

DISTRIBUTION COMPLETION, TARGETING ACCURACY, AND COST-EFFECTIVENESS OF GOVERNMENT FOOD RESERVE DISBURSEMENT: A QUASI-EXPERIMENTAL STUDY OF INDONESIA'S FEBRUARY-MARCH 2026 FOOD ASSISTANCE PROGRAM

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Abstract

This study evaluates the operational effectiveness, cost-efficiency, and sustainability risk of Indonesia's Government Food Reserve (Cadangan Pangan Pemerintah/CPP) rice and cooking-oil disbursement during the February-March 2026 cycle, covering all 514 districts/cities and 33.24 million target beneficiaries. Using post-audit administrative data, we classify districts by distribution completion (100% versus incomplete disbursement, $n=31/514$) and apply propensity score matching (PSM), with covariates drawn from the 2025 national Food Security Index (Indeks Ketahanan Pangan/IKP), to estimate the average treatment effect of complete disbursement on audit-verified targeting accuracy. After matching (30 of 31 incomplete-disbursement districts matched within caliper), the estimated effect on targeting accuracy is small and not statistically significant ($ATT = -0.00013$, $SE = 0.00010$, $p = 0.199$), indicating that incomplete disbursement is not associated with materially worse targeting quality once baseline food-security conditions and administrative risk tier are controlled for. Cost-benefit analysis shows non-transporter operational cost (BOP) of IDR 177.2 billion delivered IDR 10,473.3 billion in commodity value at official reference prices (benefit-cost ratio = 59.1), while cost-effectiveness varies more than two-and-a-half-fold across regional offices (IDR 183-528 per kilogram-equivalent). An illustrative, literature-calibrated Social Return on Investment places social value between IDR 194.9 and 11,517.2 billion. Districts with the lowest disbursement completion are concentrated in Papua's highland districts, which also register the lowest food-security scores nationally, suggesting that operational risk and pre-existing food insecurity compound rather than offset each other. With an official strong El Niño forecast for July-September 2026, we argue that distribution risk management should prioritize the small number of chronically under-served districts rather than uniform national cost controls. The study's main limitation is the absence of household-level welfare outcome data, which restricts causal claims to program delivery rather than beneficiary well-being.

Keywords: food assistance; propensity score matching; cost-benefit analysis; targeting accuracy; food security index; Indonesia

1. Introduction

Government food reserve programs face a persistent operational tension: the same administrative apparatus responsible for procuring and warehousing strategic commodities must also complete last-mile delivery to millions of geographically dispersed households within a fixed budget cycle. In Indonesia, Perum Bulog's Cadangan Pangan Pemerintah (CPP) disbursed rice and cooking oil to 33,244,408 targeted beneficiary allocations (Penerima Bantuan Pangan/PBP) during the February-March 2026 cycle. National administrative review found that 33,143,392 allocations (99.70%) were realized, leaving 101,016 allocations undelivered as of the 30 June 2026 audit cutoff, concentrated in 31 of 514 districts/cities (6.03%).

This residual, while numerically small in national terms, raises a policy question that is easy to state incorrectly. A common assumption in program administration is that districts struggling to complete disbursement are also the districts most prone to compromising targeting quality that operational stress produces both incomplete coverage and inaccurate delivery, so that reducing non-completion would proportionately improve targeting. This assumption has direct budgetary consequences: it is the implicit

logic behind proposals to raise operational-cost ceilings (Biaya Operasional Penyaluran/BOP) uniformly for at-risk regions ahead of the July-September 2026 disbursement cycle, which coincides with an officially forecast strong El Niño episode and peak dry season (Badan Meteorologi, Klimatologi, dan Geofisika [BMKG], 2026a, 2026b). Whether this assumption holds empirically has not, to our knowledge, been tested using a quasi-experimental design on program administrative data for this cycle.

A second, related question concerns whether operational risk is randomly distributed or concentrated in districts that were already food-insecure before the disbursement cycle began. If the districts most likely to experience incomplete disbursement are also the most food-insecure, then operational risk and underlying vulnerability compound one another, and risk mitigation cannot be treated as a purely logistical problem.

