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Research Paper

Special Allocation Funds, Stunting, and Regional Policy Typologies in West Java: Panel Evidence

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Abstract

Regional differences in service capacity and implementation may weaken the direct link between Special Allocation Fund (DAK) ceilings and stunting outcomes, creating a planning challenge across West Java. This study examines associations between previous-year Physical and Non-Physical DAK ceilings and stunting, while developing regional typologies and planning strategies. The method used combines a balanced panel of 27 regencies and municipalities (135 observations; 2019 and 2021–2024), two-way fixed-effects estimation with small-cluster robust inference, k-means clustering, and a structured review of 1,067 eligible policy documents. The results show that mean stunting declined from 25.28% in 2019 to 17.84% in 2024, while neither DAK ceiling showed a consistent association with stunting at the 5% level. The DAK-free typology classified seven regions as High-Priority, 13 as Transition/Strengthening, and seven as Relatively Better. The conclusion is that DAK planning should prioritize verified needs, implementation readiness, coordinated physical and operational support, and monitoring of service functionality.

Keywords: fiscal transfers; Physical DAK; Non-Physical DAK; stunting; regional typology.

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1. Introduction

The World Health Organization classifies a child under five as stunted when height-for-age is more than two standard deviations below the median of the WHO Child Growth Standards (World Health Organization, 2025). Stunting develops through sustained constraints on child growth, not a single episode of inadequate nutrition. Infection, maternal health, care practices, food access, and household conditions may reinforce one another over time. The consequences extend beyond childhood to cognitive development, schooling, adult productivity, and later health (Akseer et al., 2022). Reducing stunting therefore involves coordinated action across nutrition, water and sanitation, education, family planning, social protection, and local institutional capacity (Beal et al., 2018; Black et al., 2013; Danaei et al., 2016; Torlesse et al., 2016; Victora et al., 2008).

Many of these services are planned or delivered by subnational governments in Indonesia's decentralized system. Intergovernmental transfers can support national priorities and compensate for differences in local fiscal capacity, yet similar nominal resources do not automatically yield similar services (Martínez-Vázquez et al., 2017). Whether funds become functioning services depends on planning, technical readiness, staff, procurement, maintenance, geographic access, and accountability (Agustina et al., 2019; Asante et al., 2023; Boadway & Shah, 2007; Fanda et al., 2025; Lewis, 2017; Lewis & Smoke, 2017). This distinction is especially important when the fiscal variable records an allocation ceiling rather than spending, outputs, service quality, or actual beneficiary exposure.

The Special Allocation Fund (Dana Alokasi Khusus, DAK) operates through two related instruments. Physical DAK finances infrastructure, facilities, and equipment. Non-Physical DAK supports specified operations and services. In practice, neither stream works in isolation: facilities need staff, supplies, operating funds, referral arrangements, and maintenance, while operational services depend on adequate infrastructure and access. Annual health-sector rules provide an operational pathway from Non-Physical DAK to local stunting-related services. Permenkes No. 2 of 2022, as amended by Permenkes No. 19 of 2022, included BOK Puskesmas and a dedicated BOK stunting component within health-sector Non-Physical DAK. In practical terms, BOK Puskesmas supported local public-health operations, while BOK stunting provided operational support for district/city convergence activities related to stunting prevention and management. Permenkes No. 42 of 2022, as amended by Permenkes No. 32 of 2023, governed BOK Dinas and BOK Puskesmas for fiscal year 2023; under that framework, BOK Puskesmas financed essential primary public-health activities, including maternal-child health and community-nutrition pathways, while BOK Dinas supported district/city public-health operations and implementation functions (Ministry of Health of the Republic of Indonesia, 2022b, 2022c). These provisions show how Non-Physical DAK can finance operational activities relevant to stunting prevention and management; they do not imply that every component of health-sector DAK is exclusively stunting-specific.

DAK ceilings may be associated with stunting for several, sometimes opposing, reasons. Allocation formulas and decisions can reflect population size, service shortages, difficult geography, or vulnerability, so regions with greater need may receive more funding. Under such conditions, a positive coefficient can reflect need-responsive allocation rather than policy failure (Lago et al., 2024). A negative coefficient, conversely, would not by itself identify a causal return to additional funding. The one-year lag provides limited temporal ordering, and physical projects may take longer to become operational. Survey or estimation changes and other annual shocks may also move outcomes across all regions at the same time.

West Java provides a useful setting for examining these issues. Its 27 regencies and municipalities differ in social capacity, service coverage, urbanization, geography, and implementation conditions. Official local-government stunting estimates are available for five years, from 2019 to 2024, but the surveys and estimation arrangements underlying those estimates changed over the period. The analysis therefore treats regional heterogeneity and changes in data generation as separate concerns: local conditions are central to planning, whereas longitudinal comparisons require caution.

Empirical findings on Indonesian fiscal transfers and development outcomes are not uniform. Associations between health-sector DAK and health performance differ by indicator and regional context, and estimates relating fiscal decentralization to stunting vary with the funding instrument and model specification (Alvaro et al., 2022; Apriliani & Khoirunurrofik, 2020; Hamzah et al., 2025). Such variation is plausible because local incentives, administrative capacity, and accountability affect the path from fiscal resources to actual service delivery (Lewis, 2017; Lewis & Smoke, 2017).

The child-growth literature consistently points to socioeconomic conditions, women's education, water and sanitation, and service use as relevant correlates. Research on implementation in Indonesia, however, also records gaps in coordination, staffing, institutional commitment, and operational continuity (Herawati & Sunjaya, 2022; Permatasari et al., 2023; Sufri et al., 2024; Titaley et al., 2019). Less attention has been given to combining these strands in one design that separates Physical from Non-Physical DAK, accounts for common annual shocks, and uses regional heterogeneity for planning without allowing DAK itself to define need.

Four questions organize the study. The first concerns the distribution and development of reported stunting prevalence and previous-year Physical and Non-Physical DAK ceilings across the five observed outcome years (2019 and 2021–2024). The second asks whether the two ceilings are conditionally associated with stunting after controlling for time-invariant regional characteristics, common year shocks, and adjusted per capita expenditure. The third develops a regional typology from stunting, basic services, women's schooling, and economic capacity without using DAK, then examines how the classification changes when DAK is added. The fourth combines the quantitative profiles with structured evidence from policy documents to formulate operational optimization strategies. Six proximal indicators are retained only for supplementary exploratory analysis.

The analytical design keeps fiscal estimation separate from regional diagnosis and strategy development. The fiscal model uses two-way fixed effects (TWFE) and small-cluster procedures. The official stunting series is reviewed for comparability, and the main typology is constructed without DAK, followed by a DAK-inclusive sensitivity test.

2. Methods

2.1. Study Design, Data, and Comparability Audit

The research used a quantitative observational design alongside a structured review of regional policy documents. Regencies and municipalities were the units of analysis. Descriptive statistics characterized stunting and DAK ceilings, panel models estimated conditional within-region associations, and supplementary specifications examined selected service and capacity indicators. Clustering summarized recent regional conditions, while document review and SWOT analysis informed implementation interpretation and strategy formulation.

