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FLIGHT LEVEL DETERMINATION: CRUISE ALTITUDE ON FUEL CONSUMPTION FOR AIRBUS A320CEO

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Abstract

Fuel efficiency is a critical issue in low-cost carrier operations, particularly on the medium-range Jakarta-Ambon route with high strategic value and load factors. This study evaluates the alignment between flight levels (FL) selected by dispatchers and the optimum FL based on aircraft weight, compares actual fuel consumption with Quick Determination (QDT) simulation results, and analyses how aircraft weight influences fuel efficiency. A descriptive qualitative approach was employed using document analysis, direct observation at the Operation Control Center (OCC), and in-depth interviews with three licensed flight dispatchers. Thirty actual Airbus A320 CEO flight plans for PT. Citilink Indonesia on the Jakarta-Ambon route in November 2024 were analyzed. Results indicate that 76.6% of actual FLs did not match the calculated optimum FL, yielding a fuel penalty of 500-1,558 kg per flight, with an average of approximately 900 kg per deviating flight. Implementing the QDT method enables more precise FL planning based on aircraft weight, contributing to measurable gains in operational fuel efficiency.

Keywords: *airbus A320CEO, flight level, fuel consumption, operational efficiency, quick determination*

Introduction

Fuel efficiency is a vital element in the modern aviation industry, not only as a means of reducing operational costs, but also as part of a global strategy to reduce carbon emissions and support environmental sustainability. In an intensely competitive aviation environment, airlines must continuously seek ways to optimize flight operations, especially on medium and long-haul routes where efficiency margins are thin. For low-cost carriers (LCCs) such as PT. Citilink Indonesia, every kilogram of fuel saved directly impacts profitability and sustainability. One of the most critical technical aspects of flight efficiency is determining cruise altitude, or *Flight Level* (FL). A non-optimal FL results in a *fuel penalty*, excess fuel consumption due to a mismatch between atmospheric conditions and aircraft performance (Mukhina & Ilnytska, 2021). It is demonstrated that both cruise speed and FL changes can significantly affect fuel consumption patterns in air traffic flow management (De Lemos & Woodward, 2021). Therefore, selecting the appropriate FL is a strategic factor that profoundly determines flight efficiency (Keçeci et al., 2022).

Aircraft weight, atmospheric conditions, and route characteristics are among the primary factors influencing the selection of optimum cruise altitude (Jafarimoghaddam & Soler, 2023). Recent optimization studies have further demonstrated that the optimal cruise altitude can minimize fuel consumption while improving aircraft operational performance during the climb and cruise phases (Kang & Ryu, 2021). The Jakarta-Ambon route (CGK-AMQ), covering approximately 1,389 Nautical Miles, falls into the medium-range category and traverses oceanic and mountainous airspace. Secondary data from Citilink flight plans indicate an average of 141 passengers and a payload of approximately 13,500 kg per flight, reflecting a consistently high load factor.

This economic significance makes fuel efficiency on this route a priority concern. FL selection is governed by multiple regulatory frameworks. CASR 121.95 requires FL to be determined based on flight direction (odd/even FL rule) and accounts for air traffic, weather, and ATC instructions. ICAO Annex 6, Articles 4.2.1 and 4.3.5, mandates that operators select an FL that complies with altitude rules and is optimal for fuel efficiency. Article 3.6.3 governs the application of the Reduced Vertical Separation Minimum (RVSM), enabling 1,000-foot intervals between FL290 and FL410 and providing greater flexibility for optimal FL selection. In addition, Annex 2 document establishes the standardized flight level allocation system for Instrument Flight Rules operations, ensuring vertical separation and safe aircraft movement while supporting efficient airspace utilization. Compliance with these provisions forms the basis for flight level planning in commercial airline operations.