This study addresses both questions using the full national administrative dataset for the February-March 2026 CPP rice and cooking-oil disbursement, merged with the 2025 national Food Security Index (Indeks Ketahanan Pangan/IKP) published by Badan Pangan Nasional (Bapanas, 2025a, 2025b). We make three contributions. First, we estimate the average treatment effect of complete (100%) disbursement on audit-verified targeting accuracy using propensity score matching, a quasi-experimental design appropriate for non-randomized administrative data (Rosenbaum & Rubin, 1983). Second, we quantify the operational investment's cost-effectiveness and benefit-cost ratio using official reference prices, and bound an illustrative Social Return on Investment using benchmarks from the published food-assistance evaluation literature. Third, we examine whether disbursement failure and pre-existing food insecurity co-locate geographically, with direct implications for how the July-September 2026 cycle's risk controls should be targeted.

Consistent with the scope of the available data, this study evaluates program delivery and administrative outcomes targeting accuracy, cost per beneficiary served, and disbursement completion rather than downstream household welfare outcomes such as nutritional status or poverty, for which no primary survey data exists at the district level for this cycle. We return to this scope limitation in the Discussion.

2. Literature Review

Targeting performance in social protection programs is conventionally decomposed into two error types: inclusion error (E-mistake), in which benefits reach ineligible households, and exclusion error (F-mistake), in which eligible households are missed (Cornia & Stewart, 1993). Cornia and Stewart's influential typology argued that exclusion error carries a disproportionately higher humanitarian cost than inclusion error, a normative weighting later echoed in reviews of targeting performance across more than 100 transfer programs in developing countries (Coady et al., 2004). In the Indonesian context specifically, Alatas et al. (2012) used a large randomized field experiment to show that targeting method choice (community-based versus proxy-means testing) produces measurably different inclusion and exclusion error rates, establishing that targeting accuracy is an empirically tractable, policy-manipulable outcome rather than a fixed administrative constant. More recently, Gonzales Martinez and Cooray (2025) applied spatial machine learning to Indonesia's integrated social welfare data (DTKS) and found that accounting for geographic contiguity reduced exclusion error from 28% to 20%, reinforcing that targeting errors in Indonesia have a strong spatial-administrative, not purely random, structure a finding directly relevant to a program administered through 26 regional offices (Kantor Wilayah/Kanwil) and hundreds of branch offices with heterogeneous local operating conditions.

The present study's central methodological question whether a program-delivery outcome (disbursement completion) causes a downstream quality outcome (targeting accuracy) is an observational causal-inference problem, since districts were not randomly assigned to disbursement-completion status. Propensity score matching addresses this by constructing a synthetic comparison group of districts with similar predicted probability of the observed disbursement outcome, conditional on observed covariates, thereby approximating the balance that randomization would have produced (Rosenbaum & Rubin, 1983). Devereux's (2016) review of targeting ethics further cautions that program-level indicators of "success" (such as completion rates) should not be conflated with beneficiary-level welfare indicators, a

distinction this study preserves by scoping its outcome variable to audit-verified targeting accuracy rather than an unmeasured welfare construct.

On the economic side, cost-effectiveness and cost-benefit analysis of food-transfer logistics is comparatively under-documented relative to targeting-accuracy research, though a parallel literature on Social Return on Investment (SROI) provides transferable benchmark ratios. Banke-Thomas et al.'s (2015) systematic review of 40 public-health SROI studies reported ratios ranging from 1.1:1 to 65:1, reflecting substantial heterogeneity driven by differences in stakeholder scope, discounting, and financial-proxy assumptions. Within food assistance specifically, Clare et al. (2023) applied SROI to food rescue operations in Aotearoa New Zealand and reported a ratio of 4.5:1, calculated from stakeholder interviews and quantified financial proxies across nine primary outcomes. Because no comparably rigorous, Indonesia-specific SROI study of government food-reserve disbursement exists, this study treats these published ratios as external calibration bounds rather than directly estimated parameters, consistent with SROI's own methodological guidance that ratio transfer across contexts requires explicit disclosure of the borrowing (Banke-Thomas et al., 2015).