The balanced panel covers all 27 West Java regencies and municipalities across five outcome years—2019, 2021, 2022, 2023, and 2024 for a total of 135 observations. Each explanatory variable enters with a one-year lag and therefore refers to fiscal or measurement years 2018, 2020, 2021, 2022, and 2023, respectively. The official local-government stunting outcome series used in this study includes no 2020 observation, although 2020 explanatory data are used for the 2021 outcome.

Official stunting prevalence data were taken from the West Java Open Data dataset Prevalensi Balita Stunting Berdasarkan Kabupaten/Kota di Jawa Barat, which identifies the Ministry of Health as the data producer for 2019–2024 (Ministry of Health of the Republic of Indonesia, n.d.). The analysis uses the variable prevalensi_balita_stunting, measured in percent, rather than the separate dataset reporting the number of stunted children. The dataset was accessed on March 15, 2026. The panel combines the 2019 Indonesian Toddler Nutritional Status Survey (SSGBI), the 2021 and 2022 Indonesian Nutritional Status Surveys (SSGI), the nutrition component of the 2023 Indonesian Health Survey (SKI), and SSGI 2024. Comparability was assessed of producer and series, target population, survey design, sampling frame, anthropometric measurement, geographic coverage, weighting or estimation, and documented methodological change. All series report under-five stunting prevalence at the local-government level, but their data-generation processes are not identical; they were therefore classified as comparable with caution (Table 1).

Table 1. Comparability audit of the official stunting prevalence series

Year	Official series	Design and coverage	Main comparability issue	Assessment
2019	SSGBI	Integrated with March Susenas; under-five children in sampled households were measured	Susenas-linked process; incomplete public detail on weighting and z-score classification	Comparable with caution
2021	SSGI	Integrated with Susenas; national and local-government estimates	Detailed public metadata on sample, response, instruments, and weights remain limited	Comparable with caution
2022	SSGI	Cross-sectional two-stage stratified design; SP2020 frame	Dedicated SSGI design rather than a Susenas subsample	Comparable with caution
2023	SKI/SSGI	Nutrition component integrated into SKI; local-government estimates	Integration into a broader health survey with updated sampling and weighting	Comparable with caution
2024	SSGI	Cross-sectional; direct estimates and SAE for qualifying areas	Region-specific use of small area estimation	Comparable with caution

Source: Ministry of Health of the Republic of Indonesia (n.d., 2019, 2021, 2022a, 2025), Ministry of Health of the Republic of Indonesia, Health Development Policy Agency (2024), and the study audit.

In 2024, some regional estimates used small area estimation (SAE). Although the outcome construct is continuous across years, the underlying data-generation processes are not identical, and year fixed effects do not statistically harmonize the series.

Physical and Non-Physical DAK ceilings were compiled from annual allocation records of the Directorate General of Fiscal Balance (2018–2023). Early-childhood education enrollment came from the Ministry of Education's APK/APM data portal (Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia, n.d.). BPS-Statistics of Jawa Barat Province supplied contraceptive prevalence, adequate sanitation, adequate drinking water, delivery assisted by health personnel, women's mean years of schooling, adjusted per capita expenditure, district/city population projections, and consumer-price information (BPS-Statistics of Jawa Barat Province, 2019, 2019–2024a, 2019–2024b). Adjusted per capita expenditure is BPS's purchasing-power-adjusted annual expenditure measure, reported in thousands of rupiah per person per year. The contraceptive-prevalence indicator follows the denominator reported in each official BPS annual series; because source labels are not fully identical across years, we treat it as a supplementary regional aggregate. We checked region names, years, units, duplicate region-year entries, missing values, percentage ranges, and log-transformation requirements before analysis. The analytical panel was balanced, with neither duplicate region-year records nor missing analytical values.

2.2. Variables and DAK Construction

The dependent variable was stunting prevalence, measured in percentage points. The main explanatory variables were the natural logarithms of previous-year nominal Physical and Non-Physical DAK ceilings. Adjusted annual per capita expenditure, measured before transformation in thousand rupiah per person per year, was logged and used as a socioeconomic control. Percentage indicators remained in their original units, and women's mean years of schooling was measured in years.

For fiscal years 2018, 2020, 2021, 2022, and 2023, the Physical and Non-Physical DAK variables were formed by summing annual allocation components identified as relevant to stunting-related service pathways. Values reported in thousands of rupiah were multiplied by 1,000 before aggregation. Program, field, subfield, and support-category names changed across years, so the annual totals represent substantively related baskets rather than an identical program composition in every fiscal year. Bantuan Operasional Kesehatan (BOK) is included within the constructed Non-Physical DAK aggregate wherever it appears in the annual allocation records, including general BOK and, depending on the fiscal year, more specific operational categories such as BOK Puskesmas, BOK stunting, and BOK Dinas Kabupaten/Kota. Accordingly, the coefficient on Non-Physical DAK represents the constructed aggregate and must not be interpreted as a BOK-specific coefficient. Both main DAK measures are nominal administrative allocation ceilings (pagu), not realization, absorption, outputs, service quality, or beneficiary exposure.

For the reviewer-requested annual descriptive fiscal context, we additionally compiled actual central-government disbursement of total Physical and Non-Physical DAK to the same 27 regencies and municipalities for fiscal years 2019–2024 from the Directorate General of Fiscal Balance (DJPK) historical TKD realization files and, for 2024, the SIKD Lacak Salur (CakLur) portal. The values were summed across the 27 sampled local governments and exclude the Provincial Government of West Java. These figures represent central-to-local disbursement, not local-government expenditure or absorption, and they are not used as regressors. Because a complete six-year region-by-component disbursement series matching the study's changing stunting-related DAK basket is not consistently available in the public sources used here, the descriptive realization columns cover the broader Physical and Non-Physical DAK portfolios and are kept analytically distinct from the narrower previous-year allocation ceilings used in TWFE.

Sensitivity to price changes and regional size was assessed by re-expressing both DAK measures in constant 2023 rupiah and per capita. Real DAK was calculated as nominal DAK × 100 divided by a province-wide chained consumer-price index compiled from BPS annual publications and rescaled to 2023 = 100; the annual factors are documented in the supplementary DAK workbook. Per-capita DAK used official district/city population projections for the corresponding lag year. The four logged specifications were nominal ceilings, real ceilings, nominal per capita, and real per capita. In a log-TWFE model with a province-wide annual deflator, ln(real DAK) equals ln(nominal DAK) minus a year-specific term absorbed by year fixed effects. Real and nominal slope estimates are therefore algebraically identical, whereas the per-capita specifications test sensitivity to regional population size.

The supplementary analysis covers six proximal indicators: early childhood education enrollment, contraceptive prevalence, adequate sanitation, adequate drinking water, delivery assisted by health personnel, and women's mean years of schooling. Each is measured at the local-government level. Such measures leave service quality, continuity, within-region inequality, and household exposure unobserved. The one-year lag orders the variables in time but does not imply that every service mechanism operates fully within that interval.

