OPTIMIZATION OF ZAKAT, INFAQ, AND DIGITAL ALMS FOR POVERTY ALLEVIATION: ANALYSIS OF DISTRIBUTION EFFICIENCY BY *DATA ENVELOPMENT ANALYSIS*

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ABSTRACT
This study analyzes the distribution efficiency of digital zakat, infaq, and sadaqah (ZIS) in Indonesian zakat management institutions using Data Envelopment Analysis (DEA) to measure its contribution to poverty alleviation. Using data from 25 digital LAZs for the 2021-2023 period, this research applies DEA-CCR and DEA-BCC models to measure technical efficiency, scale efficiency, and allocative efficiency. Input variables include collected ZIS funds, digital operational costs, and number of personnel, while outputs encompass number of mustahik served, poverty reduction rate, and program sustainability. Results show only 9 LAZs (36%) achieved full efficiency with an average efficiency score of 0.73, indicating a 37% potential output increase. DEA- analysis identified 14 LAZs (56%) achieving pure technical efficiency, with scale inefficiency as the main source of inefficiency. LAZs with integrated digital fundraising models have 27% higher efficiency. Slack analysis reveals the largest input excess in operational costs (22.6%) and output shortfall in poverty reduction (30.4%). The study recommends scaling up for LAZs with increasing returns to scale, process optimization for decreasing returns to scale, adoption of data analytics, automated distribution systems, and increased proportion of productive programs to maximize poverty alleviation impact.BCC

INTRODUCTION

Poverty remains a crucial development challenge in Indonesia with 9.57% of the population or 26.36 million people below the poverty line as of March 2024 (Central Statistics Agency, 2024). In this context, zakat, infaq, and alms (ZIS) as an instrument of Islamic wealth redistribution have strategic potential for poverty alleviation. The potential for national zakat reaches IDR 327.6 trillion per year, but the realization of new collections is IDR 23.4 trillion or 7.1% in 2023 (BAZNAS, 2024). This significant gap indicates fundamental challenges in managing and optimizing ZIS.

Digital transformation has opened up a new paradigm in ZIS management through a platform that facilitates ease of payment, management transparency, and distribution accountability (Beik & Arsyianti, 2016). The

contribution of ZIS collection through digital channels has grown exponentially from 23% in 2019 to 67% in 2023 (BAZNAS, 2024), reflecting the shifting preference of the public towards digital platforms. However, digitalization does not automatically guarantee distribution efficiency. The crucial issue is how efficient the amil zakat institution (LAZ) is in converting digital ZIS funds into poverty alleviation outcomes.

Data Envelopment Analysis (DEA) offers a robust methodology for measuring the relative efficiency between Decision Making Units (DMUs) with multiple inputs and outputs (Charnes et al., 1978). The DEA approach has been widely used in the context of nonprofit and philanthropic institutions in various countries (Cooper et al., 2007). In the Islamic philanthropy literature, several studies use DEA to measure the efficiency of zakat institutions in Malaysia (Noor et al., 2015; Wahab & Rahman, 2013) and Indonesia (Rusydiana & Al-Farisi, 2016). However, research on the efficiency of digital LAZ in the context of poverty alleviation outcomes is still very limited.

This study aims to: (1) measure the level of technical efficiency, scale efficiency, and allocative efficiency of digital LAZ in distributing ZIS for poverty alleviation; (2) identify LAZ benchmark best practices; (3) analyze the distinguishing factors of efficient and inefficient LAZ; (4) calculating the potential for inefficient LAZ improvement; and (5) formulate strategic recommendations for digital ZIS optimization. The findings are expected to contribute to the efficiency literature of Islamic philanthropic institutions and provide actionable insights for LAZ and regulators.

LITERATURE REVIEW

1 Zakat, Infaq, and Sadaqah in Islamic Economics

Zakat is the obligation to issue a certain amount of property to be given to the entitled group (mustahik) with the terms and conditions of sharia (Al-Qaradawi, 1999). Zakat has the following characteristics: (1) it is mandatory for Muslims who meet the nisab; (2) the amount is determined to be fixed (2.5% for trade property, 5-10% for agricultural products); and (3) the recipient is determined in QS At-Taubah:60, which is eight groups. Infak and alms are voluntary but highly recommended in Islam (Hassan, 2010).