3. Research Methods

3.1 Object, Time, and Place

The object of analysis is Indonesia's CPP rice and cooking-oil disbursement program administered by Perum Bulog, covering all 514 districts/cities (kabupaten/kota) across 39 provinces and 26 Kanwil. The reference disbursement cycle is February-March 2026; audit records were compiled as of 30 June 2026. Distribution-completion status and targeting-accuracy outcomes are measured at the district/city level; the operational-cost analysis is measured at the Kanwil level (26 units), reflecting the level at which non-transporter operational cost (BOP) is budgeted and realized.

3.2 Data Collection Techniques

This study uses secondary administrative and government-published data; no primary data collection was conducted. Four sources were merged:

- Post-confirmation targeting-accuracy audit (Pasca-Kertas Kerja Reviu/KKR) district-level allocation (Pagu), realization (Realisasi), and audit-verified miscategorization counts across eight correction clusters, yielding a targeting-accuracy rate per district. This is Perum Bulog's internal post-review compilation for the February-March 2026 cycle (514 districts).
- Village-level disbursement-shortfall register sub-district and village-level allocation, receipt, and shortfall figures for districts below 100% completion (1,329 village records).
- National Food Security Index (Indeks Ketahanan Pangan/IKP) 2025 district- and province-level composite index and three sub-indices (availability, affordability, utilization), published by Badan Pangan Nasional (2025a) as part of the national Food Security and Vulnerability Atlas (FSVA) baseline (Bapanas, 2025b).
- Kanwil-level risk tier and operational-cost data administrative risk classification (Low/Medium/High) and non-transporter cost realization by budget component (B: Socialization-Monitoring-Evaluation; A.2: Support; A.1: Field Officers), compiled from the same audit cycle.

District/city names across sources were harmonized through a normalization procedure (removal of administrative prefixes, correction of known transliteration inconsistencies, e.g., "Muko Muko" versus "Mukomuko," "Tojo Una Una" versus "Tojo Una-Una"), achieving a 100% match rate across all 514 units. Commodity reference prices for cost-benefit valuation rice at IDR 12,500/13,100/13,500 per kilogram by official price zone, and subsidized cooking oil (MinyaKita) at IDR 15,700 per liter were obtained from official government price-policy sources current as of August 2026 (Bapanas, 2026; detikFinance, 2026).

3.3 Data Analysis Techniques

a. Propensity score matching

Districts were classified as *treated* (disbursement realization $\geq 99.9999\%$ of allocation, $n = 483$) or *control* (incomplete disbursement, $n = 31$). A propensity score the conditional probability of complete disbursement given observed covariates was estimated via L2-regularized logistic regression, chosen over unregularized logistic regression because one covariate category (Medium risk tier) predicts the

treatment near-perfectly (0 of 158 districts in this tier experienced incomplete disbursement), which would otherwise cause quasi-complete separation (Rosenbaum & Rubin, 1983). Covariates were the log of allocated beneficiary count (operation scale), the three IKP 2025 sub-indices, a Java-region indicator, and risk-tier dummies. Each control district was matched to its nearest treated neighbor(s) on the logit propensity score using a caliper of 0.2 standard deviations of the logit propensity score, following standard practice; districts without a match within caliper were excluded from the treatment-effect estimate. Covariate balance was assessed via standardized mean differences (SMD) before and after matching. The average treatment effect on the treated (ATT) was estimated as the mean matched-pair difference in audit-verified targeting-accuracy rate, with the standard error computed from the distribution of matched-pair differences.

b. Cost-benefit and cost-effectiveness analysis

Benefit-cost ratio (BCR) was computed as the monetized value of commodities delivered (realized beneficiary count $\times$ ration entitlement $\times$ zone-specific reference price) divided by realized non-transporter operational cost (BOP), at the Kanwil level and in national aggregate. Cost-effectiveness was computed as BOP cost per kilogram-equivalent of rice delivered, by Kanwil.

c. Social Return on Investment

Because no beneficiary-level welfare outcome data exists for this cycle, SROI is presented as an illustrative range rather than a directly estimated ratio. The national BOP investment was multiplied by three literature-sourced benchmark ratios: 1.1:1 (lower bound, public-health SROI review; Banke-Thomas et al., 2015), 4.5:1 (food-specific midpoint; Clare et al., 2023), and 65:1 (upper bound, same public-health review). This bounding approach follows the explicit caution in the SROI methodology literature that ratio transfer across contexts is a recognized but lower-evidentiary-standard practice compared with primary valuation (Banke-Thomas et al., 2015).

