

A Quantitative Meta-Synthesis of Public Transportation Fares in Indonesia: A Systematic Literature Review Approach

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Abstract: Determining public transportation fares in Indonesia often triggers conflict between operators, users, and the government due to a lack of synthesized national benchmarks. This study aims to establish a comprehensive national synthesis of public transportation fares by integrating three critical parameters: Vehicle Operating Costs (VOC), Ability to Pay (ATP), and Willingness to Pay (WTP). Utilizing a Systematic Literature Review (SLR) and quantitative meta-synthesis approach guided by the PRISMA 2020 statement, 20 eligible empirical studies across various regions in Indonesia were analyzed after undergoing rigorous quality appraisal. The meta-synthesis reveals a distinct structural pattern in the national public transport pricing ecosystem, where the average values are formulated as $VOC < ATP > WTP < \text{Actual Fare}$. Specifically, the synthesized national averages are IDR 11,353/km for VOC, IDR 14,680 for ATP, IDR 13,370 for WTP, and IDR 22,686 for the Actual Fare. This pattern exposes a systemic gap: while the public's financial capacity (ATP) is theoretically sufficient to cover operating costs, their actual willingness to pay (WTP) remains low, yet the actual fares charged in the field significantly exceed both thresholds. This study concludes that the current tariff structure imposes an inequitable cost burden on passengers. The findings provide an evidence-based framework for policymakers to design targeted subsidy schemes and service-quality improvements to bridge the tariff-affordability gap.

Keywords: Public Transportation; Fare Synthesis; Vehicle Operating Cost (VOC); Ability to Pay (ATP); Willingness to Pay (WTP); Systematic Literature Review.

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I. INTRODUCTION

Public transportation plays a strategic role in the national transportation system, serving as both a primary driver of public mobility and a crucial instrument for mitigating traffic congestion and environmental pollution in urban areas [1]. However, in recent decades, the public transit sector in Indonesia has faced significant structural challenges. Data from the Central Bureau of Statistics (BPS) indicates that the modal share of public transportation in Indonesia has hovered at a critically low level of approximately 23% of total national trips [2]. This figure falls substantially behind neighboring countries such as Singapore, which has achieved a 67% modal share, and Malaysia at 40%.

This low modal share is directly correlated with the exponential growth of private vehicle ownership, which has surged at an average annual rate of 5.1%, surpassing 152 million units nationwide. Consequently, public transit ridership

experienced a sharp decline over the 2019–2022 period, exacerbated by widespread public perception that public transit services are inefficient, uncomfortable, and unreliable [3]. This phenomenon underscores that establishing an optimized and equitable fare formulation is paramount to maintaining both the operational sustainability and the public attractiveness of transit services [4].

Theoretically and regulatively, public transportation fare setting must not rely on a unilateral perspective [5]. An equitable formulation must integrate three primary parameters: Vehicle Operating Costs (VOC) from the supply side (operators), alongside the Ability to Pay (ATP) and Willingness to Pay (WTP) from the demand side (passengers) [6]. VOC reflects the actual expenditures incurred by operators including fuel, maintenance, and fleet depreciation where fluctuations in fuel prices typically account for 30–40% of total operating expenses [7]. Conversely, ATP represents the objective financial capacity of the public based on their income

allocations for transportation [8], while WTP measures the nominal amount that users are subjectively willing to spend in exchange for the perceived quality of service [9].

Although empirical studies analyzing VOC, ATP, and WTP have been widely published across Indonesia, the existing literature exhibits fundamental limitations. Prior research has been overwhelmingly localized, focusing on isolated administrative boundaries or specific municipalities [10, 11]. Consequently, generalizing these findings to formulate macro-level policies at the national level remains highly problematic due to inherent geographical and demographic biases unique to each studied locality [12]. Furthermore, there is no scientific consensus summarizing how these interlocking variables behave structurally on a macro scale in Indonesia [13]. The research gaps identified and addressed in this study are threefold:

➤ *Contextual Limitations and Spatial Partiality:*

Prior research has been overwhelmingly localized, focusing on isolated administrative boundaries or specific municipalities (local case studies). Consequently, generalizing these findings to formulate macro-level policies at the national level remains highly problematic due to inherent geographical and demographic biases unique to each studied locality.