In Islamic economics, ZIS has three main functions: (1) a redistributive function to reduce inequality; (2) productive functions through the financing of mustahik productive businesses; and (3) preventive functions to prevent excessive wealth accumulation (Kahf, 1999). ZIS has comparative advantages: mandatory funding that ensures sustainability, clear targeting, productive implementation through economic empowerment, and the principle of professional amil which is the basis for good governance (Firdaus et al., 2012). However, the realization of ZIS potential is highly dependent on LAZ's efficiency in management and distribution.

2 Data Envelopment Analysis as a Method of Measuring Efficiency

DEA is a non-parametric mathematical programming technique for evaluating the relative efficiency of homogeneous DMUs with multiple inputs and outputs (Charnes et al., 1978). DEA advantages: (1) it does not require production function specifications; (2) can handle multiple inputs simultaneously; (3) identify specific sources of inefficiency; and (4) provide concrete improvement targets (Cooper et al., 2007). The basic model of DEA is CCR (Constant Returns to Scale) which measures overall technical efficiency and BCC (Variable Returns to Scale) which separates pure technical efficiency and scale efficiency (Banker et al., 1984).

DEA-CCR mathematical formulation for output maximization: Max θ, subject to: $\Sigma\lambda_j x_{ij} \leq x_{i_o}$ (for each input i), $\Sigma\lambda_j y_{rj} \geq \theta y_{r_o}$ (for each output r), $\lambda_j \geq 0$, where θ is the efficiency score, λ_j intensity variables, x_{ij} total input i DMU j, y_{rj} total output r DMU j. DMU is efficient if $\theta = 1$ and inefficient if $\theta < 1$ (Coelli et al., 2005). The BCC model adds a convexity constraint $\Sigma\lambda_j = 1$ to accommodate VRS. Correlation: Overall TE (CCR) = Pure TE (BCC) × Scale Efficiency (Fried et al., 2008).

3 Previous Research on the Efficiency of Zakat Institutions

Noor et al. (2015) used DEA to analyze the efficiency of 14 zakat institutions in Malaysia and found an average efficiency score of 0.68 with the main inefficiency of excess administrative costs. Wahab and Rahman (2013) compared the efficiency of state zakat collections centres in Malaysia with efficiency scores of 0.45-1.00. Rusydiana and Al-Farisi (2016) analyzed the efficiency of Indonesian provincial BAZNAS using two-stage DEA and found that GDP per capita and HDI had a significant effect. Nikmatuniayah and Marliyati (2015) examined the efficiency of

LAZ in Indonesia with DEA and found efficiency variations between LAZs. Ahmed (2004) used DEA for zakat institutions in Sudan. Saad et al. (2014) analyzed the efficiency of zakat collection in Malaysia with stochastic frontier analysis. However, research on the efficiency of digital LAZ in poverty alleviation outcomes is still limited, being a gap filled by this study.

RESEARCH METHODS

The study used a quantitative approach with the DEA method to measure the relative efficiency of digital LAZ. The population is all LAZ registered with BAZNAS with digital platforms (37 LAZ as of December 2023). The sample was selected purposive sampling with the following criteria: (1) operating for at least 3 years (2021-2023); (2) active digital platforms; (3) audited and public financial statements; and (4) measurable poverty alleviation programs. 25 LAZ were selected as DMUs in the DEA analysis.

Secondary data is sourced from: (1) LAZ audited financial statements 2021-2023; (2) Program reports and impact reports; (3) BAZNAS statistical data; and (4) Publication of zakat research institutions. Selection of input-output variables based on literature review and discussion of LAZ practitioners. Input variables: (1) Total ZIS funds collected (billion rupiah); (2) Operational costs of digital platforms (billion rupiah); and (3) The number of human resources of the manager (people). Output variables: (1) Number of mustahik served (thousand people); (2) The rate of poverty reduction of mustahik (percent); and (3) Sustainability index of empowerment programs (scale 0-100).

Data analysis was conducted using MaxDEA Pro 8.0 and DEAP Version 2.1 software. Stages: (1) Descriptive statistics characteristic of DMUs; (2) Correlation analysis for isotonicity assumption; (3) DEA-CCR analysis for overall technical efficiency with CRS; (4) DEA-BCC analysis for pure technical efficiency with VRS; (5) Calculation of scale efficiency; (6) Returns to scale analysis; (7) Slack analysis for excess inputs and output shortfalls; (8) Benchmarking analysis for reference sets; and (9) Sensitivity analysis for robustness. Interpretation was carried out by comparing efficiency scores, identifying LAZ efficiency best practices, and formulating inefficient LAZ improvement targets.

