

# “Determinants of village SDG achievement in Kuningan Regency, Indonesia: The mediating role of village fund optimization”

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# DETERMINANTS OF VILLAGE SDG ACHIEVEMENT IN KUNINGAN REGENCY, INDONESIA: THE MEDIATING ROLE OF VILLAGE FUND OPTIMIZATION

## Abstract

Fiscal decentralization has transferred substantial financial authority to Indonesian villages, yet whether these resources translate into measurable development progress continues to depend on the quality of local governance and institutional capacity. This study examines the determinants of perceived village-level Sustainable Development Goal (SDG) achievement by testing the mediating role of village fund optimization in the relationships among collaborative governance, human resource capacity, and local government support.

Using a quantitative, cross-sectional design, primary data were collected between September 2025 and February 2026 from 100 village officials in Kuningan Regency, West Java, Indonesia, and analyzed using partial least squares structural equation modeling (PLS-SEM), with hypothesis decisions based on 95% bias-corrected and accelerated (BCa) bootstrap confidence intervals. Collaborative governance ( $\beta = 0.650$ ) and local government support ( $\beta = 0.451$ ) significantly predict village fund optimization (adjusted  $R^2 = 0.675$ ). The direct effect of human resource capacity ( $\beta = 0.204$ ) is not statistically distinguishable from zero. Village fund optimization is also significantly associated with perceived village SDG achievement ( $\beta = 0.762$ ; adjusted  $R^2 = 0.576$ ) and mediates the relationship for collaborative governance ( $\beta = 0.495$ ) and local government support ( $\beta = 0.343$ ), but not for human resource capacity ( $\beta = 0.155$ ).

These findings indicate that how village funds are managed, rather than the volume of the transfer alone, is closely associated with village officials' perceptions of progress toward village SDGs, and that this effectiveness is shaped primarily by collaborative governance and local government support rather than by human resource capacity as measured here.

## Keywords

village fund, collaborative governance, fiscal decentralization, local government, SDG localization

## JEL Classification

H83, R51, O18, M48

## INTRODUCTION

Sustainable development goals (SDGs) constitute the dominant global framework for organizing development priorities, yet their translation into measurable progress at the sub-national level remains uneven, particularly in rural areas confronting depopulation, thin infrastructure, and unequal access to public services (OECD, 2020; Rodríguez-Pose & Ketterer, 2020; Sachs et al., 2022). This reflects a deeper, unresolved problem in the decentralization literature: how governance quality and institutional capacity condition whether fiscal transfers are converted into development outcomes rather than dissipated through weak administration (Bardhan & Mookherjee, 2006; Faguet, 2014).

Indonesia offers an instructive setting for examining this problem. Since Government Regulation of the Republic of Indonesia Number 6 of 2014 on Villages (Legislation of the Republic of Indonesia, 2014), the national

government has channeled a rapidly growing volume of direct fiscal transfers, known as Dana Desa (Village Fund), to more than 75,000 villages, reaching approximately IDR 71 trillion in the 2025 state budget (DJPK, 2024). To monitor how these transfers translate into local outcomes, the Ministry of Villages, Development of Disadvantaged Regions, and Transmigration has institutionalized the Village Building Index (Indeks Desa Membangun) and, more recently, the SDGs Desa framework, disaggregating the global SDGs into eighteen village-level goals (Lestari et al., 2023; Legislation of the Republic of Indonesia, 2020).

Yet independent case studies and governance audits continue to document persistent weaknesses in this transfer system, including uneven administrative capacity, inconsistent reporting, and recurring fund misallocation that have drawn sustained scrutiny from Indonesia's anti-corruption institutions and civil-society monitors (Ginting et al., 2024; Lewis, 2015; Wardhani et al., 2025). These findings suggest that transfer volume alone is a poor predictor of development outcomes, and that governance-related antecedents deserve closer empirical attention. Despite growing scholarly interest in Indonesia's village fund policy, the mechanisms through which collaborative governance, human resource capacity, and local government support jointly shape village fund management, and through it progress toward village SDGs, remain insufficiently understood. Existing studies tend to examine these antecedents separately rather than model village fund management as the intervening pathway connecting them. This gap constitutes the problem addressed here: the extent to which these three antecedents jointly determine village SDG achievement via village fund optimization.

## 1. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Collaborative governance theory holds that multi-stakeholder engagement in public decision-making improves the effectiveness and legitimacy of collective outcomes (Ansell & Gash, 2008; Emerson et al., 2012). Applied to village development, this perspective suggests that when village governments, communities, local governments, universities, and other stakeholders jointly participate in planning and oversight, information asymmetries are reduced, collective responsibility is strengthened, and fund-allocation decisions become more responsive to local needs (Fanida & Ladiqi, 2024; Halim et al., 2023; Lee & Esteve, 2023; Sidik, 2025). Collaborative arrangements enhance trust, coordination, and shared commitment among stakeholders, which in turn improves public-sector performance and reduces the misallocation of public funds (Emerson & Nabatchi, 2015; Rammohan & Tohari, 2023). On this basis, collaborative governance is expected to function as a key antecedent of effective village fund management.

The resource-based view (RBV) posits that organizational performance is substantially determined by the availability and effective deployment of inter-

nal resources, particularly human capital (Barney, 1991). In village governance, human resource capacity, encompassing formal education, technical training, work experience, and administrative competence of village officials, shapes the quality of planning, budgeting, implementation, and monitoring of village fund utilization (Dangui et al., 2026; Madubun, 2024). Prior research on decentralized public financial management identifies limited administrative and technical capacity as a persistent constraint on effective resource use, particularly where local governments have gained substantial autonomy without a commensurate increase in staff competence (Andrews et al., 2013; Grindle, 1997; Sidik, 2025). Conversely, villages with more capable officials tend to exhibit stronger financial management practices and better development outcomes (Bake et al., 2026; Kustono et al., 2026). Human resource capacity is therefore expected to positively influence village fund optimization, although, consistent with the RBV's emphasis on resources operating jointly with organizational structures, its effect may be comparatively modest where governance and institutional-support mechanisms already carry most of the explanatory weight.