2.3. Descriptive Analysis, TWFE, and Robust Inference

Descriptive statistics summarize the distribution of the variables, annual means, and changes in reported stunting prevalence across the observed outcome years (2019 and 2021–2024). They answer the descriptive question only and are not interpreted as causal evidence.

Model selection compared pooled ordinary least squares, one-way fixed effects, and random effects through the F test for individual effects, the Breusch-Pagan Lagrange Multiplier test, and the Hausman test (Breusch & Pagan, 1980; Hausman, 1978). The role of annual effects was then assessed by comparing one-way fixed effects with a two-way fixed-effects (TWFE) model. TWFE is the main specification because it removes time-invariant regional characteristics and common shocks occurring in each year.

The main specification was:

$$\mathrm{STUNT}_{it} = \beta_1 \ln\mathrm{DAKF}_{i,t-1} + \beta_2 \ln\mathrm{DAKNF}_{i,t-1} + \beta_3 \ln\mathrm{EXP}_{i,t-1} + \alpha_i + \lambda_t + \varepsilon_{it}$$

In the equation, STUNT_{it} is stunting prevalence in region i at year t. $\ln\mathrm{DAKF}_{i,t-1}$ and $\ln\mathrm{DAKNF}_{i,t-1}$ denote the natural logarithms of previous-year Physical and Non-Physical DAK ceilings; $\ln\mathrm{EXP}_{i,t-1}$ is logged adjusted per capita expenditure. Region and year fixed effects are represented by α_i and λ_t, and ε_{it} is the idiosyncratic error. Because stunting is measured in percentage points and DAK enters in logarithms, a proportional change p corresponds to $\beta \times \ln(1 + p)$ percentage points. This is a scale translation of the coefficient, not a causal effect estimate.

HC1 standard errors clustered at the regional level provide the primary inference (Arellano, 1987; Cameron & Miller, 2015). With 27 clusters, inference was also checked using a CR2 variance correction and Satterthwaite-adjusted degrees of freedom (Pustejovsky & Tipton, 2018). Tests of the two DAK coefficients used a null-imposed, two-sided WCR-fnw11 wild cluster bootstrap (WCB) with Rademacher weights, 99,999 replications, and 95% confidence intervals (MacKinnon & Webb, 2017; MacKinnon et al., 2023). A Hotelling's T-squared Wald test with Zhang's small-sample correction (HTZ) evaluated the coefficients jointly. One-way fixed effects, diagnostics, and leave-one-region-out estimates served as specification, data, and influence checks. Statistical interpretation used 5% as the primary threshold; values between 0.05 and 0.10 were described only as weak or indicative evidence (Wasserstein & Lazar, 2016; Wasserstein et al., 2019).

2.4. Supplementary Proximal-Indicator Analysis

We first entered each proximal indicator separately into the baseline TWFE specification. Coefficient direction and HC1 and CR2 inference were reported for these exploratory models. We also estimated a specification that entered all six indicators jointly, and an HTZ Wald test evaluated their joint contribution. These specifications neither select the fiscal model nor test mediation.

2.5. Regional Typology and Sensitivity Analysis

The main typology uses the latest cross-section available: stunting prevalence for 2024 and explanatory indicators for 2023. Six variables were converted to z-scores: stunting prevalence, women's mean years of schooling, delivery assisted by health personnel, adequate sanitation, adequate drinking water, and logged adjusted per capita expenditure. DAK is omitted from the main clustering so that the fiscal instrument later examined is not used to define need and capacity. A sensitivity specification adds logged Physical and Non-Physical DAK.

K-means clustering used Euclidean distance, 1,000 random starts, and no more than 1,000 iterations (MacQueen, 1967). We assessed candidate solutions from k = 2 through k = 8 using average silhouette, Calinski-Harabasz, and Davies-Bouldin indices (Rousseeuw, 1987). For k = 3, we checked reproducibility across 100 random seeds and stability through 1,000 bootstrap resamples using the Jaccard measure. Cramer's V assessed the association with regency-municipality status. The adjusted Rand index compared the main partition with the partition that included DAK.

Further validation focused on k = 2, k = 3, and k = 5. It compared group size, pairwise adjusted Rand index, nesting purity, the same 1,000-resample Jaccard stability exercise, and association with administrative status (Hennig, 2007; Hubert & Arabie, 1985). Temporal sensitivity repeated the DAK-free analysis using 2023 stunting and 2022 explanatory indicators. The final number of clusters was selected by jointly considering internal validity, bootstrap stability, temporal agreement, group size, administrative dependence, and policy interpretability.

An equally weighted relative-vulnerability score determined the cluster labels. Standardized stunting contributed positively to the score; women's schooling, delivery assisted by health personnel, sanitation, drinking water, and logged expenditure contributed negatively. Mean scores were used to name the groups High-Priority, Transition/Strengthening, and Relatively Better. The score describes relative position within this sample; it is not a child-level probability, performance ranking, or allocation formula (OECD & Joint Research Center, 2008).

2.6. Policy-Document Review, SWOT, and Strategy Formulation

The document review covered regional regulations, plans, implementation reports, evaluations, official publications, outcome data, and local studies. Regional records were consolidated from 26 local-government audit workbooks and the Kabupaten Sukabumi historical and prospective archives. The counting unit was one unique regional document: identical copies and alternate folder placements were collapsed into one canonical record, while national, provincial, and cross-regional materials were used for context and not added to the regional count. The audit identified 1,076 candidate regional documents. Nine were excluded: three single-image activity publications lacked substantive evidence, three records were unreadable or incomplete, one was substantively irrelevant, and two were assigned to the wrong region, leaving 1,067 eligible documents (Figure 1). Documents from 2018–2024 informed interpretation of the empirical period, while materials from 2025–2026 were considered prospectively. The supplementary screening workbook records the regional source, canonical or candidate ID, eligibility status, and exclusion reason. Evidence was read according to function: regulations show formal authority, plans record intended action, implementation reports describe reported activity, and evaluations or outcome data are limited by their respective designs (Bowen, 2009; Dalglish et al., 2020).

Figure 1. Selection of Regional Policy Documents for Structured Review
Source: Consolidated regional document-screening log.

SWOT analysis brought together the quantitative profiles and recurring documentary evidence at the level of the main typology. Documentary statements were organized as internal strengths or weaknesses and external opportunities or threats, then synthesized across regions within each typology. The resulting factors were compared with the quantitative profiles to identify feasible implementation responses (Helms & Nixon, 2010). Each proposed strategy specifies an action, responsible actors, a process standard, required conditions, and a monitoring arrangement.

3. Results

3.1. Development and Distribution of Stunting and DAK

The audit found continuity in the local-government stunting construct, alongside changes in survey integration, sampling frames, and estimation procedures. All five official series were retained, but longitudinal comparisons are made with caution. Year fixed effects absorb shifts common to all regions; they do not harmonize the surveys themselves.

Across the 135 region-year observations, the unweighted panel mean of reported stunting prevalence is 21.5388%, with values ranging from 6.00% to 35.20% (Table 2). Physical and Non-Physical DAK ceilings differ markedly across regions and years. Considerable variation also appears in the service and capacity indicators, especially adequate sanitation, women's mean years of schooling, and adjusted per capita expenditure. Average coverage of adequate drinking water and delivery assisted by health personnel is high, but the minimum values show that local gaps remain.