➤ *High Heterogeneity and Disparities in Findings:*

Empirical calculations across different regions demonstrate severe variance and structural anomalies. For instance, several studies report that calculated VOC values sit far above actual fares, leading to severe operational deficits for operators, whereas other studies reveal that ATP values fall below official tariffs, giving rise to "transport poverty." To date, there is no scientific consensus summarizing how these interlocking variables behave structurally on a macro scale in Indonesia.

➤ *Absence of Evidence-Based Quantitative Synthesis:*

The terrestrial transportation literature in Indonesia is heavily dominated by conventional primary survey methods. There has been no academic effort utilizing a Systematic Literature Review (SLR) combined with a quantitative meta-synthesis to cross-examine and consolidate the scattered empirical datasets. The lack of a systematic synthesis deprives regulators of a valid national benchmark required to evaluate subsidy efficiencies and tariff thresholds.

To bridge these critical gaps, this study aims to execute a rigorous quantitative meta-synthesis to systematically integrate empirical findings regarding VOC, ATP, WTP, and actual fares across various geographic regions and public transit modes in Indonesia. The novelty of this research lies in its application of a systematic review framework strictly adhering to the PRISMA 2020 statement to screen, extract, and beauty a unified national structural fare pattern [14].

The novelty of this research lies in its application of a systematic review framework strictly adhering to the PRISMA 2020 statement to screen, extract, and synthesize quantitative secondary data from 20 high-quality empirical studies that passed a stringent quality appraisal process. By pooling data

across diverse transit modes (including urban buses, microtransit/angkot, and Bus Rapid Transit/BRT) and varied socio-economic regions, this study successfully models a unified national structural fare pattern ($VOC < ATP < WTP < \text{Actual Fare}$). The findings contribute not only to the theoretical expansion of evidence synthesis within transport engineering but also offer concrete, evidence-based policy recommendations for regulators designing targeted subsidy frameworks and service-quality intervention strategies in Indonesia.

II. METHODOLOGY

➤ *Study Design and Protocol*

This study employs a Systematic Literature Review (SLR) coupled with a quantitative meta-synthesis approach to integrate empirical findings regarding public transportation fares in Indonesia. The research design is systematically structured and executed in strict accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement [14]. This methodological framework ensures that the process of identification, screening, eligibility assessment, and inclusion of primary studies is reproducible, transparent, and free from selection bias.

➤ *Search Strategy and Information Sources*

A comprehensive electronic search was conducted to identify relevant peer-reviewed journal articles and academic publications. The primary bibliographic database utilized was Google Scholar, accessed systematically through the Publish or Perish (PoP) software interface. To ensure maximum coverage of the literature, metadata harvesting was restricted to publications written in English and Indonesian. The search query was constructed using specific Boolean operators and combinations of precise keywords, formulated as follows:

("Tarif Angkutan Umum" OR "Public Transport Fare") AND ("Biaya Operasional Kendaraan" OR "VOC" OR "BOK") AND ("Ability to Pay" OR "ATP") AND ("Willingness to Pay" OR "WTP") AND "Indonesia"

The publication search window was restricted to the last decade to ensure the contemporary relevance of the synthesized socio-economic and operational data.

➤ *Eligibility Criteria (Inclusion and Exclusion Criteria)*

To establish a rigorous boundary for the meta-synthesis, explicit inclusion and exclusion criteria were defined prior to the screening process:

• *Inclusion Criteria*

- ✓ Empirical studies analyzing land-based public transportation fares in Indonesia (e.g., urban buses, microtransit/angkot, and Bus Rapid Transit/BRT).
- ✓ Studies that concurrently measure and present explicit quantitative values for at least two of the primary parameters: Vehicle Operating Costs (VOC/BOK), Ability to Pay (ATP), and Willingness to Pay (WTP).

- ✓ Peer-reviewed journal articles, conference proceedings, or institutional academic theses containing primary empirical data.