Institutional theory explains that organizational behavior is shaped by formal rules, external pressures, and the broader institutional environment within which an organization is embed-

ded (DiMaggio & Powell, 1983; Jakobsen, 2015). Village governments in Indonesia's decentralized system do not operate independently; they function within a supervisory structure in which district and provincial governments provide regulatory guidance, technical assistance, monitoring, and fiscal oversight (Syukri, 2024). This form of institutional support is particularly consequential for village fund management, where administrative capacity and regulatory compliance are often uneven (Hasenberger, 2024; Ma & Su, 2024). From an institutional perspective, such support enhances legitimacy and accountability, reduces uncertainty in decision-making, and helps deter mismanagement and corruption (Faguet, 2014; Kequan, 2023; Smoke, 2015). Local government support is therefore expected to be positively associated with village fund optimization.

Beyond these three antecedents, village fund optimization itself is expected to shape village SDG achievement. Public financial management theory holds that translating fiscal inputs into development outcomes depends not merely on the volume of resources but on how well they are planned, allocated, implemented, monitored, and evaluated (Aini Kusumaningrum et al., 2021; Shah, 2007). In the village context, optimized fund management supports poverty alleviation, rural infrastructure development, environmental sustainability initiatives, and more equitable distribution of development benefits (Anjani et al., 2020; Eko Prasetyo et al., 2025; Handayani et al., 2023; Meirinawati et al., 2024). Because these are precisely the domains that the village SDG framework is designed to track, the effectiveness of village fund management is expected to be closely linked to villages' progress on these indicators (Nyeleker & Suswanta, 2025; Sachs et al., 2022).

Governance quality, organizational resources, and institutional support do not automatically translate into development outcomes. Their influence is realized largely through the effectiveness with which public resources are subsequently managed (Sutikno et al., 2024). Village fund optimization is therefore conceptualized here as the intermediary process through which governance-related antecedents are converted into tangible development results (Prasetyo et al., 2021). Collaborative governance is expected to support this pathway by

improving the accuracy with which development priorities are identified and by strengthening oversight of fund allocation (Bianchi et al., 2021). Human resource capacity is expected to operate through the same pathway by improving the quality of planning, budgeting, and financial reporting (Kimaro, 2006; Waruwu et al., 2025), while local government support is expected to strengthen it through regulatory guidance, technical assistance, and monitoring (Fanida & Ladiqi, 2024; Kequan, 2023). Prior research has examined governance-related antecedents' direct effects on development performance but rarely village fund optimization as the mechanism linking them to village SDG achievement. This study addresses that gap.

This study examines the determinants of perceived village-level Sustainable Development Goal (SDG) achievement by testing the mediating role of village fund optimization in the relationships among collaborative governance, human resource capacity, and local government support.

Collaborative governance, human resource capacity, and local government support are thus hypothesized to shape village SDG achievement both directly and indirectly through village fund optimization, integrating collaborative governance theory, the resource-based view, and institutional theory into one model. This study accordingly tests village fund optimization as the mediating mechanism linking these determinants to village SDG achievement in Kuningan Regency, Indonesia.

Study hypotheses are as follows:

- H1: Collaborative governance has a positive effect on village fund optimization.*
- H2: Human resource capacity has a positive effect on village fund optimization.*
- H3: Local government support has a positive effect on village fund optimization.*
- H4: Village fund optimization has a positive effect on village SDG achievement.*
- H5: Village fund optimization mediates the relationship between collaborative governance and village SDG achievement.*

- H6: *Village fund optimization mediates the relationship between human resource capacity and village SDG achievement.*
- H7: *Village fund optimization mediates the relationship between local government support and village SDG achievement.*

## 2. METHODS

This study adopts a quantitative research approach to examine the relationships among collaborative governance, human resource capacity, local government support, village fund optimization, and village SDG achievement, testing theoretically grounded hypotheses and analyzing causal relationships among latent constructs using statistical techniques (Sekaran & Bougie, 2016). Because exactly one respondent was surveyed per village, the unit of analysis is unambiguous, and intra-village clustering does not arise in this dataset.

Specifically, this paper employs a variance-based structural equation modeling approach, namely partial least squares (PLS-SEM). PLS-SEM suits this study: it accommodates complex models with multiple constructs and mediating relationships, does not require normally distributed data, and supports predictive analysis and theory development in relatively underexplored contexts such as village governance and SDG achievement (Hair et al., 2019; Sarstedt et al., 2017).

Furthermore, this study uses a cross-sectional design, in which data are collected at a single point in time, an approach commonly applied in governance and public-sector research to capture respondents' perceptions of organizational practices and policy implementation (Sekaran & Bougie, 2016). Respondents were village officials directly involved in village fund management, and the achievement construct analyzed in this study is therefore a perception-based measure reported by these officials rather than an externally audited outcome.

All constructs in this study were operationalized using multiple indicators adapted from prior studies to ensure content validity, and responses were measured using a five-point Likert scale ranging

from 1 (strongly disagree) to 5 (strongly agree). Each construct is specified reflectively, consistent with the source instruments from which its indicators were adapted; because the human resource capacity and village SDG achievement constructs combine indicators that could plausibly form rather than reflect the underlying construct, this specification is tested empirically rather than assumed, using the confirmatory tetrad analysis and formative-model robustness check reported later in this section.

The operationalization of variables, including their respective indicators and sources, is presented in Table 1.

Data for this study were collected using a structured questionnaire distributed to village officials involved in the management and implementation of village funds. The respondents include village heads, village secretaries, financial officers, and other relevant administrative staff who have direct responsibilities in governance and development programs at the village level.

This study employs a two-stage purposive sampling approach. In the first stage, all 32 districts in Kuningan Regency were approached, and district officials were asked to nominate villages within their jurisdiction considered to demonstrate strong practice in village fund management. Because this nomination was left to each district's own judgment rather than allocated according to a predetermined quota, the number of villages nominated varied unevenly across districts, yielding a pool of 145 nominated villages overall. This reputational, criterion-based selection procedure (Patton, 2002; Tremblay, 1957) was chosen to ensure that respondents had direct, substantive exposure to village fund management practice. However, it does not constitute random or stratified sampling by village development status (IDM category), and it is expected to bias the sample toward comparatively well-performing villages. In the second stage, within each nominated village, the village head appointed a single official, typically the one judged most knowledgeable about village fund management, to complete the questionnaire, following a key-informant sampling logic (Etikan et al., 2016), which also ensures exactly one respondent per village.