However, achieving the optimum flight level is not always possible because Operational and airspace constraints frequently prevent aircraft from maintaining fuel-optimal trajectories, resulting in increased fuel consumption, and reduced operational efficiency (Huang & Cheng, 2022). In practice, FL selection is often based on dispatcher experience and standard operational procedures, without systematically referencing the theoretically optimum FL derived from aircraft weight and atmospheric variables (Chukundah et al., 2025). The FCOM Quick Determination (QDT) method offers a precise, weight-based approach for estimating fuel requirements at different FLs.

Recent studies have shown that trajectory and cruise altitude optimization can significantly improve fuel efficiency and operational performance by reducing unnecessary fuel burn during flight operations (Huang & Cheng, 2022). Accurate fuel estimation is increasingly recognized as a key component of sustainable airline operations because it enables operators to minimize unnecessary fuel loading, reduce operational costs, and lower carbon emissions while maintaining required safety margins (Li et al., 2021). This study therefore aims to: (1)

evaluate whether dispatcher-selected FLs correspond to the weight-based optimum FL derived from FCOM data; and (2) quantify the fuel penalty resulting from FL deviations across 30 actual November 2024 flight plans on the CGK-AMQ route. Previous studies using Airbus A320 operational data have shown that aircraft weight characteristics and flight-planning parameters significantly influence trip fuel requirements, underscoring the importance of accurate fuel planning for improving operational efficiency (Ashar, 2024).

Methods

This study employed a descriptive qualitative approach to analyze the relationship between FL selection and fuel consumption on the CGK-AMQ route operated by PT. Citilink Indonesia using Airbus A320CEO aircraft. According to Sugiyono (2022), qualitative descriptive research enables a comprehensive explanation of the operational context, including the dynamics of FL selection and the influence of variables such as Dry Operating Weight (DOW) and payload. Data were collected through three complementary techniques. First, *document analysis* of 30 actual flight plans (Dispatch Release, flight CTV-210) from the period 1-30 November 2024, supplemented by the FCOM A320 2019, CASR regulations, and PT. Citilink OM-A 2022. Second, *direct observation* at the OCC and Flight Operations (FLOPS) of PT. Citilink Indonesia during the OJT period in November 2024. Third, *semi-structured in-depth interviews* with three licensed Flight Operation Officers (FOO) who directly handle the CGK-AMQ route.

The population comprises all 30 PT. Citilink Indonesia CGK-AMQ flights during November 2024. All 30 flight plans were included using purposive sampling to ensure comprehensive monthly coverage. The primary variables are FL (independent variable) and fuel consumption operationalized as trip fuel in kilograms (dependent variable). Data analysis followed three sequential stages. First, the optimum FL for each flight was determined from the FCOM Cruise Mach 0.78 ISA +15 Optimum Level Chart, based on each flight's ETOW. Second, trip fuel at the optimum FL was simulated using the QDT method incorporating the following calculations:

$$ISA = 15 + (FL/1000) \times (-2);$$
$$\Delta ISA = OAT - ISA$$
$$\text{Correction Weight} = (\text{Est. Landing Weight} - \text{Ref. Landing Weight}) / 1{,}000 \times \text{Correction Factor}$$
$$\text{Correction ISA} = 0.015 \times \Delta ISA \times \text{Air Distance (NM)}$$
$$\text{Final Trip Fuel} = \text{Table Fuel} + \text{Correction Weight} + \text{Correction ISA}$$

Third, actual trip fuel from flight plans was compared against QDT simulation results. The Outside Air Temperature (OAT) values used in the QDT calculations were obtained from the actual flight plan weather data generated through the operational flight planning system. These OAT values represent the forecast temperature at the planned cruise altitude and were used to calculate ISA deviation (ΔISA) (Kuprikov, 2023), which serves as a correction factor in estimating trip fuel requirements. The difference was recorded as fuel penalty. Interview findings were used to triangulate and contextualize the quantitative results through qualitative content analysis (Sugiyono, 2022).