- *Exclusion Criteria*

- ✓ Studies focusing exclusively on non-land transport modes (e.g., maritime, air, or rail transport).
- ✓ Qualitative or conceptual papers that do not provide quantitative numerical data for VOC, ATP, or WTP.
- ✓ Duplicate publications or studies with overlapping datasets from the same author and location

- *Study Selection and Quality Appraisal*

The study selection followed a multi-stage screening pipeline. Initially, duplicate records and unrelated titles were removed. The remaining records underwent abstract screening based on the predefined eligibility criteria. Full-text versions of the remaining articles were then retrieved and subjected to a rigorous Quality Appraisal process. The quality assessment evaluated the robustness of the primary data collection methods, the mathematical transparency of the VOC formulations, and the validity of the survey instruments used to elicit ATP and WTP values. Following this appraisal, exactly 20 high-quality empirical studies met all criteria and were selected for final quantitative inclusion.

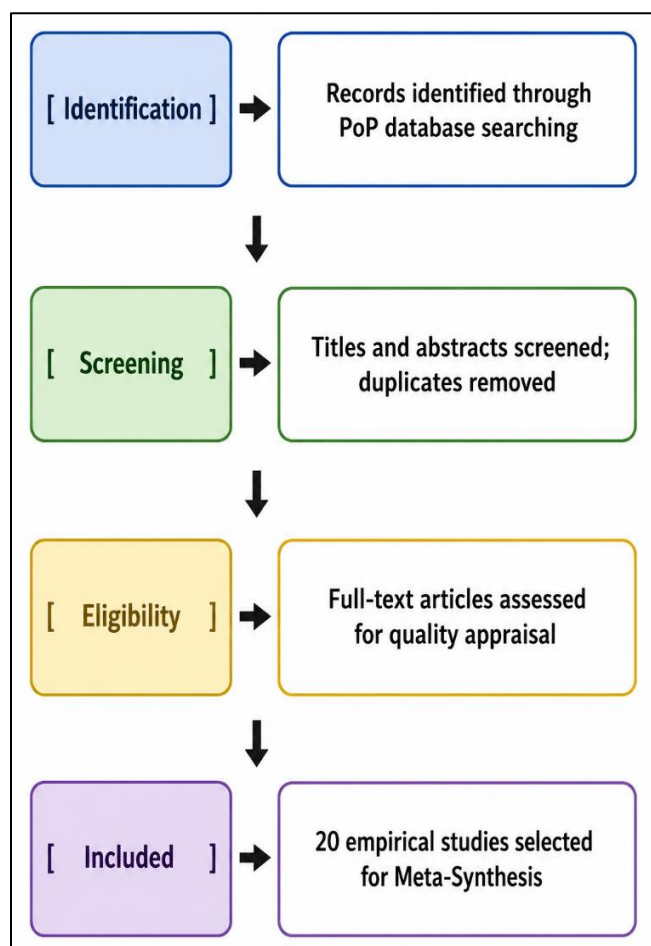


Fig 1 Systematic Literature Review and Study Selection Process for the Quantitative Meta-Synthesis of Public Transportation Fares in Indonesia

- *Data Extraction and Quantitative Meta-Synthesis*

Data extraction from the 20 included studies was standardized using a matrix sheet. The extracted parameters included: author(s), publication year, geographic location, vehicle transit mode, vehicle-kilometers, and the numerical values of VOC (converted to a per-kilometer base where necessary), ATP, WTP, and the Actual Fare charged in the field.

The quantitative meta-synthesis was executed by calculating the weighted national averages and identifying structural mathematical hierarchies among the parameters across different regions and modes. To ensure economic comparability across different study years, the monetary units were normalized, allowing for the cross-sectional aggregation of the overarching national pricing ecosystem pattern: $VOC < ATP > WTP < \text{Actual Fare}$.