RESULTS AND DISCUSSION

1 Descriptive Statistics of Research Variables

Table 1 presents descriptive statistics of the input and output variables of 25 digital LAZ for the 2021-2023 period.

Table 1. Descriptive Statistics of Digital LAZ Input and Output Variables

Variable	Red	Median	Min	Max	SD	CV
INPUT						
ZIS Fund (IDR Billion)	87,3	62,5	12,4	456,8	98,7	1,13
Operating Costs (Rp Billion)	8,4	6,2	1,8	34,5	7,9	0,94
Number of human resources (people)	124	95	28	487	118	0,95
OUTPUT						
Mustahik Served (thousands)	47,6	35,2	8,3	234,7	52,8	1,11
Poverty Reduction (%)	23,7	21,5	8,2	48,6	11,4	0,48
Sustainability Index	64,3	62,8	38,5	89,2	13,9	0,22

Source: LAZ data processed (2024)

Table 1 shows significant variation between LAZs. The average ZIS fund of IDR 87.3 billion with a standard deviation of IDR 98.7 billion indicates high heterogeneity. The largest LAZ manages IDR 456.8 billion, the smallest IDR 12.4 billion. The coefficient of variation of 1.13 indicates a very high dispersion. Operational costs range from IDR 1.8-34.5 billion with an average of IDR 8.4 billion (9.6% of the fund). On average, mustahik is served by 47,600

people with wide variations. The poverty reduction rate varies from 8.2 to 48.6% (average 23.7%), indicating a substantial difference in the effectiveness of poverty alleviation programs. The average sustainability index of 64.3 shows that the sustainability of the program is quite good, but there is still significant room for improvement.

2 Results of DEA-CCR and DEA-BCC Efficiency Analysis

Table 2 presents the results of efficiency analysis using the DEA-CCR and DEA-BCC models for 25 digital LAZs.

Table 2. LAZ Digital Efficiency Scores (Sample)

LAZ	CCR	BCC	Scale Eff.	RTS	Status
LAZ-01	1,000	1,000	1,000	CRS	Efficient
LAZ-02	0,847	0,892	0,950	IRS	Inefficient
LAZ-03	1,000	1,000	1,000	CRS	Efficient
LAZ-04	0,723	0,816	0,886	IRS	Inefficient
LAZ-05	0,612	0,734	0,834	DRS	Inefficient
...	...	...	...	...	...
LAZ-25	0,568	1,000	0,568	DRS	Inefficient
Average	0,730	0,857	0,852	-	-

Source: DEA analysis results with MaxDEA Pro 8.0 (2024)

The DEA-CCR results showed that only 9 LAZ (36%) achieved full efficiency (efficiency score = 1,000). LAZ-LAZ is at the frontier of efficiency and is a benchmark. Meanwhile, 16 LAZ (64%) are still inefficient with scores of 0.568-0.987 (average 0.730), indicating that LAZ only reaches 73% of the maximum efficiency potential. DEA-BCC analysis showed that 14 LAZ (56%) achieved pure technical efficiency (BCC score = 1,000) with an average of 0.857. The difference between CCR-BCC indicates that the main inefficiency comes from scale inefficiency rather than pure managerial inefficiency. The average scale efficiency of 0.852 indicates that LAZ is inefficient in operating on a suboptimal scale.

Returns to scale analysis showed that of the 16 inefficient LAZs: 11 LAZ (68.75%) operated on increasing returns to scale (IRS), meaning they could increase efficiency by increasing the scale of operations. Only 5 LAZ (31.25%) on decreasing returns to scale (DRS), indicating that they are too large and need optimization without expansion. The findings have different strategic implications: LAZ with IRS needs expansion and scaling up, LAZ with DRS needs to focus on process optimization and efficiency improvement.

3 Slack Analysis and Potential Efficiency Improvements

The analysis of slack variables provides information on specific sources of inefficiency and magnitude of improvement. Table 3 presents the average input excesses and output shortfalls of inefficient LAZ.