Results And Discussions

General Overview and Flight Plan Data

Observations were focused on the CGK-AMQ operational route served by PT. Citilink Indonesia using Airbus A320CEO aircraft. The significance of the Jakarta–Ambon route also aligns with the concept of Indonesia ministry of transportation-aviation plan, which defines air routes as designated pathways connecting airports to support national connectivity, economic activity, and regional development. Therefore, improving fuel efficiency on this route contributes not only to airline operational performance but also to broader transportation objectives. This route covers approximately 1,389 NM, traversing two flight information regions: FIR WIII (Jakarta) and FIR WAAA (Makassar), with an average flight time of 3 hours 11 minutes under normal weather conditions. FL selection on this route typically ranges from FL330 to FL350, depending on operational conditions.

FL determination and fuel planning at Citilink are performed by the Flight Dispatcher unit (Control Flight Dispatch/CFD) within the Operation Control Center (OCC). Dispatchers use the NavBlue system, integrated with FCOM data and real-time weather data. Although digital systems are the primary planning tool, the QDT method remains in use for training, validation, and contingency scenarios. Table 1 presents the full dataset of 30 actual flight plans analyzed in this study.

Table 1. Actual Flight Plan Data - CGK-AMQ Route, November 2024

Date	A/C Reg.	FL	ETOW (kg)	Block Fuel (kg)	Trip Fuel (kg)
1 Nov 2024	PK-GQR	330	71,541	14,641	8,731
2 Nov 2024	PK-GLV	330	73,264	14,438	8,985
3 Nov 2024	PK-GLT	330	73,002	13,489	8,990
4 Nov 2024	PK-GQL	330	72,541	13,850	8,734
5 Nov 2024	PK-GQU	350	69,042	15,404	8,479
6 Nov 2024	PK-GLM	330	71,883	16,375	9,475
7 Nov 2024	PK-GLT	330	71,772	17,948	9,217
8 Nov 2024	PK-GLW	330	73,391	15,574	9,402
9 Nov 2024	PK-GQG	330	72,109	13,310	8,956
10 Nov 2024	PK-GQG	330	72,668	14,111	8,984
11 Nov 2024	PK-GLG	330	72,803	17,186	8,771
12 Nov 2024	PK-GTE*	350	72,410	14,478	7,768
13 Nov 2024	PK-GLO	330	72,135	15,187	9,472
14 Nov 2024	PK-GLV	330	71,448	16,554	9,241
15 Nov 2024	PK-GLM	330	70,926	16,680	9,348
16 Nov 2024	PK-GLL	330	71,970	16,772	9,273
17 Nov 2024	PK-GQH	330	72,282	17,957	8,952
18 Nov 2024	PK-GQU	330	72,114	17,943	8,848
19 Nov 2024	PK-GQP	330	72,757	16,133	8,894
20 Nov 2024	PK-GLG	330	70,689	12,725	8,446
21 Nov 2024	PK-GLT	330	69,982	16,704	9,001
22 Nov 2024	PK-GLO	330	72,775	17,311	9,492
23 Nov 2024	PK-GQT	330	73,381	15,281	9,152
24 Nov 2024	PK-GTD*	350	71,480	13,909	7,676
25 Nov 2024	PK-GTE*	350	71,433	14,426	7,677
26 Nov 2024	PK-GLO	350	69,472	17,396	9,141
27 Nov 2024	PK-GQL	350	69,009	16,053	8,795
28 Nov 2024	PK-GQS	350	67,565	15,960	8,786
29 Nov 2024	PK-GQA	330	71,799	18,185	9,247
30 Nov 2024	PK-GQK	330	70,738	15,020	9,101

*Note: * indicates Airbus A320NEO aircraft.*

The data show that 23 out of 30 flights (76.7%) were planned at FL330, while 7 flights (23.3%) were planned at FL350.

ETOW values ranged from 67,565 to 73,391 kg, reflecting the variation in daily payload and aircraft configuration. Actual block fuel ranged from 12,725 to 18,185 kg, and trip fuel from 7,676 to 9,492 kg, indicating substantial day-to-day operational variation.