**Table 1.** Variables

| Variable                  | Dimension                                         | Data         | References                                                                                   |
|---------------------------|---------------------------------------------------|--------------|----------------------------------------------------------------------------------------------|
| Collaborative governance  | Stakeholder participation in village governance   | Primary Data | Ansell and Gash (2008), Condro et al. (2025), Emerson et al. (2012), Nurhayati et al. (2024) |
|                           | Coordination among involved actors                |              |                                                                                              |
|                           | Transparency in decision-making                   |              |                                                                                              |
|                           | Joint decision-making                             |              |                                                                                              |
| Human resource capacity   | Formal educational level                          | Primary Data | Becker (1993), Kimaro (2006)                                                                 |
|                           | Technical Training                                |              |                                                                                              |
|                           | Work experience                                   |              |                                                                                              |
|                           | Technical and administrative capability           |              |                                                                                              |
| Local government support  | Assistance from district government               | Primary Data | OECD (2023), World Bank (2021)                                                               |
|                           | Availability of information and reporting systems |              |                                                                                              |
|                           | Regular monitoring and evaluation                 |              |                                                                                              |
|                           | Technical assistance or facilitation              |              |                                                                                              |
| Village fund optimization | Utilization of funds in accordance with planning  | Primary Data | Mardiasmo (2018), Sarifuddin et al. (2022), Syafingi et al. (2020)                           |
|                           | Effectiveness of program implementation           |              |                                                                                              |
|                           | Timeliness of fund absorption                     |              |                                                                                              |
|                           | Impact on community needs                         |              |                                                                                              |
| Village SDG achievement   | Access to basic services                          | Primary Data | del Arco et al. (2021), Prasetyo et al. (2021), Sachs et al. (2022), United Nations (2015)   |
|                           | Availability of basic infrastructure              |              |                                                                                              |
|                           | Improvements of community welfare                 |              |                                                                                              |
|                           | Environmental sustainability activities           |              |                                                                                              |

The data collection process was conducted through both direct and indirect distribution methods. Questionnaires were distributed in person and through online platforms to improve accessibility and response rates. Prior to the main survey, a pilot test was conducted to ensure the clarity and reliability of the measurement instruments.

Questionnaires were distributed to all 145 nominated villages (one per village). Of these, 135 were returned, with a response rate of 93.1% (135/145); the remaining 10 questionnaires were not retrieved because they were lost during on-site data collection in the corresponding villages. Of the 135 returned questionnaires, 100 were retained as valid for analysis after data screening, yielding a usable response rate of 68.97% (100/145), equivalent to 74.1% of returned questionnaires (100/135). The 35 excluded questionnaires were removed on the basis of a single, pre-specified attention-check criterion. The instrument included reverse-worded (negatively phrased) items that an attentive respondent would be expected to answer toward the low end of the scale. The 35 excluded respondents instead answered homogeneously at the high end of the scale (predominantly “5”) across the entire instrument, including these reverse-worded items, a pattern consistent with careless or straight-line responding (DeSimone et al., 2015; Meade & Craig, 2012). The final sample of 100 satisfies the mini-

mum sample-size guidance for PLS-SEM based on the ten-times rule and prior methodological recommendations for models of comparable complexity (Hair et al., 2019).

The data analysis in this study employs both descriptive and inferential statistical approaches. Descriptive statistics are used to summarize respondents’ characteristics and provide an overview of the distribution of responses for each research variable. This analysis includes measures such as mean scores, percentages, and categorization levels to interpret respondents’ perceptions of the constructs under investigation.

PLS-SEM also serves as the primary inferential technique, given its capability to analyze complex models with multiple latent constructs and its suitability for exploratory research with relatively small samples (Hair et al., 2019; Henseler et al., 2016).

The analysis is conducted using SmartPLS software, which enables simultaneous assessment of the measurement model and the structural model. The evaluation process consists of two main stages. First, the measurement model (outer model) is assessed to ensure the validity and reliability of the constructs. Convergent validity is evaluated through indicator loadings ( $\geq 0.70$ ) and av-

erage variance extracted ( $AVE \geq 0.50$ ). Internal consistency reliability is assessed using composite reliability ( $CR \geq 0.70$ ) and Cronbach's Alpha ( $\geq 0.70$ ). Discriminant validity is examined using the Fornell–Larcker criterion and cross-loadings (Hair et al., 2019). Second, the structural (inner) model is evaluated through path coefficients obtained via bootstrapping with 500 subsamples, bias-corrected and accelerated (BCa) 95% confidence intervals, and a two-tailed test at  $\alpha = 0.05$ , together with the coefficient of determination ( $R^2$ ) (Hair et al., 2019). Hypothesis decisions are based primarily on whether the 95% BCa confidence interval for a given path excludes zero. Next,  $t$ -statistics and  $p$ -values are reported alongside for transparency but are not used on their own to override a confidence interval that includes zero.

Beyond these baseline criteria, this study addresses the measurement-specification concern raised for human resource capacity and village SDG achievement by empirically testing their reflective specification rather than relying solely on the source instruments. A confirmatory tetrad analysis (CTA-PLS) was conducted for all five constructs to test whether each construct's non-redundant tetrads differ significantly from zero, which would indicate that a formative specification fits the data better than a reflective one (Gudergan et al., 2008). For village SDG achievement, whose CTA-PLS result indicated a formative pattern, a formative re-specification was additionally estimated as a robustness check, evaluated using outer weights, outer VIF, and bootstrap confidence intervals rather than the reflective criteria above. Full CTA-PLS results and the formative robustness check are reported in the Results and discussion section and in Appendix A.