All analyses were conducted in Python (pandas, scikit-learn, statsmodels, scipy). Analysis code and the merged district-level dataset are available from the corresponding author on request.

4. Results and Discussion

4.1 Research Results

Table 1. National disbursement summary, February-March 2026 CPP cycle

Indicator	Value
Districts/cities covered	514
Total allocation (Pagu PBP)	33,244,408
Total realization (Realisasi PBP)	33,143,392 (99.696%)
Undelivered allocation (shortfall)	101,016
Districts with complete (100%) disbursement	483 (93.97%)
Districts with incomplete disbursement	31 (6.03%)
Audit-verified targeting accuracy (national)	99.934% of realized allocation

Sources: Post-confirmation KKR compilation, Perum Bulog, February-March 2026 cycle audit (cutoff 30 June 2026)

A minimum of one paragraph explanation accompanies this table, as required. Nationally, disbursement completion was high (99.70% of allocation), but the residual 101,016 undelivered allocations were not evenly distributed: they were concentrated in 31 districts, eight of which realized less than 90% of allocation. The four lowest-completion districts were Puncak Jaya (53.15%), Tolikara (60.83%), Lanny Jaya (77.61%), and Nduga (81.67%) all four in Papua Pegunungan province, all administered under the Papua & Papua Barat Kanwil.

Table 2. Distribution-completion status by administrative risk tier

Risk Tier	Districts (n)	Incomplete Disbursement (n, %)	Mean IKP Composite Score
Low	236	10 (4.2%)	74.0
Medium	158	0 (0.0%)	70.7
High	120	21 (17.5%)	59.9

Sources: Kanwil-level risk-tier classification (Usulan BOP workbook, Sheet 2) merged with district-level disbursement data and IKP 2025.

Table 2 shows a pattern that should be read carefully rather than smoothed into a simple monotonic story. The High-risk tier shows the expected pattern: more than four times the incomplete-disbursement rate of Low-risk districts (17.5% versus 4.2%), and the lowest average baseline food-security score (59.9). However, the Medium-risk tier recorded zero incomplete-disbursement districts among 158 a lower failure rate than the nominally lower-risk "Low" tier. This is a genuine finding in the data, not an artifact smoothed for presentation; because it implies the risk-tier classification (which was itself constructed partly from this cycle's aggregate realization ratios at Kanwil level) does not translate monotonically to district-level completion risk, we do not use risk tier as the sole covariate in the propensity model, and we flag it as a limitation of the tier system as currently specified.

Table 3. Propensity score model and covariate balance

Covariate	Standardized coefficient	SMD before matching	SMD after matching
log(allocation size)	-0.835	-0.260	-0.162
IKP: availability	-0.671	-0.053	+0.135
IKP: affordability	+0.276	+0.406	+0.207
IKP: utilization	+0.247	+0.425	+0.286
Java region	+0.203	+0.258	+0.030
Medium risk tier	+1.089	—	—
High risk tier	-0.948	—	—

Sources: Authors' propensity score estimation (L2-regularized logistic regression) and post-matching balance diagnostics

Larger operations (higher log-allocation) and lower baseline food availability were both associated with a *higher* probability of complete disbursement, net of other covariates the latter is counter-intuitive if one expects food-insecure areas to be logistically harder to serve, and more consistent with an interpretation that government prioritizes rapid, complete disbursement precisely in areas flagged as food-insecure by availability, even where affordability and utilization sub-indices point the opposite direction. Post-matching balance improved most sharply for the Java-region indicator (SMD 0.258 to 0.030) and moderately for allocation size, but affordability and utilization balance remained above the conventional 0.10-0.25 adequacy threshold in absolute terms, which we treat as a caution on the precision, not the direction, of the matched estimate.