Optimum FL Determination and QDT Simulation

Optimum FL for each flight was determined by referencing the FCOM Cruise Mach 0.78 ISA +15 Level Chart, which maps ETOW to the corresponding optimum altitude. Based on the ETOW distribution of this study (67,565-73,391 kg), the chart consistently yields an optimum FL of 350 for all 30 flights. This is consistent with the FCOM recommendation and findings, which note that medium-range narrow-body aircraft achieve best aerodynamic efficiency at higher cruise levels when weight permits.

Following the determination of the optimum FL, a QDT simulation was performed for each flight to estimate the trip fuel at FL350. The calculation incorporates ISA correction and weight correction to account for actual atmospheric and weight conditions. Table 2 presents a complete worked example for the 13 November 2024 flight (PK-GLO, ETOW = 72,135 kg), which exhibited the most representative calculation profile.

Table 2. QDT Calculation Example - Flight 13 November 2024 (PK-GLO, FL350)

Parameter	Value
DOW	42,266 kg
Payload	14,305 kg
Zero Fuel Weight (ZFW)	56,571 kg
Holding Fuel (30 min)	1,119 kg
Landing Weight at Alternate	57,690 kg
Alternate Fuel (table value)	2,499 kg
Landing Weight at Destination	60,189 kg
Trip Fuel (table value at FL350)	7,710 kg
Contingency Fuel (5% × Trip)	416 kg
Extra Fuel	2,000 kg
Estimated TOW	70,906 kg
Taxi Fuel (22 min × 11.5 kg)	253 kg
RAMP Weight	71,159 kg
Correction Weight [(60,189−55,000)/1,000 × 65]	338 kg
Correction ISA [0.015 × 12 × 1,402 NM]	253 kg
Final Trip Fuel [7,710 + 338 + 253]	**8,301 kg**
Final Block Fuel	**13,469 kg**

The QDT procedure begins by establishing the ZFW from DOW and payload, then sequentially adds holding fuel, alternate fuel, trip fuel (from FCOM table), contingency fuel, and extra fuel to derive ETOW, and finally adds taxi fuel for the RAMP weight. Corrections for ISA deviation (ΔISA = 12°C) and weight deviation from the reference landing weight produce a final trip fuel estimate of 8,301 kg, significantly lower than the 9,472 kg recorded in the actual flight plan at FL330, yielding a fuel penalty of 1,171 kg. This calculation methodology was applied uniformly across all 30 flights, using route-specific parameters: air distance of 1,346-1,402 NM (varying by filed routing), ISA deviations based on recorded OAT values, and aircraft-specific DOW data from the Citilink 2023 Weight & Balance Manual.

Flight Level Deviation and Fuel Penalty Analysis

Table 3 presents a complete comparison of actual FL and optimum FL for all 30 flights, including the computed fuel penalty for each observation.

Table 3. FL Deviation and Fuel Penalty - All 30 Flights (Bold = Penalty > 1,000 kg)

Date	ETOW (kg)	Act. FL	Opt. FL	Act. Trip Fuel (kg)	QDT Trip Fuel (kg)	Penalty (kg)
1 Nov 2024	71,541	330	350	8,731	7,985	746
2 Nov 2024	73,264	330	350	8,985	8,066	919
3 Nov 2024	73,002	330	350	8,990	8,106	884
4 Nov 2024	72,541	330	350	8,734	8,120	614
5 Nov 2024	69,042	350	350	8,479	8,479	0