Table 2. Descriptive statistics of the study variables, outcome years 2019 and 2021–2024

Variable	N	Mean	SD	Minimum	Median	Maximum
Stunting prevalence (%)	135	21.5388	5.8171	6.00	21.35	35.20
Physical DAK (billion rupiah)	135	39.6405	22.4378	3.1568	36.7795	112.1813
Non-Physical DAK (billion rupiah)	135	64.5009	37.0607	11.8996	61.3723	181.9502
Early-childhood education enrolment (%)	135	41.5954	13.5905	15.79	39.77	84.22
Contraceptive prevalence (%)	135	55.4976	7.1540	37.23	55.56	73.34
Adequate sanitation (%)	135	73.0183	16.1007	24.82	75.35	98.72
Adequate drinking water (%)	135	93.0329	6.7335	69.20	95.51	100.00
Delivery assisted by health personnel (%)	135	95.0259	6.3578	72.11	97.87	100.00
Women's mean years of schooling	135	8.2568	1.4922	5.27	7.83	11.66
Adjusted per capita expenditure (thousand rupiah)	135	10,942.40	2,291.49	7,597	10,578	18,236

Source: Study calculations from the analytical panel.

Annual reported stunting averaged 25.28% in 2019, 23.06% in 2021, 19.96% in 2022, 21.54% in 2023, and 17.84% in 2024; the 2020 cell is reported as n.a. because the official local-government outcome series used in the study has no observation for that year (Table 3). Across the 27 sampled local governments, actual central-government disbursement of Physical DAK was Rp3,046.94 billion in 2019, Rp2,034.53 billion in 2020, Rp2,547.35 billion in 2021, Rp2,384.08 billion in 2022, Rp2,204.34 billion in 2023, and Rp2,880.60 billion in 2024. Corresponding Non-Physical DAK disbursement was Rp8,084.66 billion, Rp8,407.74 billion, Rp8,149.04 billion, Rp13,276.63 billion, Rp14,112.96 billion, and Rp14,143.08 billion.

Table 3. Annual reported stunting and actual DAK disbursement to the 27 sampled local governments, 2019–2024

Year	Reported stunting (%)	Physical DAK disbursement (billion rupiah)	Non-Physical DAK disbursement (billion rupiah)	Total DAK disbursement (billion rupiah)
2019	25.28	3,046.94	8,084.66	11,131.60
2020	n.a.	2,034.53	8,407.74	10,442.27
2021	23.06	2,547.35	8,149.04	10,696.39
2022	19.96	2,384.08	13,276.63	15,660.72
2023	21.54	2,204.34	14,112.96	16,317.30
2024	17.84	2,880.60	14,143.08	17,023.68

Source: Study calculations from DJPK historical TKD realization files (2019–2023) and SIKD CakLur (2024); stunting from the official local-government series used in the analytical panel.

Table 3 shows stunting is the unweighted annual mean across the 27 sampled regencies/municipalities; 2020 is n.a. because the official local-government outcome series used in the study has no 2020 observation and no value was imputed. DAK values are actual central-government disbursement to the 27 sampled local governments, summed across those governments and excluding the Provincial Government of West Java. They refer to the broader Physical and Non-Physical DAK portfolios, not local-government expenditure/absorption and not the narrower year-specific stunting-related allocation basket used in TWFE. The TWFE regressors remain previous-year administrative allocation ceilings.

3.2. DAK and Stunting in the Main TWFE Model

The model tests favored regional fixed effects and the addition of year effects. Pooled OLS versus one-way fixed effects produced $p < 0.001$; the Breusch-Pagan Lagrange Multiplier test produced $p = 0.0017$; and the Hausman test produced $p < 0.001$. The comparison between one-way fixed effects and the model with year effects yielded $p = 0.0028$. Regional and year fixed effects are therefore included in the main estimates.

For Physical DAK, the TWFE coefficient is 1.4472, with HC1 p = 0.1628, CR2 p = 0.2152, and WCB p = 0.2426. Its 95% bootstrap interval extends from -1.4493 to 3.4309. The Non-Physical DAK coefficient is 6.7688; the corresponding p-values are 0.0672, 0.1006, and 0.0806, with an interval from -0.8841 to 14.8235. The joint HTZ Wald test gives p = 0.2023. Thus, at the primary 5% level, the data do not support either coefficient individually or the two coefficients jointly.

Both bootstrap intervals include zero. For Non-Physical DAK, HC1 and wild cluster bootstrap inference provide the only indications below the 10% threshold, whereas CR2 exceeds 10% and the joint test of the two DAK coefficients does not reject the null.

Table 4. Main TWFE estimates, small-cluster inference, and one-way FE comparison

Variable	TWFE coefficient	HC1 p	CR2 p	WCB p [95% CI]	One-way FE coefficient	One-way HC1 p
ln Physical DAK (t-1)	1.4472	0.1628	0.2152	0.2426 [-1.4493; 3.4309]	-1.1009	0.2218
ln Non-Physical DAK (t-1)	6.7688	0.0672	0.1006	0.0806 [-0.8841; 14.8235]	-1.4960	0.6792

Variable	TWFE coefficient	HC1 p	CR2 p	WCB p [95% CI]	One-way FE coefficient	One-way HC1 p
ln adjusted per capita expenditure (t-1)	-18.1029	0.6542	0.6755	-	-57.5510	<0.001

Source: Study calculations from the estimation output.

The TWFE specification includes region and year fixed effects, with HC1 and CR2 standard errors clustered at the region level. WCB used 99,999 replications, and the joint HTZ Wald test for the two DAK coefficients yielded $p = 0.2023$. The TWFE within-R^2 was 0.0357, and the adjusted within-R^2 was −0.2794, compared with 0.2364 and 0.0254, respectively, for the one-way fixed-effects model.

Table 5. Scale robustness of DAK measurement in the TWFE model

DAK measurement	Physical DAK β (HC1/CR2/WCB p)	Non-Physical DAK β (HC1/CR2/WCB p)	Joint HTZ p
Nominal ceiling	1.4472 (0.1628/0.2152/0.2426)	6.7688 (0.0672/0.1006/0.0806)	0.2023
Real ceiling, 2023 rupiah	1.4472 (0.1628/0.2152/0.2426)	6.7688 (0.0672/0.1006/0.0806)	0.2023
Nominal per capita	1.4848 (0.1583/0.2105/0.2392)	6.1657 (0.1041/0.1465/0.1163)	0.2528
Real per capita, 2023 rupiah	1.4848 (0.1583/0.2105/0.2392)	6.1657 (0.1041/0.1465/0.1163)	0.2528

Source: Study calculations from the analytical panel and official BPS population and consumer-price series.

All specifications include region and year fixed effects and logged adjusted per capita expenditure. WCB used 99,999 replications. The 95% WCB intervals were [−1.4493, 3.4309] and [−0.8841, 14.8235] for nominal Physical and Non-Physical DAK, and [−1.4354, 3.4977] and [−1.5293, 15.0800] for their per-capita counterparts.