### 3. RESULTS AND DISCUSSION

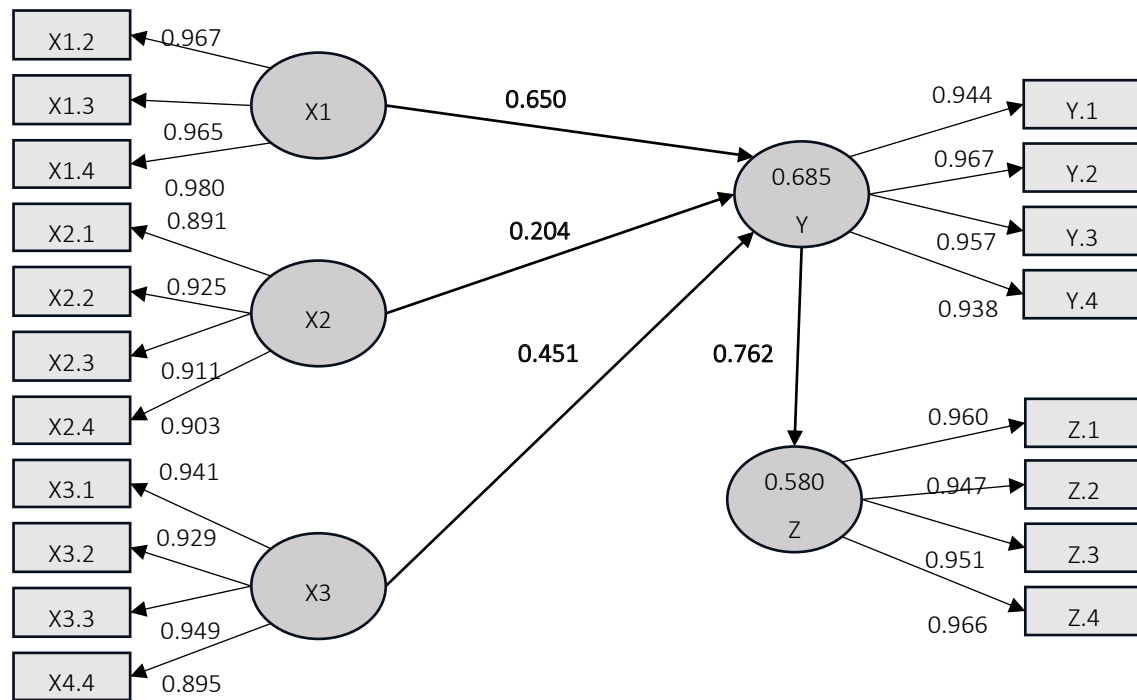
This study is based on data collected from 100 respondents. The descriptive statistics of the five research variables are presented in Table A1.

The analysis of the five research variables indicates that all measured aspects fall within the “good” range, although variations are observed across dimensions. Collaborative governance recorded the highest overall mean among the five variables (Mean = 3.79, 75.70%), with transparency in de-

cision-making the strongest dimension (76.40%) and stakeholder participation the weakest (74.60%), suggesting governance processes are functioning well, although deeper community participation could still be enhanced. Human resource capacity was the lowest-performing variable (Mean = 3.37, 67.98%): technical and administrative capability scored comparatively well (74.50%), whereas technical training (63.40%) and work experience (62.80%) lagged well behind. Local government support scored similarly low (Mean = 3.38, 67.67%). Assistance from the district government (71.10%) and technical assistance (72.70%) were comparatively strong, while information and reporting systems (63.90%) and monitoring and evaluation (63.00%) were the weakest dimensions. Village fund optimization performed well overall (Mean = 3.84, 76.23%), led by the timeliness of fund absorption (79.10%). Village SDG achievement was similarly strong (Mean = 3.83, 76.58%), with infrastructure availability (78.10%) and access to basic services (77.20%) the leading dimensions. Taken together, village fund optimization and village SDG achievement were the strongest-performing variables, while human resource capacity and local government support lagged behind, an early pattern that foreshadows human resource capacity's weaker performance in the structural model.

The evaluation of the measurement (outer) model proceeded in three stages: convergent validity assessed through factor loadings, construct reliability assessed through average variance extracted (AVE) and composite reliability (CR), and discriminant validity.

All indicators exhibit standardized loading factors ranging from 0.89 to 0.98 (Figure 1), well above the 0.70 threshold, indicating that each indicator reliably represents its respective construct. The most dominant indicator in each construct is joint decision-making for collaborative governance ( $X1.4 = 0.980$ ), work experience for human resource capacity ( $X2.3 = 0.925$ ), monitoring and evaluation for local government support ( $X3.3 = 0.949$ ), effectiveness of program implementation for village fund optimization ( $Y.2 = 0.967$ ), and environmental sustainability activities for village SDG achievement ( $Z.4 = 0.966$ ). This pattern is consistent with a coherent, well-represented measurement model overall.



Note: X1 = Collaborative governance; X2 = Human resource capacity; X3 = Local government support; Y = Village funds optimization; Z = Village SDG achievement.

**Figure 1.** Standardized loading factor (SLF) model

Composite reliability (CR) and average variance extracted (AVE) were used to assess construct reliability and convergent validity, alongside Cronbach's Alpha and rho\_A, as reported in Table 2.

All constructs exceed the recommended thresholds: CR ranges from 0.949 to 0.983, Cronbach's Alpha from 0.929 to 0.977, rho\_A from 0.946 to 0.977, and AVE from 0.824 to 0.934 (Table 3), indicating excellent internal consistency and convergent validity throughout the measurement model.

Discriminant validity was assessed using cross-loadings (Table 3) and the heterotrait-monotrait ratio of correlations (Table 4). All indicators

load more strongly on their intended construct than on any other, and all ten construct-pair HTMT values fall below the conservative 0.85 threshold, including the pair for village fund optimization and village SDG achievement (HTMT = 0.778).

To address the measurement-specification concern raised for human resource capacity and village SDG achievement, a confirmatory tetrad analysis (CTA-PLS) was conducted for all five constructs, testing whether each construct's non-redundant tetrads differ significantly from zero. This pattern would favor a formative over a reflective specification (Gudergan et al., 2008). Table 5 reports the results.

**Table 2.** Composite reliability and average variance extracted

| Construct                      | Cronbach's Alpha | rho_A | Composite Reliability (CR) | Average Variance Extracted (AVE) |
|--------------------------------|------------------|-------|----------------------------|----------------------------------|
| Collaborative governance (X1)  | 0.977            | 0.977 | 0.983                      | 0.934                            |
| Human resource capacity (X2)   | 0.929            | 0.946 | 0.949                      | 0.824                            |
| Local government support (X3)  | 0.947            | 0.960 | 0.962                      | 0.863                            |
| Village funds optimization (Y) | 0.965            | 0.968 | 0.975                      | 0.906                            |
| Village SDG achievement (Z)    | 0.969            | 0.976 | 0.977                      | 0.914                            |