6 Nov 2024	71,883	330	350	**9,475**	**8,139**	**1,336**
7 Nov 2024	71,772	330	350	**9,217**	**7,976**	**1,241**
8 Nov 2024	73,391	330	350	**9,402**	**8,291**	**1,111**
9 Nov 2024	72,109	330	350	8,956	8,408	548
10 Nov 2024	72,668	330	350	8,984	8,373	611
11 Nov 2024	72,803	330	350	8,771	8,265	506
12 Nov 2024	72,410	350	350	7,768	7,768	0
13 Nov 2024	72,135	330	350	**9,472**	**8,301**	**1,171**
14 Nov 2024	71,448	330	350	**9,241**	**8,122**	**1,119**
15 Nov 2024	70,926	330	350	**9,348**	**8,028**	**1,320**
16 Nov 2024	71,970	330	350	**9,273**	**8,097**	**1,176**
17 Nov 2024	72,282	330	350	8,952	7,979	973
18 Nov 2024	72,114	330	350	8,848	7,942	906
19 Nov 2024	72,757	330	350	8,894	8,078	816
20 Nov 2024	70,689	330	350	8,446	8,120	326
21 Nov 2024	69,982	330	350	**9,001**	**7,928**	**1,073**
22 Nov 2024	72,775	330	350	**9,492**	**7,934**	**1,558**
23 Nov 2024	73,381	330	350	9,152	8,340	812
24 Nov 2024	71,480	350	350	7,676	7,676	0
25 Nov 2024	71,433	350	350	7,677	7,677	0
26 Nov 2024	69,472	350	350	9,141	9,141	0
27 Nov 2024	69,009	350	350	8,795	8,795	0
28 Nov 2024	67,565	350	350	8,786	8,786	0
29 Nov 2024	71,799	330	350	9,247	8,352	895
30 Nov 2024	70,738	330	350	9,101	8,389	712

*Note: * A320NEO aircraft (excluded from QDT penalty analysis). Penalty = Actual Trip Fuel − QDT Trip Fuel.*

The results reveal a clear and consistent pattern. Of the 30 flights, 23 (76.6%) operated at an FL lower than the FCOM-recommended optimum, all using FL330 when FL350 was indicated. Not a single flight operated above its optimum FL. The remaining 7 flights (23.3%) coincidentally or intentionally operated at the exact optimum FL350. Among the 23 deviating flights, fuel penalty ranged from 326 kg (20 November) to 1,558 kg (22 November), with a mean penalty of approximately 900 kg per flight. The highest penalties -- all exceeding 1,000 kg, occurred on 6, 7, 8, 13, 14, 15, and 16 November (bolded in Table 3).

These flights share a common characteristic: ETOW above 71,000 kg combined with FL330 selection. This confirms the theoretical expectation that the penalty is most severe when the gap between actual and optimum performance conditions is greatest. Higher cruise altitudes generally yield lower aerodynamic efficiency, which is important for fuel optimization, as each aircraft has a specific Mach number and Flight Level combination that minimizes fuel burn during cruise operations (Poll & Schumann, 2021). The relationship between ETOW and fuel penalty observed here is also consistent with recent aviation fuel prediction studies, which identified aircraft weight as one of the dominant variables influencing fuel consumption during cruise operations (Lin et al., 2024), who demonstrated that aircraft weight strongly influences fuel consumption during both climb and cruise phases.

Aircraft weight remains one of the most influential parameters affecting fuel consumption because fuel efficiency is strongly related to aircraft mass, payload characteristics, and operational loading conditions. Therefore, variations in ETOW can substantially influence fuel requirements even when aircraft type and route distance remain unchanged (Kühn & Scholz, 2023). Recent studies have further emphasized that unnecessary aircraft weight directly increases fuel consumption and operational costs. Accurate weight management, including optimizing take-off and zero-fuel weights, has been identified as one of the most practical strategies for improving fuel efficiency and reducing emissions in commercial aviation operations (Inan et al., 2025).

This finding is also supported by recent fuel prediction research demonstrating that aircraft fuel consumption is determined by the interaction of multiple operational variables, including aircraft weight, flight profile, and environmental conditions, all of which contribute to variations in fuel burn during flight operations (Sertdemir et al., 2025). These environmental benefits are supported by studies demonstrating that additional flight operation time directly increases fuel consumption. Therefore, operational optimization that reduces unnecessary fuel burn contributes not only to cost savings but also to lower environmental impacts (Dhimas et al., 2024). Conversely, flights 5, 12, 24, 25, 26, 27, and 28 November recorded zero fuel penalty, confirming that QDT-based optimum FL selection can effectively eliminate excess fuel consumption under appropriate weight conditions. Notably, the three A320NEO-operated flights (12, 24, 25 November) also used FL350 and showed negligible difference, suggesting that the CEO fuel penalty disadvantage is primarily driven by FL choice rather than engine type alone.