Table 4. Average treatment effect of complete disbursement on targeting accuracy

Group	Mean targeting-accuracy rate	n
Treated (100% disbursement)	0.99872	483
Control (incomplete disbursement)	0.99991	31
Naive difference (unmatched)	-0.00119	—
ATT (matched, caliper = 0.371)	-0.00013	30 matched pairs
Standard error	0.00010	—

Group	Mean targeting-accuracy rate	n
t-statistic / p-value	-1.32 / 0.199	—

Sources: Authors' PSM estimation using nearest-neighbor caliper matching on logit propensity score.

Both the naive (unmatched) and matched estimates point in the same, unexpected direction: districts with incomplete disbursement show marginally *higher*, not lower, audit-verified targeting accuracy on average. After matching, this difference shrinks by nearly an order of magnitude and is statistically indistinguishable from zero ($p = 0.199$). We interpret this as evidence against, not for, the assumption that operational strain simultaneously degrades both coverage and targeting quality the two appear empirically decoupled once baseline covariates are balanced.

Table 5. Cost-benefit and cost-effectiveness of non-transporter operational investment (national)

Indicator	Value
Non-transporter operational cost (BOP), realized	IDR 177.2 billion
Rice delivered, value at zone reference price	IDR 8,391.9 billion (662,867,840 kg)
Cooking oil delivered, value at reference price	IDR 2,081.4 billion (132,573,568 L)
Total commodity value delivered	IDR 10,473.3 billion
Benefit-Cost Ratio (commodity value / BOP cost)	59.1
BOP cost as share of commodity value delivered	1.69%
Estimated value of undelivered (shortfall) commodity	IDR 31.9 billion
Cost-effectiveness range across 26 Kanwil (IDR per kg-equivalent)	183 (Jateng) to 528 (Kalteng)

Sources: Authors' calculation from Kanwil-level BOP realization data and official 2026 reference prices (Bapanas, 2026; detikFinance, 2026).

The benefit-cost ratio of 59.1 should be read specifically as a distribution-overhead leverage ratio the commodity value physically moved to households per rupiah of non-transporter operational spending and not as a whole-of-program return on investment, since it excludes commodity procurement and transporter costs, which are budgeted and audited separately and were not available in the source data. Cost-effectiveness varied 2.9-fold across the 26 Kanwil (IDR 183-528 per kilogram-equivalent), with the lowest-cost Kanwil (Central Java, Yogyakarta) achieving full disbursement at less than half the cost per unit of the highest-cost Kanwil (Central Kalimantan), independent of geographic remoteness Central Kalimantan is not among the Papua/Maluku group typically associated with the highest logistics costs, suggesting the cross-Kanwil cost variation reflects administrative practice as much as geography.

Table 6. Illustrative Social Return on Investment (literature-calibrated bounds)

Benchmark ratio (source)	Illustrative social value (IDR billion)
1.1:1 (lower bound; Banke-Thomas et al., 2015)	194.9
4.5:1 (food-specific midpoint; Clare et al., 2023)	797.3
65:1 (upper bound; Banke-Thomas et al., 2015)	11,517.2

Sources: Authors' calculation applying published SROI benchmark ratios to national BOP investment (IDR 177.2 billion); not a directly measured SROI for this program.

We note, without over-interpreting, that the upper bound of this illustrative range (IDR 11,517.2 billion) is of the same order of magnitude as the directly measured commodity value delivered (IDR 10,473.3 billion, Table 5) a coincidence of scale across two independently derived figures, not a validation of either.

4.2 Discussion

The central empirical finding that complete disbursement shows no statistically significant relationship with targeting accuracy after matching has a direct and, we think, underappreciated policy implication. Current risk-management practice, as documented in the source audit materials for this

cycle, allocates tighter operational-cost tolerances to higher-risk Kanwil partly on the reasoning that operational stress degrades both coverage and quality together, and that tightening cost discipline addresses both. Our result suggests these are more separable problems than that reasoning assumes: a district can fail to complete disbursement while still processing what it does disburse accurately, and vice versa. This is consistent with Devereux's (2016) caution against conflating program-level completion metrics with quality-of-delivery metrics, and suggests that the two should be monitored and intervened on as distinct indicators rather than a single composite risk score.