**Table 3.** Discriminant validity (cross-loadings)

| Indicators | X1     | X2     | X3     | Y     | Z      |
|------------|--------|--------|--------|-------|--------|
| X1.1       | 0.954  | 0.288  | -0.069 | 0.686 | 0.424  |
| X1.2       | 0.967  | 0.188  | 0.096  | 0.682 | 0.459  |
| X1.3       | 0.965  | 0.304  | 0.053  | 0.730 | 0.510  |
| X1.4       | 0.980  | 0.234  | 0.050  | 0.677 | 0.457  |
| X2.1       | 0.202  | 0.891  | -0.317 | 0.182 | -0.038 |
| X2.2       | 0.257  | 0.911  | -0.328 | 0.181 | -0.121 |
| X2.3       | 0.186  | 0.925  | -0.291 | 0.134 | -0.136 |
| X2.4       | 0.287  | 0.903  | -0.432 | 0.214 | 0.127  |
| X3.1       | 0.064  | -0.440 | 0.941  | 0.412 | 0.689  |
| X3.2       | -0.058 | -0.351 | 0.929  | 0.319 | 0.332  |
| X3.3       | -0.040 | -0.379 | 0.949  | 0.393 | 0.469  |
| X3.4       | 0.166  | -0.239 | 0.895  | 0.322 | 0.571  |
| Y.1        | 0.755  | 0.216  | 0.267  | 0.944 | 0.808  |
| Y.2        | 0.613  | 0.256  | 0.381  | 0.967 | 0.687  |
| Y.3        | 0.769  | 0.179  | 0.347  | 0.957 | 0.745  |
| Y.4        | 0.580  | 0.111  | 0.521  | 0.938 | 0.646  |
| Z.1        | 0.526  | -0.014 | 0.529  | 0.767 | 0.960  |
| Z.2        | 0.317  | -0.081 | 0.716  | 0.658 | 0.947  |
| Z.3        | 0.580  | 0.091  | 0.345  | 0.802 | 0.951  |
| Z.4        | 0.373  | -0.144 | 0.607  | 0.663 | 0.966  |

Note: X1 = Collaborative governance; X2 = Human resource capacity; X3 = Local government support; Y = Village funds optimization; Z = Village SDG achievement.

**Table 4.** Heterotrait-monotrait ratio (HTMT) of correlations

| Construct Pair | HTMT  | Assessment |
|----------------|-------|------------|
| X1 – X2        | 0.268 | Below 0.85 |
| X1 – X3        | 0.099 | Below 0.85 |
| X1 – Y         | 0.734 | Below 0.85 |
| X1 – Z         | 0.482 | Below 0.85 |
| X2 – X3        | 0.394 | Below 0.85 |
| X2 – Y         | 0.206 | Below 0.85 |
| X2 – Z         | 0.135 | Below 0.85 |
| X3 – Y         | 0.412 | Below 0.85 |
| X3 – Z         | 0.591 | Below 0.85 |
| Y – Z          | 0.778 | Below 0.85 |

Note: X1 = Collaborative governance; X2 = Human resource capacity; X3 = Local government support; Y = Village funds optimization; Z = Village SDG achievement.

**Table 5.** Confirmatory tetrad analysis (CTA-PLS) summary

| Construct                     | Tetrad 1<br>(P; adj. 95% CI) | Tetrad 2<br>(P; adj. 95% CI) | CTA-PLS Indication | Specification Retained                             |
|-------------------------------|------------------------------|------------------------------|--------------------|----------------------------------------------------|
| Collaborative Governance (X1) | 0.380                        | 0.021                        | Formative-leaning  | Reflective                                         |
|                               | [-0.028, 0.012]              | [0.001, 0.042]               |                    |                                                    |
| Human Resource Capacity (X2)  | 0.227                        | 0.120                        | Reflective         | Reflective                                         |
|                               | [-0.012, 0.042]              | [-0.081, 0.013]              |                    |                                                    |
| Local Government Support (X3) | 0.083                        | < 0.001                      | Formative-leaning  | Reflective                                         |
|                               | [-0.037, 0.004]              | [-0.110, -0.032]             |                    |                                                    |
| Village Fund Optimization (Y) | < 0.001                      | 0.349                        | Formative-leaning  | Reflective                                         |
|                               | [-0.022, -0.011]             | [-0.001, 0.004]              |                    |                                                    |
| Village SDG Achievement (Z)   | 0.007                        | 0.002                        | Formative-leaning  | Reflective (formative tested see robustness check) |
|                               | [-0.022, -0.002]             | [0.002, 0.014]               |                    |                                                    |

Human resource capacity was the only construct for which neither tetrad differed significantly from zero ( $p = 0.227$  and  $0.120$ ; adjusted 95% CIs  $[-0.012, 0.042]$  and  $[-0.081, 0.013]$ , both including zero), so its reflective specification cannot be rejected on this test and is retained. Village SDG achievement showed the clearest formative signal, with both tetrads significant and their adjusted confidence intervals excluding zero. Collaborative governance, local government support, and village fund optimization each showed at least one significant tetrad as well.

For collaborative governance, local government support, and village fund optimization, the reflective specification is nonetheless retained. Their indicators are conceptually interchangeable manifestations of a single underlying quality. The various facets of participatory governance, of institutional support, and of disciplined fund management are each expected to move together rather than to combine additively (Gudergan et al., 2008), and all three constructs already show excellent reflective psychometric properties, with no measurement-specification concern raised for them in prior review. A single statistical diagnostic is treated here as one input among several, alongside conceptual fit and psychometric performance, rather than as a mechanical trigger for re-specification, consistent with guidance that CTA-PLS results should be read together with theoretical judgment (Gudergan et al., 2008).

For human resource capacity, the CTA-PLS result reinforces the reflective specification retained throughout this study, though this deserves explicit comment: composite constructs of this general type, combining education, training, and experience, are conventionally treated as formative in the measurement literature, e.g., socioeconomic status (Bollen & Lennox, 1991). That this sample's

data instead support a reflective pattern may partly reflect common method variance, since all four indicators were rated by the same respondent on the same instrument at the same time.

For village SDG achievement, the CTA-PLS result, together with the conceptual observation that access to basic services, infrastructure, welfare, and environmental sustainability need not move together within a single village, motivated a formative re-specification, estimated as a robustness check and summarized next.