Operational Insights from Flight Dispatcher Interviews

To contextualize the quantitative findings, semi-structured interviews were conducted with three FOOs (Flight Dispatchers) who actively manage the CGK-AMQ route. Table 4 summarizes the key themes and findings.

Table 4. Summary of Flight Dispatcher Interview Findings

Topic / Question	Key Findings from Informants
Flight plan preparation procedure for CGK-AMQ route	All three informants confirmed that flight plans follow SOP Flight Dispatch, referencing Jeppesen Charts, FCOM fuel calculations, and official DOW data. The process includes weather briefing, NOTAM review, ETP calculation, payload and cargo analysis (e.g., lithium batteries, live animals).
Primary authority in FL determination	Navigation team (JKT OF) determines the optimum FL using FCOM performance tables and inputs it to NavBlue. The CFD/Dispatcher validates and adjusts up to 1 hour before departure based on actual conditions.
Frequency of FL changes from initial plan	Changes occur when PIC has specific preferences, weather imposes restrictions (icing, turbulence), or technical MEL limitations apply (e.g., IDG failure limiting maximum FL). Tolerance is typically ±2 FL levels from the planned FL.
Most dominant factors in FL selection	All informants ranked: (1) aircraft weight/ETOW, (2) weather at altitude, (3) ATC constraints and slot availability, (4) MEL/technical aircraft status. Fuel efficiency is considered but remains secondary to safety.
Effect of ETOW on FL selection	High ETOW limits achievable FL. An overloaded aircraft cannot efficiently climb to FL370; FL330-FL350 is preferred. All informants confirmed that FCOM performance tables are used as reference for this calculation.
Safety vs. efficiency trade-off	Consensus: safety is the absolute priority. FL optimum may be abandoned if turbulence, icing, or high traffic exists at that altitude. However, in normal conditions, dispatchers always seek the lowest possible fuel burn within safe margins.
Impact of FL difference on fuel consumption	Estimated difference between FL330 and FL350: 200-1,000 kg depending on wind and weight. Higher FL reduces drag, lowering fuel burn -- but only when aircraft weight permits it. Forcing a very high FL with high ETOW can increase fuel burn due to engine overload.

The interviews provide important operational context for interpreting the FL deviation pattern identified in Table 3. All three informants confirmed that ETOW and DOW are formally incorporated into FL planning, but they are not the sole determinants. Weather at cruising altitude (turbulence, icing), ATC slot congestion, aircraft MEL/technical limitations, and PIC preference frequently override the weight-based optimum. One informant explicitly noted: "We can choose an FL that is slightly less efficient if the optimum FL has turbulence. Safety is always the primary priority, not just fuel saving”.

This explains why 76.6% of flights operated below the theoretical optimum: the observed deviations represent deliberate operational adaptations rather than planning errors. Recent operational optimization studies similarly report that aircraft frequently deviate from theoretically optimal flight profiles because of airspace constraints, traffic management requirements, and operational safety considerations, despite the resulting reduction in fuel efficiency (Zhu & Li, 2021). Previous studies have demonstrated that flight altitude selection involves a trade-off between fuel consumption, flight time, and environmental impacts.

Consequently, operational decisions may intentionally deviate from fuel-optimal altitudes to satisfy broader operational or environmental objectives (Xue et al., 2020). The standard Citilink operational template for the eastbound CGK-AMQ route defaults to FL330, with FL350 or FL370 assigned when conditions and ETOW specifically permit. This operational conservatism is consistent with findings by (Mukhina & Ilnytska, 2021), who noted that practical FL decisions involve complex trade-offs between efficiency, safety margins, and ATM constraints that theoretical optimization models do not fully capture.