The scale checks produce similar inferential results. In the per-capita model, the Physical DAK coefficient is 1.4848 (HC1 $p = 0.1583$; CR2 $p = 0.2105$; WCB $p = 0.2392$), while the Non-Physical DAK coefficient is 6.1657 (HC1 $p = 0.1041$; CR2 $p = 0.1465$; WCB $p = 0.1163$). Both 95% bootstrap intervals include zero, and the joint HTZ test gives $p = 0.2528$. The real-value specifications reproduce their nominal counterparts because year fixed effects absorb the common annual deflator.

The adjusted within-R-squared is -0.2794. This statistic is calculated after region and year demeaning and adjustment for model complexity. The negative adjusted within-R^2 reflects the limited proportion of remaining within-region variation explained by the regressors after two-way demeaning relative to the degrees-of-freedom adjustment; it does not indicate negative explained variance.

In the one-way fixed-effects comparison, the coefficients are -1.1009 for Physical DAK, -1.4960 for Non-Physical DAK, and -57.5510 for adjusted per capita expenditure; only the expenditure estimate is statistically supported. In this level-log specification, a 10% increase in adjusted per capita expenditure corresponds mechanically to $-57.5510 \times \ln(1.10) = -5.49$ percentage points. Once common year effects are included, the expenditure coefficient falls to -18.1029 and loses statistical support (HC1 $p = 0.6542$).

At the 5% level, the Wooldridge, panel Breusch-Godfrey, and Pesaran CD tests did not reject their null hypotheses, and the largest two-way-demeaned VIF was 1.068. Across leave-one-region-out estimates, the Physical DAK coefficient varied between 0.8570 and 1.9743, while the Non-Physical DAK coefficient ranged from 4.8016 to 8.3551. Signs remained positive throughout, but uncertainty was still substantial.

3.3. Supplementary Proximal-Indicator Results

Entered separately in the baseline TWFE model, early childhood education enrollment has a coefficient of -0.1400 (HC1 $p = 0.0263$; CR2 $p = 0.0974$; Table 6). Because support weakens after the small-cluster correction, this result is treated as exploratory. Delivery assisted by health personnel, adequate drinking water, and adequate sanitation all have negative coefficients without statistical support. The contraceptive-prevalence estimate is positive and near zero, and the estimate for women's mean years of schooling is positive but imprecise.

The joint HTZ Wald test for the six proximal indicators yields $p = 0.2578$. The joint test therefore does not provide statistical support for an association between the six indicators and stunting.

Table 6. Supplementary individual proximal-indicator results

Indicator	Coefficient	Direction	HC1 p	CR2 p	Change in adjusted within-R^2
Early childhood education enrollment	-0.1400	Negative	0.0263	0.0974	0.0553
Contraceptive prevalence	0.0050	Positive	0.9702	0.9718	-0.0128
Adequate sanitation	-0.0080	Negative	0.7997	0.8146	-0.0124
Adequate drinking water	-0.1597	Negative	0.3305	0.4182	0.0000
Delivery assisted by health personnel	-0.2042	Negative	0.1511	0.2069	0.0077
Women's mean years of schooling	2.4816	Positive	0.6368	0.6610	-0.0061

Source: Study calculations from the estimation output.

3.4. Regional Typologies and Sensitivity

No single value of k dominated the validation scan from k = 2 to k = 8. For the selected k = 3 partition, the same membership appeared in all 100 random-seed runs. The 1,000-resample bootstrap produced cluster-specific Jaccard values from 0.766 to 0.909, and the average silhouette for k = 3 was 0.2739.

Table 7 compares the policy-relevant k = 2, k = 3, and k = 5 solutions. The k = 2 solution records the highest average silhouette (0.3313) and Calinski-Harabasz value (13.5931). Although k = 5 has the lowest Davies-Bouldin value (0.8843), it creates groups containing only two and three regions and includes one unstable cluster. The k = 3 solution produces groups of 13, 7, and 7. Its temporal ARI is 0.760: 25 of the 27 regions keep the same labels between the 2024/2023 and 2023/2022 cross-sections. In the alternative year, Kabupaten Purwakarta and Kota Sukabumi move to Transition/Strengthening. Higher silhouette and Calinski-Harabasz values and lower Davies-Bouldin values indicate better internal separation. Jaccard stability was assessed using 1,000 bootstrap resamples, while temporal ARI compares the 2024/2023 and 2023/2022 partitions.

Table 7. Validation of alternative cluster solutions (k = 2, 3, and 5)

Panel A. Internal validation, 2024/2023

k	Average silhouette	Calinski-Harabasz	Davies-Bouldin	Group sizes	Smallest group
2	0.3313	13.5931	1.1845	19, 8	8
3	0.2739	12.8420	1.2060	13, 7, 7	7
5	0.3178	12.4523	0.8843	11, 6, 5, 3, 2	2

Panel B. Stability, administrative structure, and temporal sensitivity

k	Jaccard range	Cramer's V	Temporal ARI	2023/2022 sizes	Main diagnostic
2	0.851-0.897	0.459	0.134	16, 11	Strong internal stability, but coarse and temporally unstable
3	0.766-0.909	0.847	0.760	15, 6, 6	Best temporal agreement; strong administrative-status dependence
5	0.555-0.873	0.921	0.505	10, 8, 4, 3, 2	Small groups and one unstable cluster

Source: Study calculations from the additional clustering-validation output.

Pairwise results indicate that k = 3 mostly refines k = 2 (nesting purity = 0.963; ARI = 0.437), whereas k = 5 mostly subdivides k = 3 (nesting purity = 0.926; ARI = 0.686). Dependence on administrative status rises with the number of groups: Cramer's V equals 0.459 for k = 2, 0.847 for k = 3, and 0.921 for k = 5.

Seven regions fall in the High-Priority group, thirteen in Transition/Strengthening, and seven in Relatively Better. Average stunting differs little among the groups. The clearer numerical contrasts concern women's schooling, service coverage, adjusted expenditure, and the vulnerability score (Table 8). Typology membership is strongly associated with regency-municipality status. Figure 2 maps the 7-13-7 membership.

Table 8. Mean profiles of the main regional policy typologies

Panel A. Service, socioeconomic, and vulnerability profile (explanatory indicators 2023; stunting 2024)

Typology	Regions (n)	Stunting (%)	Women's schooling (years)	Health-personnel-assisted delivery / sanitation / drinking water (%)	Adjusted expenditure (thousand rupiah/person/year)	Vulnerability score
High-Priority	7	17.57	7.53	85.20 / 61.26 / 87.30	9,788.43	0.840
Transition/Strengthening	13	17.98	7.93	97.75 / 81.34 / 95.32	10,910.77	-0.068
Relatively Better	7	17.86	10.73	99.13 / 77.25 / 98.75	14,405.43	-0.714

Panel B. Nominal DAK profile after the typology was formed (2023 ceilings)

Typology	Regions (n)	Mean Physical DAK (billion rupiah)	Mean Non-Physical DAK (billion rupiah)
High-Priority	7	45.49	113.36
Transition/Strengthening	13	41.21	68.70
Relatively Better	7	26.22	48.62

Source: Study calculations from the clustering output.