A formative re-specification of village SDG achievement was estimated, evaluating its four indicators using outer weights, outer variance inflation factors (VIF), and bootstrap confidence intervals rather than the reflective criteria used elsewhere in this study. The check revealed outer VIF values between 8.5 and 15.1 across the four indicators, well above the conventional threshold of 5. Together with an outer weight that reversed sign relative to its own outer loading for one indicator, this indicates a pattern of severe multicollinearity among formative indicators rather than a substantive finding about village development (full results are reported in Table A7, Appendix A). Collinearity of this magnitude is generally considered to make formative weight estimates unstable and difficult to interpret; village SDG achievement is therefore retained as a reflective construct throughout the analysis, and a formative re-specification with a revised or reduced indicator set is identified as a direction for future research rather than adopted here.

The structural model was evaluated using path coefficients obtained through bootstrapping, with hypothesis decisions based primarily on whether the 95% BCa confidence interval for each path excludes zero.

**Table 6.** Results of direct effect testing

| Direct Effect Path | Original Sample (O) | SE    | t-statistic | P Values | 95% CI (Bca)    | Description   |
|--------------------|---------------------|-------|-------------|----------|-----------------|---------------|
| X1 → Y             | 0.650               | 0.072 | 9.026       | < .001   | [0.499, 0.787]  | Supported     |
| X2 → Y             | 0.204               | 0.101 | 2.009       | 0.045    | [-0.013, 0.386] | Not Supported |
| X3 → Y             | 0.451               | 0.076 | 5.912       | < .001   | [0.298, 0.591]  | Supported     |
| Y → Z              | 0.762               | 0.061 | 12.423      | < .001   | [0.629, 0.872]  | Supported     |

*Note:* The corresponding bootstrapped structural model displaying t-statistics for every path is provided as Figure A1 in Appendix A. X1 = Collaborative governance; X2 = Human resource capacity; X3 = Local government support; Y = Village funds optimization; Z = Village SDG achievement.

All hypothesized direct paths are statistically significant at the 5% level based on conventional  $p$ -values (Table 6), applying the 95% BCa confidence interval as the primary decision criterion. However, three of the four are supported, and one is not. Collaborative governance has a strong and significant effect on village fund optimization ( $\beta = 0.650$ , 95% CI [0.499, 0.787]), supporting H1: higher levels of participatory governance, transparency, and collective decision-making are associated with more effective village fund management. Local government support also has a significant, moderate effect ( $\beta = 0.451$ , 95% CI [0.298, 0.591]), supporting H3: external support mechanisms such as supervision, technical assistance, and monitoring systems are associated with more effective fund utilization. Village fund optimization, in turn, has a strong effect on village SDG achievement ( $\beta = 0.762$ , 95% CI [0.629, 0.872]), supporting H4.

Human resource capacity presents a different picture. Its effect on village fund optimization is nominally significant by conventional standards ( $\beta = 0.204$ ,  $t = 2.009$ ,  $p = 0.045$ ), but its 95% BCa confidence interval, [-0.013, 0.386], includes zero. Applying the same decision criterion used for every other path in this study, H2 is therefore rejected: this study finds no reliable evidence that human resource capacity, as measured here, affects village fund optimization, despite its conventional  $p$ -value.

The indirect effects in Table 7 follow the same pattern. Village fund optimization mediates the relationship between collaborative governance and village SDG achievement ( $\beta = 0.495$ , 95% CI [0.362, 0.603]) and between local government support and village SDG achievement ( $\beta = 0.343$ , 95% CI [0.214, 0.467]), supporting H5 and H7. The indirect effect of human resource capacity through village fund optimization is small ( $\beta = 0.155$ ) and, as with the corresponding direct path, its 95% BCa confidence interval, [-0.010, 0.278], includes zero despite a conventional  $p$ -value of .042; H6 is therefore not supported. Overall, village fund optimization functions as a mediating mechanism linking collaborative governance and local government support, but not human resource capacity as measured here, to village SDG achievement.

Village fund optimization has an adjusted  $R^2$  of 0.675, indicating that collaborative governance, human resource capacity, and local government support jointly explain 67.5% of its variance. Village SDG achievement has an adjusted  $R^2$  of 0.576. The goodness of fit (GoF) index, the square root of the product of average AVE (0.888) and average  $R^2$  (0.633), is 0.750. GoF is treated here only as supplementary background information rather than as evidence of model validity, since it has been shown not to reliably discriminate valid from misspecified models (Henseler et al., 2015). The model's SRMR is 0.096 for the saturated model and 0.128 for the estimated model.

**Table 7.** Indirect effect testing

| Indirect Effect Path               | Original Sample (O) | t-statistic | p-value | 95% CI (Bca)    | Description   |
|------------------------------------|---------------------|-------------|---------|-----------------|---------------|
| X1 $\rightarrow$ Y $\rightarrow$ Z | 0.495               | 8.241       | < .001  | [0.362, 0.603]  | Supported     |
| X2 $\rightarrow$ Y $\rightarrow$ Z | 0.155               | 2.035       | 0.042   | [-0.010, 0.278] | Not Supported |
| X3 $\rightarrow$ Y $\rightarrow$ Z | 0.343               | 5.368       | < .001  | [0.214, 0.467]  | Supported     |

Note: X1 = Collaborative governance; X2 = Human resource capacity; X3 = Local government support; Y = Village funds optimization; Z = Village SDG achievement.

**Table 8.** Goodness of fit

| Construct                     | Average Variance Extracted (AVE) | R Squared | R Squared Adjusted |
|-------------------------------|----------------------------------|-----------|--------------------|
| Collaborative Governance (X1) | 0.934                            |           |                    |
| Human Resources Capacity (X2) | 0.824                            |           |                    |
| Local Government Support (X3) | 0.863                            |           |                    |
| Village Fund Optimization (Y) | 0.906                            | 0.685     | 0.675              |
| Village SDG Achievement (Z)   | 0.914                            | 0.580     | 0.576              |
| Average                       | 0.888                            | 0.633     |                    |
| GoF                           | 0.750                            | 0.750     |                    |

**Table 9.** Effect size ( $f^2$ )

| Construct                      | Village Fund Optimization (Y) | Village SDG Achievement (Z) |
|--------------------------------|-------------------------------|-----------------------------|
| Collaborative Governance (X1)  | 1.219                         |                             |
| Human Resources Capacity (X2)  | 0.102                         |                             |
| Local Government Support (X3)  | 0.537                         |                             |
| Village Funds Optimization (Y) |                               | 1.381                       |
| Village SDG Achievement (Z)    |                               |                             |

The effect size ( $f^2$ ) indicates that collaborative governance has a very large effect on village fund optimization ( $f^2 = 1.219$ ), the most dominant predictor in the model, and local government support has a substantial effect ( $f^2 = 0.537$ ). Human resource capacity's effect size is small ( $f^2 = 0.102$ ), consistent with, and corroborating, its lack of support under the 95% BCa criterion above. Village fund optimization, in turn, has a very large effect on village SDG achievement ( $f^2 = 1.381$ ), confirming it as the key driver of development outcomes among the paths that are supported in this model. The complete SmartPLS project file, dataset, and analysis output underlying Tables 3 to 9 are available as supplementary material to support replication.