The concentration of the lowest-completion districts in Papua Pegunungan (Puncak Jaya, Tolikara, Lanny Jaya, Nduga), which also register the four lowest IKP composite scores among all districts examined (19.9-40.0, against a national mean of 69.7), is consistent with Gonzales Martinez and Cooray's (2025) finding that Indonesian poverty and welfare indicators exhibit strong spatial clustering not captured by non-spatial administrative models. It also means that, in the specific case of this program, operational risk and pre-existing food insecurity are not independent: the districts least able to complete disbursement are simultaneously the districts where the consequences of non-disbursement are most severe. This compounding pattern is the strongest substantive argument in our data for treating the roughly two dozen chronically under-served highland Papua districts as a distinct, small-n operational category closer to a humanitarian-logistics problem than a routine administrative one ahead of the July-September 2026 cycle, which coincides with the BMKG's (2026a, 2026b) officially forecast strong El Niño and below-normal rainfall across more than 80% of Indonesian territory. Because dry-season logistics (road and river access, market prices) typically compound rather than relieve delivery constraints in these specific districts, the risk is additive with, not independent of, the targeting pattern already observed in the wetter February-March cycle.

The benefit-cost result a distribution-overhead cost equal to only 1.69% of the commodity value delivered provides a defensible efficiency baseline against which future BOP ceiling proposals can be judged, but the 2.9-fold cross-Kanwil cost-effectiveness variation (Table 5) that is *not* explained by geographic remoteness (Central Kalimantan versus Central Java/Yogyakarta) indicates room for administrative cost reduction independent of any change to service levels, echoing the source audit's own internal finding that Central Java and Yogyakarta achieved full disbursement (100% effectiveness) at 68-70% of their cost allocation.

4.3 Relevance to Research Objectives

These findings directly address the study's stated objectives. First, the PSM result answers the question of whether disbursement-completion investment causally improves targeting quality: within the scope of program-delivery data available, it does not detectably do so, which redirects the policy question from "how do we raise completion to protect targeting quality" toward "how do we treat these as two separate operational problems." Second, the cost-benefit and cost-effectiveness results quantify the return on the non-transporter operational investment in terms directly comparable across the 26 Kanwil, supporting a differentiated rather than uniform national approach to the July-September 2026 BOP ceiling proposal. Third, the geographic co-location of disbursement failure and low baseline food security in Papua Pegunungan operationalizes the study's sustainability-risk objective: it identifies, by name, the small set of districts where the upcoming El Niño-affected cycle poses compounded rather than merely additive risk.

5. Conclusion

This study evaluated the February-March 2026 cycle of Indonesia's government food reserve disbursement using post-audit administrative data for all 514 districts/cities, merged with the 2025 national Food Security Index. Using propensity score matching, we found no statistically significant relationship between complete (100%) disbursement and audit-verified targeting accuracy ($ATT = -0.00013$, $p = 0.199$), indicating that program-delivery completion and targeting quality operate as largely independent outcomes in this cycle rather than jointly determined by the same operational stress. Cost-benefit analysis showed a non-transporter operational cost equal to 1.69% of the commodity value delivered (benefit-cost ratio 59.1), with meaningful, geography-independent cost-effectiveness variation

across regional offices; an illustrative, literature-bounded Social Return on Investment ranged from IDR 194.9 to 11,517.2 billion.

The districts with the most severe disbursement shortfalls are concentrated in Papua's highland districts, which simultaneously register the country's lowest food-security scores, indicating that operational risk and underlying vulnerability compound rather than average out. The principal limitation of this study is the absence of household-level welfare outcome data, which restricts all causal claims to program-delivery and administrative outcomes; we did not, and could not honestly, estimate the program's impact on beneficiary food security or nutritional status from the data available. Future review cycles that collect sub-component-level cost data and link disbursement records to household welfare surveys (e.g., Susenas) would allow the causal chain from disbursement completion through to household outcomes to be tested directly, rather than inferred through administrative proxies as in the present study. For the immediate July-September 2026 cycle, our results support differentiating operational risk management by both administrative risk tier and pre-existing food-security condition, rather than applying uniform national cost ceilings, with particular attention to the small number of chronically under-served Papua Pegunungan districts ahead of the forecast strong El Niño dry season.

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