.

EQUITY DISTRIBUTION THEORY

According to Musgrave (1959), in public finance, the function of distribution emphasizes both horizontal equity and vertical equity principles. In terms of horizontal equity, every individual must attain the same treatment in the same situation. Otherwise, vertical equity portrays a group of individuals who receive proportionally different treatment relevant to their needs. Inside the lens of public spending, those principles suggest that budget allocations for education and healthcare must be even, with a greater focus on impoverished communities and remote areas to bridge the gap. In practice, however, the efficiency budgeting procedure often has negative impacts on the neediest communities (Supriyantony, 2024). This case arises from a finite budget allocation that is frequently shifted to the more economically efficient project or program, yet often lacks consideration for social justice. For example, in several less fortunate regions, the education and healthcare sectors are constantly faced with limited and insufficient resources. Both sectors, as asserted by Rais et al. (2025), are in fact the main pillars for boosting community prosperity.

RESEARCH METHOD

This research employs Data Envelopment Analysis (DEA) with a Variable Return to Scale (VRS) model to assess the output-oriented efficiency of local government budgets in the education and healthcare sectors in Bangkalan, Sampang, Pamekasan, and Sumenep, Madura, from 2015 to 2024. The DEA is implemented to assess the technical efficiency of the Decision-Making Unit (DMU) by considering the quantity of inputs and outputs simultaneously (Cooper et al., 2007). This approach is chosen for its advantage in comparing relative performance between DMUs without requiring an assumption of a particular

production function (Charnes et al., 1978). The objective of this method is to measure production efficiency empirically in DMU, which comprises a business entity, organization, or certain parts of it (Vajjhala & Eappen, 2024). The VRS model application is used, judging that those four regions have different fiscal capacity and economic scale, to allow generating more realistic, varied results (returns to scale)

An output-oriented approach is selected, as the aim of this research is to assess the local government's ability to maximize the output of human resource development from available public expenditure, rather than focusing on increasing input (Veronese et al., 2021). Every regency is treated as DMU observed for ten years, so there are 40 units of observation as a result (4 DMU x 10 years)

TABLE 2. CLASSIFICATION OF RESEARCH DMUS

No	District	Decision Making Unit (DMU)
1	Bangkalan	DMU 1
2	Sampang	DMU 2
3	Pamekasan	DMU 3
4	Sumenep	DMU 4

To measure the efficiency, the combination of input and output variables is applied. The input variable comprises three primary indicators: education expenditure per capita, health expenditure per capita, and Gross Domestic Product (GDP) per capita, which represent regional economic capacity. Regarding the output variable, it contains three indicators that represent human development dimensions, namely the average years of schooling (AYS), the expected years of schooling (EYS), and the life expectancy (LE). The input and output combination is designed to comprehensively identify the relationship between public expenditure and the output of human resource development. The increase in GDP per capita, as an input, is considered an innovation in this research, given that the majority of previous studies, as done by Jibir et al. (2024), tend to use sectoral expenditure without considering regional economic capacity. The data are obtained from official publications published by Statistics Indonesia (BPS) and the Directorate General of Fiscal Balance (DJPK) in the form of annual panel data.

TABLE 3. CLASSIFICATION OF RESEARCH VARIABLES IN THE EDUCATION SECTOR

Tipe Variabel	
Input Variables	Education Expenditure, Gross Regional Domestic Product (GRDP)
Output Variables	Average Years of Schooling (RLS), Expected Years of Schooling (HLS)

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TABEL 4. KLASIFIKASI VARIABEL PENELITIAN BIDANG KESEHATAN

Tipe Variabel	
Input Variables	Health Expenditure, Gross Regional Domestic Product (GRDP)
Output Variables	Life Expectancy (AHH)

Efficiency analysis is conducted using STATA software version 17 through the DEA order with a VRS specification and an output-oriented approach. The efficiency score ranges from 0 to 1, where a score of 1 indicates full efficiency, while scores below 1 indicate technical inefficiency. The DEA calculation result is thereafter descriptively interpreted to find out efficiency variation amongst the four regencies and Returns tendency, whether it goes increase, constant, or decreasing returns to scale (Zarrin & Brunner, 2023)

RESULTS AND DISCUSSION

RESULTS

In this study, the relative efficiency of each DMU is determined by applying the DEA method with the VRS approach. The selection of this method is based on its practical use in measuring technical efficiency, as it is unnecessary to involve a fixed result scale, which is also considered appropriate for the population living in Madura. This research concentrates on output-oriented. It aims to assess the efficiency of the local government in expending education, health, and GDP per capita. As a result, it achieves optimum human resource development. Additionally, this approach is selected for this research, which aims to assess the efficiency of local government expenditure in optimizing human resource development output, rather than merely increasing output without considering the available fiscal capacity.