The findings of this study offer robust empirical evidence on the determinants of village fund optimization and, through it, village SDG achievement. Applying the 95% BCa confidence interval consistently as the primary decision criterion, collaborative governance and local government support are confirmed as reliable drivers of village fund optimization, while human resource capacity's effect does not survive the same criterion despite reaching conventional significance.

First, collaborative governance's significant, strong effect on village fund optimization ( $H1$ ) confirms the importance of participatory, inclusive governance in rural development, consistent with collaborative governance theory's emphasis on multi-stakeholder engagement, transparency, and consensus-oriented decision-making (Ansell & Gash, 2008). Active community and institutional participation makes fund allocation more responsive and accountable, in line with evidence that governance quality enhances public financial management effectiveness (Emerson et al., 2012; Fung, 2015).

Second, human resource capacity presents a different picture. Under the 95% BCa confidence interval,  $H2$  is not supported: although its path

to village fund optimization reaches conventional significance ( $p = .045$ ), the bootstrap interval,  $[-0.013, 0.386]$ , includes zero, and its effect size is small ( $f^2 = 0.102$ ) against the moderate-to-large effect sizes for collaborative governance and local government support. This does not contradict the resource-based view outright, but it suggests that human resource capacity alone is an unreliable predictor of fund management once governance and institutional-support mechanisms are already present. Its contribution may be absorbed by, or conditional on, those complementary mechanisms rather than operating independently (Crook et al., 2011). The descriptive pattern in Table 2 supports this reading: technical and administrative capability was rated considerably higher (74.50%) than technical training (63.40%) and work experience (62.80%), pointing to heterogeneity among the four indicators even though the CTA-PLS test finds no statistical basis for treating them as anything but reflective indicators of one construct.

This bears directly on the measurement-specification concern raised for human resource capacity and village SDG achievement, addressed here empirically rather than assumed away. The confirmatory tetrad analysis (Table 5) found no evidence against a reflective specification for human resource capacity, and a formative re-specification of village SDG achievement, estimated as a robustness check, produced severe multicollinearity (outer VIF 8.5–15.1) and a sign-reversed weight, evidence that the data do not support a workable formative model with its current four indicators. Together, these checks reinforce confidence in the reflective specification retained throughout the model, and clarify that human resource capacity's weak effect is a substantive finding about this sample rather than an artifact of measurement misspecification.

Third, local government support has a significant, substantial effect on village fund optimization ( $H3$ ), consistent with institutional theory's empha-

sis on external pressures and support systems as drivers of organizational effectiveness (DiMaggio & Powell, 1983). Supervision, technical assistance, and monitoring systems play a central role in improving administrative quality and compliance, echoing evidence that institutional support enhances local government performance (Andrews et al., 2013; Jakobsen, 2015).

Furthermore, village fund optimization, in turn, has a strong, significant effect on village SDG achievement (*H4*), reinforcing effective financial management as a key driver of sustainable development outcomes (Sachs et al., 2022). Proper fund allocation and utilization contribute directly to public services, infrastructure, welfare, and environmental sustainability, consistent with evidence that fiscal decentralization improves outcomes when paired with strong governance (Oates, 1999; Smoke, 2015).

The indirect-effect pattern in Table 7 mirrors these direct effects. Village fund optimization mediates the relationship between collaborative governance and village SDG achievement and between local government support and village SDG achieve-

ment, supporting *H5* and *H7*. This confirms fund management as the mechanism translating governance quality and institutional support into development outcomes, in line with prior work on the mediating role of financial management (Geng et al., 2024; Papenfuß & Keppeler, 2020). The corresponding indirect path through human resource capacity is not supported (*H6*), for the same reason as its direct counterpart: its 95% BCa confidence interval,  $[-0.010, 0.278]$ , includes zero.

Overall, this study contributes to the literature by integrating collaborative governance, institutional capacity, and financial management perspectives into a single model of village development, while showing, through consistent application of 95% BCa confidence intervals and the CTA-PLS and formative robustness checks above, that not every theoretically predicted path survives a more conservative decision criterion. Sustainable village development, on this evidence, depends more on collaborative governance and institutional support than on individual capacity in isolation, with direct implications for the practical recommendations.

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## CONCLUSION

This study examined the extent to which collaborative governance, human resource capacity, and local government support are associated with village SDG achievement in Kuningan Regency through the mediating role of village fund optimization. Collaborative governance and local government support were both reliably associated with village fund optimization, which in turn was strongly associated with village SDG achievement, supporting five of the study's seven hypotheses (*H1*, *H3*, *H4*, *H5*, and *H7*). Human resource capacity's association with fund optimization, and the corresponding mediated path to village SDG achievement, did not survive the 95% BCa confidence interval applied throughout this study (*H2*, *H6*). In conclusion, sustainable village development in this sample is better explained by collaborative governance and institutional support operating through disciplined fund management than by individual administrative capacity in isolation. Moreover, financial management is confirmed as the mechanism through which governance quality and institutional capacity translate into development outcomes at the village level.

Village administrators should prioritize participatory, transparent, and coordinated decision-making, since collaborative governance shows the strongest association with effective fund utilization; local governments should sustain structured oversight, technical assistance, and monitoring, given local government support's substantial contribution to the same outcome. Because optimized fund management is the strongest predictor of village SDG achievement in this model, it merits treatment as a strategic leverage point rather than a routine administrative task, best pursued jointly with governance and institutional-support interventions rather than through fund allocation alone. Continuous training and capacity-building for village officials remain good administrative practice, but this study's finding that human resource capacity's statistical association with fund optimization does not survive the 95% BCa

criterion suggests such investments are best paired with, rather than relied on as a substitute for, the governance and institutional-support mechanisms shown here to matter more directly.