Table 3. Input Excesses and Output Inefficient LAZ Shortfalls

Variable	Slack Value	% Average
INPUT EXCESSES		
ZIS Fund Collected	IDR 12.3 billion	14,1%
Digital Operational Costs	IDR 1.9 billion	22,6%
Number of Human Resources Manager	18 people	14,5%
OUTPUT SHORTFALLS		

Mustahik Served	8.7 thousand people	18,3%
Poverty Reduction Mustahik	7.2 percentage points	30,4%
Sustainability Index	14.8 points	23,0%

Source: DEA slack variables analysis results (2024)

The largest excess input in digital operational costs (Rp 1.9 billion or 22.6%), indicates that LAZ is inefficient in allocating excessive costs for digital infrastructure without proportional output. The excess of ZIS funds of IDR 12.3 billion (14.1%) shows that LAZ is inefficient in having sufficient resources but not optimal in use. Excess human resources of 18 people (14.5%) showed overstaffing or underutilization. Of the output shortfalls, the largest deficit is the poverty reduction rate (7.2 percentage points or 30.4%), the most critical finding because it is the ultimate outcome of ZIS. Inefficient LAZ also experienced shortfalls in served mustahik (8,700 people or 18.3%) and sustainability index (14.8 points or 23.0%). If the LAZ is inefficient in eliminating input excesses and achieving the output targets based on the benchmark, there will be a 37% increase in aggregate output without increasing the inputs.

4 Distinguishing Factors of Efficient and Inefficient LAZ

Table 4 presents a comparison of the operational characteristics of efficient and inefficient LAZ.

Table 4. Comparison of Efficient vs Inefficient LAZ Characteristics

Characteristics	Efficient (n=9)	Inefficient (n=16)	Δ %
Ratio of Operating Costs to Funds (%)	7,2	11,8	+64
Digital Fundraising Channels	5,8	3,4	-41
Analytics Data Usage (%)	89	48	-46
Automated Distribution System (%)	78	31	-60
Productive Programs/Total (%)	68	43	-37
Donor Retention Rate (%)	73	52	-29

Source: LAZ data and analysis results (2024)

LAZ operates efficiently with a much lower operating cost ratio (7.2% vs 11.8%), indicating superior cost management. The diversification of digital fundraising channels is wider (5.8 vs 3.4 channels) contributing to stability and growth. The use of data analytics was very different (89% vs 48%), reflecting more data-driven efficient LAZ in donor segmentation, targeting, and impact measurement (Muneeza et al., 2018). The adoption of an automated distribution system is higher (78% vs 31%) improving targeting accuracy and reducing leakages (Shirazi, 2014). The proportion of productive programs is higher (68% vs 43%) explaining poverty reduction outcomes better (Said et al., 2013). Higher donor retention rates (73% vs 52%) indicate superior relationship management results in loyalty and repeated donations. The findings confirm the importance of technology adoption and program design in driving efficiency (Ali et al., 2015).

CONCLUSIONS

The study confirms a significant efficiency gap in the distribution of digital ZIS for poverty alleviation. Of the 25 LAZs, only 36% achieved full efficiency with an average efficiency score of 0.73, indicating a potential 37% increase in output. Decomposition analysis showed that the majority of inefficiencies were sourced from scale inefficiency with 68.75% of LAZ inefficient in increasing returns to scale. LAZ with integrated digital fundraising and data-driven distribution systems has a 27% higher efficiency. The largest excess input was in the platform's operating costs (22.6%), the largest shortfall output in poverty reduction (30.4%).

Strategic recommendations: (1) LAZ with the IRS needs to scale up through geographic coverage expansion, diversification of fundraising channels, and investment in technology infrastructure; (2) LAZ with DRS focuses on process optimization and quality enhancement; (3) Serious cost-benefit analysis of digital platform

investment; (4) Benchmarking LAZ best practices efficiently in data analytics adoption, automated distribution systems, productive empowerment programs, and rigorous M&E framework (Ayuniyyah et al., 2018); (5) BAZNAS facilitates knowledge sharing and capacity building; (6) Consideration of strategic consolidation or partnerships for small LAZ with severe scale inefficiency; (7) Development of standardized metrics and reporting framework for comparative analysis and accountability enhancement (Obaidullah & Shirazi, 2015).

Future research needs to explore factors affecting LAZ efficiency using second-stage regression analysis, as well as longitudinal studies for efficiency dynamics and sustainability improvements (Hasan, 2007; Hassan & Shahid, 2010). With the implementation of recommendations, Indonesia's digital ZIS sector can optimize its contribution to SDG 1 No Poverty. The limitations of the study include the use of secondary self-reported LAZ data that can be biased, as well as a focus on distribution efficiency without in-depth analysis of long-term sustainability outcomes that require longitudinal research.

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