Output-oriented efficiency is considered relevant to public expenditure efficiency in Madura, as it corresponds to the significant concentration of the local government, i.e., improving development results on AYS, EYS, and LE without decreasing the insufficient expenditure. Thus, this approach visualizes the output that the local government can generate from the available resources in use. The relative efficiency rate of those four regencies is assessed in this study using the DEA method with an output-oriented approach. The result of the analysis identifies inefficient DMU (score <1) that points out the must-improve regency, while DMU (score =1) demonstrates the output-achieved regency from available resources in use.

Kabupaten	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Bangkalan	0.857637	0.860462	0.846263	0.847487	0.847140	0.868585	0.857462	0.916650	0.874433	0.875091
Pamekasan	1000000	0.983891	1000000	0.999182	0.998552	1000000	0.999801	1000000	1000000	1000000
Sampang	0.812226	0.842847	0.841139	0.864344	0.886676	0.912259	0.907361	0.906362	0.915997	0.916728
Sumenep	0.907587	0.930112	0.931498	0.955519	0.963991	0.966209	0.974129	0.986852	0.991965	0.992695

Source: ***Panel Data (2025), processed***

TABLE 5. EDUCATION SECTOR EFFICIENCY SCORING RESULT WITH DEA METHOD

In reference to the table above, the efficiency rate in the education sector varies across four regencies in Madura from 2015 to 2024. The DEA output-oriented method generates an efficiency score for education that ranges from 0.81 to 1.00, reflecting an education expenditure optimization gap among Bangkalan, Pamekasan, Sampang, and Sumenep. Pamekasan, for example, achieves the highest score of efficiency rate, nearly peaking at 1.00 for several years of observation. Pamekasan is hence perceived as the most efficient regency, scoring at 1. This also asserts that education investment has had a positive influence on improving the quality of human resources.

Regencies such as Sampang and Sumenep exhibit a score variation in efficiency ranging from 0.81 to 0.99. Both are grouped as the most efficient regencies. Despite this significant number, the data above clearly indicate that education expenditure is still not optimized. This inefficiency is likely caused by AYS being lower than that of other regencies, uneven resource distribution, and a weak absorption of the education budget. In Bangkalan, efficiency has not reached perfection, but remains sufficient. It is clustered at a medium rate of efficiency, between 0,84 and 0,91. Of this, Bangkalan has incurred considerable expenses for education, yielding nearly ideal results; nonetheless, financial governance and fair access to education in Bangkalan remain areas for improvement.

Kabupaten	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Bangkalan	0.987247	1.000.000	0.984038	0.983448	0.984472	0.988621	0.991091	1.000.000	0.998764	1.000.000
Pamekasan	1.000.000	1.000.000	0.995853	0.992714	0.989975	0.994174	0.992675	0.993293	0.992184	0.990693
Sampang	0.984986	0.984241	0.981478	0.979750	0.978855	0.979823	0.980104	0.981931	0.982636	0.984421
Sumenep	0.982016	0.981415	0.983183	0.984287	0.987233	0.990270	0.990933	0.995158	0.998831	1.000.000

Source: Panel Data (2025), *processed*

TABLE 6. HEALTH SECTOR EFFICIENCY SCORING RESULT WITH DEA METHOD

Based on the VRS scoring in the healthcare sector, several DMUs achieve a maximum efficiency rate of 1.00, as shown in the table above. Pamekasan was able to maintain the highest score of efficiency, albeit for only two years. This clearly signifies that the healthcare sector runs relatively consistently and controllably. The efficiency rate in Bangkalan increased significantly in 2016, 2022, and 2024, but declined in 2023. It shows that the effectiveness rate of the healthcare sector needs to be reinforced. In Sumenep, no stable, efficient rate changes were found. It nevertheless tends to grow better and more stable compared to Sampang. This fact highlights a geographical issue and the need for healthcare facility equality. Moreover, lastly, Sampang has the most fluctuating efficiency score. Healthcare expenditure and economic growth have not led to a significant transformation in Life Expectancy (LE), and this is reflected in ineffective expenditure and poor healthcare services.