III. RESULTS AND DISCUSSION

- *Description and Characteristics of Synthesized Data*

The systematic screening process based on the PRISMA 2020 protocol yielded exactly 20 empirical studies that met all inclusion criteria and passed the rigorous methodological quality appraisal. From these selected literatures, a total of 51 distinct fare variable indicators were extracted and cross-examined. Indicators for Ability to Pay (ATP) and Willingness to Pay (WTP) dominated the dataset, each contributing 35% (18 studies) of the total variables, while Vehicle Operating Cost (VOC) components were analyzed across 15 studies (29%). The quantitative data extracted from these studies represents diverse regions across Indonesia and is categorized into two major public transit modes: bus transit (urban/intercity) and microtransit (angkot).

- *National Meta-Synthesis of Fare Indicators*

By aggregating and normalizing the numerical datasets from the 20 included studies, the synthesized national averages for each primary fare-setting parameter were established as follows:

- Vehicle Operating Cost (VOC): IDR 11,353 per kilometer (km).
- Ability to Pay (ATP): IDR 14,680 per passenger.
- Willingness to Pay (WTP): IDR 13,370 per passenger.
- Actual Fare Charged in the Field (Fare): IDR 22,686 per passenger.

Through the cross-sectional synthesis of these values, an overarching structural macro-pattern in Indonesia's public transportation ecosystem was modeled as: $VOC < ATP > WTP < \text{Actual Fare}$. This pattern exposes a distinct and severe systemic gap. Although the objective financial capacity or purchasing power of the public is theoretically sufficient to cover the operational costs of transport operators ($ATP > VOC$), the public's actual willingness to pay falls below their financial capacity ($WTP < ATP$). This structural anomaly is further exacerbated by the fact that actual fares charged to passengers in the field drastically exceed all established thresholds ($\text{Actual Fare} > ATP > WTP$).

➤ *Modal Heterogeneity Analysis*

The quantitative meta-synthesis uncovers sharp operational and socio-economic variations when the fare parameters are disaggregated by the type of transit mode:

• *Bus Transit Mode*

- ✓ VOC: IDR 8,357/km | ATP: IDR 9,166/pax | WTP: IDR 6,987/pax | Actual Fare: IDR 19,196/pax
- ✓ Structural Pattern: $VOC < ATP > WTP < \text{Actual Fare}$
- ✓ Analysis: In the bus transit mode, the lower VOC reflects the inherent efficiency of mass transit capacity (economies of scale). However, a profound gap exists between the public's ATP (IDR 9,166) and the actual fare charged (IDR 19,196). The condition where $ATP < \text{Actual Fare}$ indicates that bus passengers—primarily consisting of students, workers, and lower-middle-class communities—bear an inequitable financial burden, a clear symptom of "transport poverty."

• *Microtransit Mode (Angkutan Kota / Mikrolet)*

- ✓ VOC: IDR 17,343/km | ATP: IDR 29,015/pax | WTP: IDR 29,962/pax | Actual Fare: IDR 32,822/pax
- ✓ Structural Pattern: $VOC < ATP < WTP < \text{Actual Fare}$
- ✓ Analysis: Microtransit exhibits a significantly higher VOC (IDR 17,343/km) due to limited passenger capacity per vehicle and higher fuel consumption driven by frequent stop-and-go cycles in congested urban corridors. Interestingly, the demand side demonstrates a $ATP < WTP$ pattern, indicating that microtransit users experience high mobility urgency, making them willing to pay above their theoretical budget capacity to ensure short-distance route availability. Nonetheless, the actual field fare (IDR 32,822) remains at the absolute peak of the structural hierarchy.

➤ *Discussion and Public Transport Policy Implications*

The cumulative findings showing that national actual fares (IDR 22,686) are nearly double the VOC values (IDR 11,353/km) point to a forced "premium fare" phenomenon in the field. This high fare structure is heavily decoupled from the enforcement of Minimum Service Standards (MSS). This imbalance triggers passenger resistance, which is empirically validated by the suppressed national WTP.

From a transport economics perspective, a market state where actual fares consistently exceed both the capacity (ATP) and willingness (WTP) of the public represents a structural market failure. The long-term consequence of this socially unsustainable fare structure is a mass migration of transit users toward private motorized vehicles. As ridership declines, the vehicle load factor collapses, which ultimately undermines the financial viability of transport operators.