DAK was added to the profiles only after the main classification had been formed. Average Physical and Non-Physical DAK ceilings are highest in High-Priority regions and lowest in Relatively Better regions. When both DAK variables enter the clustering, the groups change to 8 High-Priority, 10 Transition/Strengthening, and 9 Relatively Better regions (Table 9). Kabupaten Bandung moves into High-Priority; Kota Banjar and Kota Tasikmalaya move into Relatively Better. The two partitions have an ARI of 0.6569. In the DAK-inclusive analysis, the k = 3 silhouette drops to 0.2212, while the largest silhouette is 0.2955 at k = 8.

Table 9. Membership of the main typology and sensitivity changes

Main typology	Regions	Changes when DAK was included
High-Priority	Kabupaten Bandung Barat; Kabupaten Bogor; Kabupaten Cianjur; Kabupaten Garut; Kabupaten Purwakarta; Kabupaten Sukabumi; Kabupaten Tasikmalaya	Kabupaten Bandung moved into High-Priority.
Transition/Strengthening	Kabupaten Bandung; Kabupaten Bekasi; Kabupaten Ciamis; Kabupaten Cirebon; Kabupaten Indramayu; Kabupaten Karawang; Kabupaten Kuningan; Kabupaten Majalengka; Kabupaten Pangandaran; Kabupaten Subang; Kabupaten Sumedang; Kota Banjar; Kota Tasikmalaya	Kabupaten Bandung moved out; Kota Banjar and Kota Tasikmalaya moved out.
Relatively Better	Kota Bandung; Kota Bekasi; Kota Bogor; Kota Cimahi; Kota Cirebon; Kota Depok; Kota Sukabumi	Kota Banjar and Kota Tasikmalaya moved into Relatively Better.

Source: Study calculations from the clustering output.

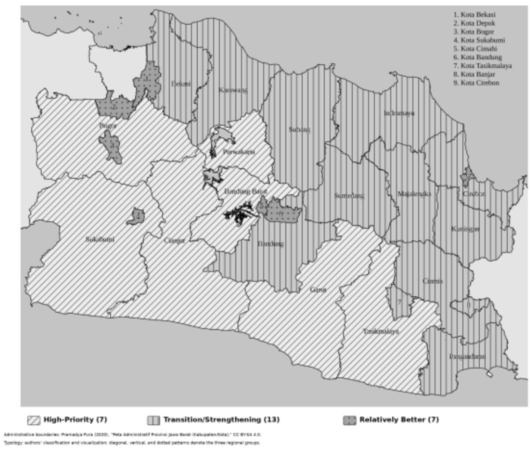

Figure 2. Regional Policy Typology of West Java (7–13–7)

Source: Authors' classification and visualization; administrative boundaries adapted from Pramadya Pura (2020), licensed under CC BY-SA 4.0. Diagonal, vertical, and dotted patterns denote High-Priority, Transition/Strengthening, and Relatively Better regions; numbered labels identify small municipalities.

3.5. Policy-Document Review and SWOT Results

The structured review retained 1,067 eligible regional policy documents. Recurrently coded evidence concerned regulations, coordination bodies, service networks, cadres, priority-location mechanisms, local innovations, implementation activities, and selected service or outcome reporting. The documentary record was denser for formal arrangements and reported activities than for evidence linking financing to service performance and outcomes.

Across the eligible documents, the financing-to-service chain was incompletely documented. Records more often identified planned budgets, institutional responsibilities, activities, or outputs than a continuous link from allocation ceilings to realization, locations, beneficiaries, service functionality, continuity, quality, utilization, and changes in stunting. The review therefore identified a recurrent traceability gap between fiscal inputs and evidence of functioning services.

The SWOT synthesis showed different recurring implementation conditions across the three typologies. High-Priority regions were characterized by wider basic-service gaps, access constraints, operational-readiness needs, and weaker financing traceability. Transition/Strengthening regions showed broader average coverage but recurring concerns about functionality, service quality, internal inequality, and utilization. Relatively Better municipalities showed stronger average capacity alongside more localized risks related to mobility, settlement density, maintenance, and hidden pockets of vulnerability.

Table 10 summarizes these recurring strengths, weaknesses, opportunities, and threats by typology. Document quantity was not treated as evidence strength: regulations establish formal authority, plans record intended action, implementation reports record reported activity, and evaluation or outcome documents provide different levels of evidence. The synthesis therefore describes recurring implementation conditions rather than ranking regions by the number of documents available (Bowen, 2009; Dalglish et al., 2020).

Table 10. Typology-level SWOT synthesis

Typology	Strengths	Weaknesses	Opportunities	Threats
High-Priority	Coordination structures, service networks, cadres, and priority-location mechanisms.	Water, sanitation, and hygiene (WASH) and geographic-access gaps; uneven service quality; incomplete financing traceability.	DAK, local budgets, village funds, partnerships, local food initiatives, and digitalization.	Transfer changes, difficult-area costs, disasters, staff rotation, and fragmented data.
Transition/Strengthening	Broader service coverage, coordination structures, and developing local innovations.	Internal hotspots; uneven quality and asset functionality; inconsistent data.	Integrated planning, supervision, cross-agency dashboards, and interregional learning.	Regional averages conceal inequality; innovations may weaken when leadership or financing changes.
Relatively Better	Stronger human capital, economic capacity, formal services, and data capability.	Urban vulnerability pockets, safe-sanitation gaps, mobility, and variable prevalence.	Dynamic spatial targeting, digital surveillance, partnerships, and prevention of new cases.	Density, migration, informal work, high living costs, and risk of reversal.

Source: Study synthesis from the quantitative profiles and document review.

Across all three typologies, formal institutional foundations were commonly documented, while evidence on implementation depth and service functioning was more uneven. The observed differences in basic-service conditions, access, functionality, internal hotspots, and financing traceability were carried forward to the strategy synthesis in Table 11.

4. Discussion

4.1. Interpreting DAK Ceilings, BOK, and the Allocation-to-Outcome Chain

The central empirical puzzle is not simply why the DAK coefficients are statistically unsupported, but why larger upstream fiscal commitments do not map consistently onto lower stunting in the following year. One plausible interpretation begins with allocation itself. The point estimates remain positive, and the DAK-free profiles show that High-Priority regions, identified from service and capacity constraints rather than funding, subsequently have the largest average ceilings. Taken together, these patterns are compatible with need-responsive allocation: jurisdictions with larger populations, cost disadvantages, or deeper service gaps may receive more resources. Equalization and specific-purpose transfers are designed partly to address differences in fiscal capacity and expenditure need (Boadway & Shah, 2007; Lago et al., 2024), while decentralized service outcomes depend on how national resources interact with local institutional, socioeconomic, and geographic contexts (Abimbola et al., 2019; Lewis & Smoke, 2017). These patterns are compatible with need-responsive allocation and caution against reading coefficient signs as direct measures of policy success or failure.