DISCUSSION

This research reveals that an efficiency level was achieved across four regencies in Madura in managing their education and healthcare budgets. The average score achieves 0.99 with complete efficiency for six years in the education sector and two years in the healthcare sector, respectively. On this occasion, Pamekasan emerged as the most efficient according to the VRS model, followed by Sumenep and Bangkalan, resulting in diverse efficiency rates.

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Whereas Sampang was scored at 0.81, considered medium, and yet the lowest of the three. It indicates that regional expenditure has yet to be fully optimized to produce better human resource development outcomes. Therefore, this variation illustrates the finesse of each regency in Madura in transforming input (both education and healthcare expenditures, and GDP per capita) into output (AYS, EYS, and LE), influenced by variations in capacity management and fiscal scale at the regency level.

This phenomenon corresponds to the research by Afonso and Fernandes (2023) and Nurvita et al. (2022), which highlighted the importance of effective governance and resource allocation, as well as the allocation of a significant amount of dollars, in influencing public expenditure. While Sampang experienced inefficiency due to improper infrastructure establishment and the distribution of the labor force, Pamekasan, on the other hand, demonstrated its skillful performance in adjusting to public-need-based expenditure. This pattern is also consistently parallel to Jibir's research (2024) in Nigeria, uncovering that inefficient expenditure by the authorities tended to have poor governance and significant fiscal reliance, while, conversely, wise and disciplined fiscal management and a low corruption rate led to a higher efficiency level.

The fundamental originality of this research stems from its focus on analyzing interregencies in homogeneous socio-economic clusters between 2015 and 2024, using Variable Returns to Scale (VRS) with input orientation. In Indonesia, such a strategy is rarely implemented at the regency level. To capture regional economic capacity, which affects fiscal efficiency, this study also incorporates GDP per capita as a supporting input variable. This practice is barely mentioned in the previous study, carried out by Jibir et al. (2024), who only evaluated efficiency from a sectoral expenditure perspective without calculating economic variables per capita.

This research supports the findings of the existing literature, which state that not only does fiscal efficiency relate to the nominal budget, but also reflects public effectiveness and governance at the local scale. As a result, this research provides empirical support for future research on fiscal efficiency in developing regions, such as Madura. This research, in addition, can serve as a reference for policymakers to enhance the effectiveness and governance of public expenditure, thereby achieving sustainable development for human beings.

CLOSING

This research investigated the efficiency of local government expenditure in both education and healthcare in four regencies on Madura from 2020 to 2024, using Data Envelopment Analysis (DEA). The results of this research indicate that the level of fiscal efficiency in each regency in Madura varies significantly and progresses insignificantly. In the education sector, for instance, Pamekasan is classified as having the highest efficiency level. It vividly indicates that investing in education has profoundly contributed to improving the quality of human resources. Meanwhile, both Sampang and Sumenep are ranked second highest, following Pamekasan, and Bangkalan is scored and placed at a medium efficiency level. In the healthcare sector, Pamekasan achieves the highest score of efficiency level, followed by Bangkalan. At the same time, Sampang shows fluctuating efficiency compared to Sumenep, which maintains stable efficiency. These variations highlight that, despite education and health budget allocation being based on policy, their practice requires improvement to foster human

resource development, including HDI, EYS, AYS, and LE.

Overall, this research suggests that the low fiscal efficiency in Madura is attributed to structural factors, including insufficient managerial capacity, an infrastructure gap, and inadequate public expenditure. Hence, efficiency enhancement can be accomplished through performance-based financial governance, the equality of education and healthcare development, and the optimization of budget allocation, so that every public expenditure has a more profound effect on the improvement of each individual's quality in Madura.

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