Therefore, targeted regulatory interventions by the government are highly urgent through two primary strategies:

- **Formulation of Disparity-Based Subsidies (Targeted Subsidy):** Governments should design operational or tariff subsidy schemes (e.g., Buy the Service / BTS) that precisely bridge the financial gap between the operator's

ideal fare (based on VOC) and the public's objective purchasing power (ATP).

- **Service-Driven WTP Interventions:** Since WTP is highly elastic to comfort, travel-time reliability, and safety, upgrading the physical and operational qualities of public transit is a highly effective medium-term strategy to lift public willingness to pay closer to their financial capacity threshold.

IV. CONCLUSION AND RECOMMENDATIONS

➤ *Conclusion*

This study successfully established a comprehensive national synthesis of public transportation fares in Indonesia by integrating empirical datasets from 20 high-quality studies through a Systematic Literature Review (SLR) and quantitative meta-synthesis approach. The primary conclusions derived from this research are as follows:

- An overarching macro-structural pattern was successfully modeled within the national public transit ecosystem, formulated hierarchically as: $VOC < ATP > WTP < \text{Actual Fare}$. The synthesized national averages were determined to be IDR 11,353/km for Vehicle Operating Costs (VOC), IDR 14,680 per passenger for Ability to Pay (ATP), IDR 13,370 per passenger for Willingness to Pay (WTP), and IDR 22,686 per passenger for the Actual Fare.
- A severe systemic gap exists on the demand side, where passengers' objective financial capacity (ATP) is theoretically higher than their subjective willingness to pay (WTP). This discrepancy indicates that while the public possesses the baseline purchasing power to afford transit, they do not perceive the services as offering equivalent value for money.
- Significant modal heterogeneity was observed between mass transit and microtransit. The bus transit mode demonstrates operational cost efficiency due to economies of scale (VOC: IDR 8,357/km), but imposes a disproportionate financial burden on users as actual fares sit far above their financial capacity ($ATP < \text{Actual Fare}$). Conversely, the microtransit mode (angkot) exhibits an elevated operational cost profile (VOC: IDR 17,343/km) driven by low vehicle capacities and urban congestion, yet its users demonstrate high mobility urgency, expressing a willingness to pay that exceeds their theoretical budget capacity ($ATP < WTP$).
- The structural reality where the national actual fare (IDR 22,686) vastly outstrips all other thresholds—nearly doubling the actual operating costs—signifies a critical market failure. This unsustainable pricing mechanism drives a continuous ridership decline, prompting a shift toward private vehicles and threatening the socio-economic sustainability of public transit operators across Indonesia.

➤ *Recommendations*

Based on the synthesis and structural insights gained from this study, the following evidence-based policy interventions and academic directions are recommended:

- *For Regulators and Policymakers:*

- ✓ Implement Disparity-Based Targeted Subsidies: The government should move away from flat-rate subsidy models and adopt targeted operational support frameworks, such as expanding the Buy the Service (BTS) scheme. Subsidies must explicitly bridge the identified operational-affordability gap, maintaining operator viability (covering VOC) while capping field fares within the public's objective purchasing power (ATP).
- ✓ Service-Driven Fare Calibration: To naturally elevate the public's suppressed Willingness to Pay (WTP), regulatory focus must center on strict enforcement of Minimum Service Standards (MSS). Upgrading non-fare attributes such as localized air conditioning, strict travel-time reliability, integrated physical infrastructure, and enhanced security—will maximize the perceived value of transit, thereby bridging the WTP-ATP gap.
- ✓ Modal-Specific Regulatory Frameworks: Transport authorities should separate tariff policies for mass transit (buses) and microtransit (angkot). Mass transit policies should focus on lowering passenger out-of-pocket costs to mitigate "transport poverty," whereas microtransit policies should focus on route integration, vehicle modernization, and fleet optimization to lower its high operational cost structure (VOC).

- *For Future Research:*

Future academic efforts should transition toward integrating spatial-econometric mapping and real-time inflationary indicators into the meta-synthesis matrix. Expanding the search parameters to capture post-pandemic structural shifts and the rapid integration of electric transit fleets will ensure that national fare benchmarks remain dynamically aligned with evolving macro-economic realities.

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