A second interpretive consideration concerns the distance between what is measured and what must occur before child growth can change. A ceiling is an authorization at the beginning of a chain: allocation ceiling -> central-government disbursement -> local expenditure or absorption -> activities and outputs -> functioning, continuous, and good-quality services -> beneficiary access and utilization -> nutritional outcome. The TWFE regressors observe the first stage for a changing stunting-related basket. Table 3 observes only the second stage, descriptively, for the broader Physical and Non-Physical DAK portfolios. Neither source observes the complete region-by-component path through local spending, delivered activities, working assets, service quality, or use by intended families. The review of 1,067 documents provides relevant implementation context: records were richer on formal authority, planned budgets, and reported activities than on a continuous financing-to-functionality trail, and recurrent gaps appeared in traceability, implementation evidence, service functioning or utilization, and the conversion of data into action. They provide implementation context for understanding why an allocation-to-outcome specification spans several unmeasured conversion stages at which timing, targeting, readiness, and implementation can diverge across regions (Herawati & Sunjaya, 2022; Lewis, 2017; Sufri et al., 2024). A statistically unsupported ceiling-outcome association is therefore compatible with useful individual activities as well as with incomplete or uneven conversion of funding into effective exposure.

The comparison between one-way fixed effects and TWFE adds a different warning. The apparently strong association of adjusted per capita expenditure in the one-way model largely disappears when year effects are introduced. The contrast suggests that the one-way estimate partly reflected annual movement shared across West Java, rather than only region-specific changes relative to the provincial time pattern. Calendar-year indicators absorb such common variation, as well as any province-wide changes that follow the same annual pattern (Wooldridge, 2010). Pandemic disruption, national policy change, inflation, or changes in the stunting data-generation system are possible examples of common time-varying influences, but this model does not identify which of them generated the change. The comparison therefore supports the inclusion of year effects and cautions against attaching a regional mechanism to an association that does not persist after common annual variation is removed.

BOK illustrates why the Non-Physical DAK estimate also resists a single-program interpretation. BOK is included wherever it appears in the annual allocation records, but it enters with other Non-Physical components whose target groups, implementing units, delivery processes, and expected response times differ. The relevant regulations show that BOK Puskesmas, the dedicated 2022 BOK stunting component, and the 2023 BOK Dinas and BOK Puskesmas arrangements can support district/city convergence, outreach, maternal-child health, community nutrition, and other public-health operations (Ministry of Health of the Republic of Indonesia, 2022b, 2022c). Operational finance can make a capital asset usable by funding staff time, supplies, outreach, referral, supervision, and follow-up; conversely, operational activities may be constrained by inadequate facilities or access. Such complementarity is consistent with evidence that high-quality service delivery depends on both system readiness and the processes of care (Agustina et al., 2019; Kruk et al., 2018). Yet the aggregate coefficient is not a BOK effect, and the study does not observe component-specific BOK expenditure or realized Physical DAK-BOK combinations. The planning question is consequently whether capital and operational inputs are matched ex ante to the same verified constraint, not whether one aggregate coefficient validates or rejects BOK.

4.2. Service Indicators, Regional Typology, and Implementation Context

The supplementary service indicators extend the same measurement problem from finance to delivery. Several regional averages appear high, yet the six indicators are not jointly supported and the early-childhood education signal weakens under the small-cluster correction. The pattern is consistent with the distinction between administrative or aggregate coverage and effective coverage: a reported contact or nominally adequate service may still vary in readiness, continuity, technical quality, safety, intensity, targeting, and actual use by children who need it. Effective-coverage research explicitly distinguishes contact with a service from receipt of care of sufficient quality to generate health benefit (Marsh et al., 2020), and Indonesian evidence documents inequalities in facility readiness and provider knowledge even within an expanded primary-care system (Haemmerli et al., 2021). WASH effects likewise depend on sustained reductions in pathogen exposure, which require safe and continuous use rather than infrastructure classification alone (Bekele et al., 2020; Cumming & Cairncross, 2016). Effective coverage is therefore used as an interpretive framework for understanding how high district-level coverage and a weak aggregate association can coexist.

This distinction also explains why prevalence alone is an incomplete planning diagnosis. The three groups have similar mean stunting but markedly different profiles of women's schooling, maternal services, WASH, and economic capacity. A similar outcome can therefore sit above different constraint configurations: one region may face broad deficits in access and readiness, another may have extensive infrastructure but uneven functionality or internal utilization, and a better-resourced municipality may contain small pockets of deprivation hidden by the average. Indonesian multilevel evidence likewise shows that child growth reflects household characteristics together with contextual conditions beyond the child or household (Mulyaningsih et al., 2021). The typology's contribution is diagnostic: it prevents equal prevalence from being mistaken for equal development conditions (Wardhana, 2025).

The strong relationship between typology and regency-municipality status should be read in the same diagnostic spirit. Administrative status is a structural correlate, or marker of a broader bundle of differences, rather than a treatment. Urbanization, settlement density, economic structure, facility proximity, transport and geographic reach, human-resource concentration, and administrative capacity can alter both service need and the cost of reaching intended users. Those dimensions may advantage municipalities on some averages while generating mobility, congestion, informality, high living costs, and sharply localized vulnerability on others. Evidence of rural-urban differences in Indonesian health-care availability and use is consistent with this interpretation (Mulyanto et al., 2020; Wulandari et al., 2022), as is evidence that apparently better-off urban areas can still contain high-risk poor communities (Laksono et al., 2024).

Keeping DAK outside the main classification preserves the distinction between the condition to be diagnosed and the fiscal response that may follow. Once DAK is added, three memberships change and the separation of the selected three-group solution weakens. This sensitivity is substantively informative: a region with high need and a high response may move closer to a lower-need profile if fiscal resources are treated as another favorable endowment, while a small allocation can be mistaken for low capacity even when it reflects a different funding response. In other words, the clustering would mix underlying need with a potentially need-responsive instrument. DAK is therefore more informative when profiled after the need-and-capacity grouping, where the higher average ceilings in High-Priority regions remain compatible with a possible fiscal response to need. The modest silhouette and membership sensitivity keep the typology exploratory and unsuitable as an automatic allocation formula or performance ranking.

4.3. Differentiated DAK Strategies and Policy Implications

Taken together, the analyses tell one planning story. The fiscal model shows that ceiling alone does not consistently account for subsequent stunting; the service indicators, interpreted through an effective-coverage framework, indicate that aggregate coverage alone does not establish effective exposure; the typology shows that similar prevalence can arise alongside different constraints; the document review shows that financing, implementation, functionality, and utilization are not always traceable in one evidentiary chain; and Table 3 shows that central disbursement can be observed without revealing local absorption or service use. The relevant policy question therefore shifts from how much DAK is allocated in aggregate to whether Physical and Non-Physical instruments are matched to verified local constraints and converted into functional, high-quality, targeted, and utilized services. Table 11 translates that shift into differentiated planning priorities rather than predetermined funding levels.