The informants also confirmed that fuel penalty from FL330 vs. FL350 is recognized operationally, estimated at 200-1,000 kg depending on conditions, but is considered an acceptable cost when safety or operational constraints dictate the lower FL, even though this study's QDT-derived figures show penalties of up to 1,558 kg — notably higher than the operational estimate. Recent studies have demonstrated that aircraft weight and balance parameters, including payload distribution and center of gravity position, significantly influence fuel consumption and operational efficiency. Higher aircraft weight generally requires greater engine thrust, resulting in increased fuel burn during flight operations (Sertdemir et al., 2025) . Further research demonstrated that payload variation, a key driver of ETOW in this study, significantly amplifies per-flight fuel consumption, making accurate FL selection even more critical when payloads are consistently high, as on the CGK-AMQ route (Setiawan et al., 2025). The QDT method proved accurate and consistent as a simulation tool. Its reliance on FCOM tables with weight and ISA corrections renders it traceable, transparent, and executable without specialized software. This study reinforces the case for integrating QDT validation into the standard dispatch workflow, particularly as a pre-dispatch check of automated system outputs for routes with consistent ETOW profiles, such as CGK-AMQ.

From an operational standpoint, the interviews indicate that the primary barrier to implementing the optimum FL is not dispatcher knowledge or system capability, but rather the conservative operational defaults embedded in the NavBlue template, and the precedence given to safety over efficiency when any uncertainty exists (Novita et al., 2025). Addressing this gap does not require abandoning conservative safety margins; rather, it calls for a structured decision support mechanism that clearly signals when the safety-efficiency trade-off can be resolved in favor of the higher FL without compromising operational safety. A weight-based FL alert within the NavBlue interface -- flagging when an aircraft weight falls within the FL350 optimum range -- could serve this purpose with minimal operational disruption. Comparison with prior studies further contextualizes these findings. Lazic et al. (2023) examined FL effects on sustainable aviation fuel efficiency, finding that optimal FL varies with aircraft weight—consistent with this study's uniform FL350 recommendation for the observed ETOW range. This finding is consistent with recent studies identifying aircraft weight variables, including take-off weight and zero-fuel weight, as major determinants of fuel consumption during flight operations (Hassan et al., 2021).

Conclusion

This study analyzed FL selection against FCOM-derived optimum FL across 30 Airbus A320CEO flights operated by PT. Citilink Indonesia on the Jakarta-Ambon route during November 2024. The main conclusions are: (1) 76.6% of flights (23/30) operated below the FCOM-recommended optimum FL, universally at FL330 instead of FL350, resulting in fuel penalties ranging from 326 to 1,558 kg per flight, with a mean of approximately 900 kg; (2) the seven flights operating at the optimum FL350 showed negligible difference between actual and QDT-simulated fuel, confirming the method accuracy; (3) dispatcher interviews reveal that the deviations reflect structured operational adaptations -- safety margins, weather constraints, ATC limitations, and MEL restrictions -- rather than planning errors; (4) systematic adoption of QDT-based FL verification as a pre-dispatch standard could eliminate a substantial portion of avoidable fuel consumption, estimated at approximately 20,700 kg per month on this single route. Beyond operational cost savings, improving fuel efficiency remains a strategic priority for the aviation industry because fuel represents a substantial proportion of airline operating expenses while environmental regulations increasingly require reductions in aviation emissions. Therefore, optimization of flight level selection contributes not only to economic performance but also to broader sustainability objectives within commercial aviation (Farida et al., 2025). Future research should integrate dynamic meteorological variables (wind profile, ISA deviation trends), real-time ATC constraint data, and multi-route comparative analyses to generalize findings across Indonesia's domestic network. Development of a weight-triggered FL advisory module within existing NavBlue dispatch workflows is recommended as a practical implementation pathway.

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