Table 11. Differentiated operational directions for DAK optimization

Typology	Priority action	Responsible actors	Proposed process standard	Prerequisites and monitoring
High-Priority	Bundle basic-service investment with outreach, staffing, operations, maintenance, referral, and data reconciliation in verified priority locations.	Bappenas, Ministry of Finance, technical ministries, province, and local governments.	Priority proposals document service gaps, target locations, technical readiness, personnel, operations, and maintenance.	Microdata, land and design readiness, staffing, and village coordination; annual proposal review, quarterly dashboard, and asset-function audit.
Transition/Strengthening	Audit assets before expansion; target rehabilitation, sanitation, equipment, referral, supervision, quality assurance, and hotspot follow-up.	Province, local planning agencies, technical agencies, and inspectorates.	New assets follow an asset audit; internal hotspots have a service-quality improvement plan.	Asset registers, quality standards, and harmonized local data; semiannual supervision and utilization review.
Relatively Better	Use selective neighborhood-level investment, maintenance, active surveillance, mobile-family tracking, and prevention of new cases.	Municipal governments, province, and health, WASH, and social-service agencies.	Priority neighborhoods and at-risk families are updated regularly; deterioration triggers follow-up.	Integrated data, data protection, and urban service networks; monthly or quarterly surveillance and case review.

Source: Study synthesis.

Because an allocation ceiling is only the upstream fiscal commitment, evaluation should not stop at the ceiling or aggregate central disbursement. For each relevant component, planning and implementing agencies should maintain a traceable chain from ceiling to central disbursement, local expenditure or absorption, activity, location, beneficiary, output, asset or service functionality, continuity, quality, utilization, and where the design permits outcome.

Because the same prevalence can reflect different constraints, proposal appraisal should begin with a verified local diagnosis rather than a prevalence ranking. The typology can inform the intensity and content of verification and technical assistance: High-Priority regions require emphasis on reach, readiness, staffing, operations, and functionality; Transition/Strengthening regions on asset audit, quality, utilization, and internal equity; and Relatively Better regions on fine-scale targeting, maintenance, surveillance, and prevention of deterioration. Current microdata, location-specific service gaps, and validation by local authorities must remain decisive.

Because nominal coverage and fiscal inputs do not establish effective service exposure, Physical and Non-Physical DAK should be designed as complementary but separately traceable inputs around the same verified service pathway. A physical proposal should specify the personnel, supplies, operating costs, maintenance, referral, and outreach needed to make the asset functional; an operational proposal, including BOK-supported pathways, should specify the facility and access conditions on which delivery depends, and the population intended to use it. Monitoring should then test functionality, quality, continuity, targeting, and utilization rather than infer complementarity from aggregate ceilings.

Limitations

Because the design is observational, the estimates are associational rather than causal. Allocation may respond to local need, and TWFE cannot eliminate all time-varying confounding, measurement error, or endogenous allocation responses. The fiscal regressors are administrative allocation ceilings. Table 3 additionally documents DJPK-reported central-government disbursement for the broader Physical and Non-Physical DAK portfolios, but those descriptive totals are not the modeled stunting-related fiscal variables. Comparable component-level disbursement matching the study's year-specific stunting-related basket and local-government expenditure/absorption are not consistently observed. The real and per-capita checks therefore address price and population scaling but do not measure implementation, output production, service functionality, service quality, or beneficiary exposure. A one-year lag provides only limited temporal ordering and may be too short for physical investments or longer service pathways to affect nutritional outcomes.

BOK requires a specific qualification. It is already included in the constructed Non-Physical DAK aggregate where listed in the annual allocation records; the limitation is therefore not omission of BOK from the fiscal variable. Table 3 provides broader portfolio-level Non-Physical DAK central disbursement, but the available data do not identify region-year BOK-specific local expenditure/absorption or pair realized BOK utilization with Physical DAK utilization. The study consequently cannot estimate a BOK-specific association, an effect of BOK absorption, or the realized complementarity of Physical DAK and BOK. Those questions require component-level disbursement and local implementation data linked to activities, outputs, locations, and beneficiaries.

The analysis is based on 27 regional clusters observed in five outcome years. CR2 and WCB improve small-cluster inference but do not solve identification, and several predictors retain limited within-region variation after region and year effects are removed. The official stunting series measures a common outcome but is generated through survey and estimation systems that differ across years; year fixed effects absorb common annual shifts but cannot remove region-specific measurement differences. Regional averages also hide village-, neighborhood-, household-, and child-level heterogeneity. The three-group typology is exploratory, partly associated with regency-municipality status, and sensitive to the inclusion of DAK, while the document review captures formal arrangements and reported implementation rather than the complete financing-output-outcome chain. Operational use therefore requires current local microdata, verified service gaps, realization records, asset-function assessments, and validation by local authorities.

Conclusion

This study shows that the central planning problem is not whether DAK matters in the abstract, but what can legitimately be learned from an allocation ceiling. Previous-year Physical and Non-Physical DAK ceilings do not show a consistent within-region association with reported stunting once regional characteristics and common annual variation are accounted for. The finding therefore speaks to the limits of ceiling as an evaluative measure. The ceilings sit upstream of disbursement, local spending, implementation, functioning services, utilization, and child growth; they may also be larger where needs are greater. The broader disbursement series confirms that central-to-local flows can be documented, while evaluating the transmission chain requires component-matched local expenditure and service-exposure data.

The other analyses clarify why moving beyond the ceiling is necessary. High aggregate service coverage does not by itself establish effective coverage. Comparable stunting prevalence can coexist with different combinations of women's schooling, WASH, maternal services, economic capacity, access, and implementation conditions. The DAK-free typology captures those differences as a diagnostic classification, while its sensitivity to adding DAK shows the risk of mixing underlying need with a possible fiscal response to that need. The document review, in turn, identifies an evidentiary discontinuity between formal plans and a fully traceable path to functionality and utilization, providing implementation context for the fiscal results.

The overall lesson is therefore to treat DAK as a coordinated implementation system rather than a nominal input. Planning should start from verified local constraints, join capital investment to operations, staffing, and maintenance, and follow both funding streams through functioning, high-quality, targeted, and utilized services. Differentiation is essential: broad reach and readiness in High-Priority regions, consolidation of functionality and internal equity in Transition/Strengthening regions, and fine-scale targeting and maintenance in Relatively Better regions. Future research can test these pathways only when allocation ceilings are linked to component-level disbursement, local expenditure, activities, outputs, asset functionality, service quality, and beneficiary exposure.

Declaration of Generative AI Use

The authors used Grammarly on a limited basis to assist with grammar checking in the manuscript. The authors reviewed and decided on all suggested corrections. The authors remain fully responsible for the content, data, analyses, interpretations, and conclusions of the article.

Author Contributions

Mahpudin contributed to the conceptualization of the study, development of the research framework, literature review, methodology design, data collection and processing, formal analysis, visualization of results, interpretation of findings, and preparation of the initial manuscript draft. Harianto contributed to conceptual and methodological supervision, validation of the interpretation of results, critical review, and manuscript revision. Feryanto contributed to supervision of the research design and methodology, validation of the analysis and discussion, critical review, and manuscript editing. All authors participated in reviewing the manuscript and approved the final version for publication.

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Conflict of Interest

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