This study also has several limitations. Its cross-sectional design and reliance on a single category of respondents limit the ability to draw causal conclusions and do not rule out the possibility of common method variance partially explaining the strong associations observed. This issue can be addressed in future studies by separating time dimensions or data sources, or by employing marker-variable tests or unmeasured latent factors.

## AUTHOR CONTRIBUTIONS

Conceptualization: Neni Nurhayati.

Data curation: Iman Teguh.

Formal analysis: Iman Teguh.

Funding acquisition: Neni Nurhayati.

Investigation: Iman Teguh.

Methodology: Neni Nurhayati.

Project administration: Dadang Suhendar.

Resources: Dadang Suhendar.

Software: Iman Teguh.

Validation: Dadang Suhendar.

Visualization: Dadang Suhendar.

Writing – original draft: Iman Teguh.

Writing – review & editing: Neni Nurhayati, Dadang Suhendar.

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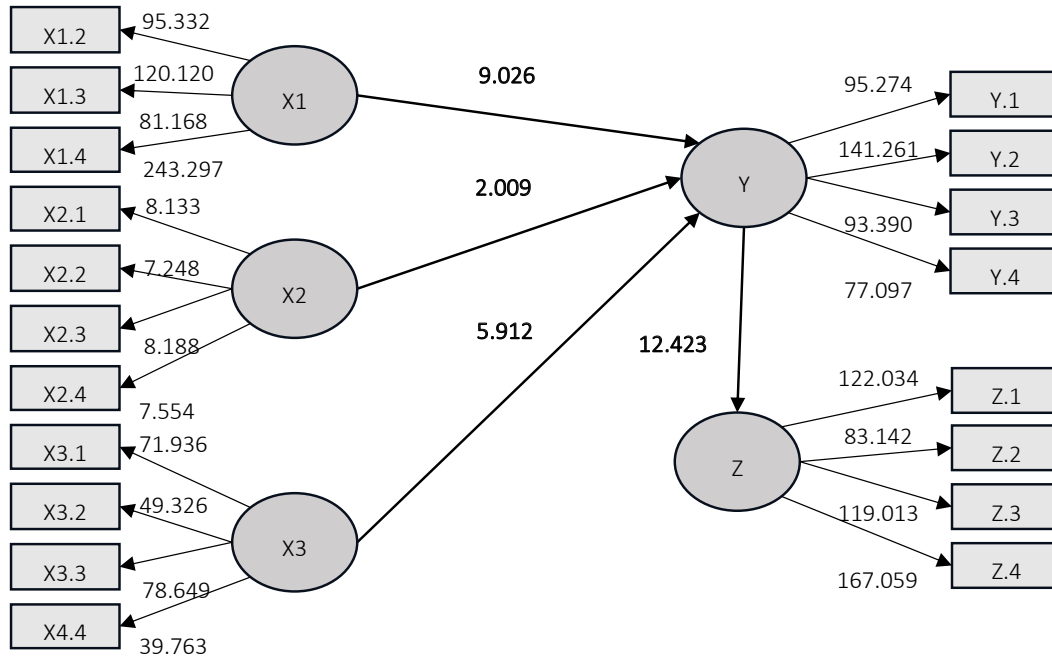
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## APPENDIX A

This section reports the full bootstrapped structural model diagram and the detailed PLS-SEM output underlying the summary tables presented in the main manuscript. The complete SmartPLS project file and dataset are available on request to support replication.



Note: X1 = Collaborative governance; X2 = Human resource capacity; X3 = Local government support; Y = Village funds optimization; Z = Village SDG achievement.

**Figure A1.** Bootstrapped structural model (t-statistics)

**Table A1.** Descriptive statistics of research variables

| Variable                  | Dimension                                         | Score | %     | Category |
|---------------------------|---------------------------------------------------|-------|-------|----------|
| Collaborative Governance  | Stakeholder participation in village governance   | 3.73  | 74.60 | Good     |
|                           | Coordination among involved actors                | 3.80  | 75.90 | Good     |
|                           | Transparency in decision-making                   | 3.82  | 76.40 | Good     |
|                           | Joint decision-making                             | 3.80  | 75.90 | Good     |
|                           | Total Score                                       | 3.79  | 75.70 | Good     |
| Human Resource Capacity   | Formal educational level                          | 3.46  | 69.20 | Good     |
|                           | Technical Training                                | 3.17  | 63.40 | Good     |
|                           | Work experience                                   | 3.14  | 62.80 | Good     |
|                           | Technical and administrative capability           | 3.73  | 74.50 | Good     |
|                           | Total Score                                       | 3.37  | 67.98 | Good     |
| Local Government Support  | Assistance from district government               | 3.56  | 71.10 | Good     |
|                           | Availability of information and reporting systems | 3.20  | 63.90 | Good     |
|                           | Regular monitoring and evaluation                 | 3.15  | 63.00 | Good     |
|                           | Technical assistance or facilitation              | 3.64  | 72.70 | Good     |
|                           | Total Score                                       | 3.38  | 67.67 | Good     |
| Village Fund Optimization | Utilization of funds in accordance with planning  | 3.88  | 77.60 | Good     |
|                           | Effectiveness of program implementation           | 3.72  | 74.40 | Good     |
|                           | Timeliness of fund absorption                     | 3.96  | 79.10 | Good     |
|                           | Impact on community needs                         | 3.79  | 75.80 | Good     |
|                           | Total Score                                       | 3.84  | 76.23 | Good     |
| Village SDG Achievement   | Access to basic services                          | 3.86  | 77.20 | Good     |
|                           | Availability of basic infrastructure              | 3.91  | 78.10 | Good     |
|                           | Improvements of community welfare                 | 3.80  | 76.00 | Good     |
|                           | Environmental sustainability activities           | 3.75  | 75.00 | Good     |
|                           | Total Score                                       | 3.83  | 76.58 | Good     |

**Table A2.** Model fit summary

| Index      | Saturated model | Estimated model |
|------------|-----------------|-----------------|
| SRMR       | 0.096           | 0.128           |
| d_ ULS     | 1.935           | 3.420           |
| d_ G       | 8.123           | 8.449           |
| Chi-Square | 1951.296        | 1973.301        |

Note: SRMR = standardized root mean square residual. d\_ ULS and d\_ G are unweighted and geodesic discrepancy statistics used in the bootstrap-based model-fit test.

**Table A3.** Fornell–Larcker criterion

| Predictors | X1    | X2     | X3    | Y     | Z     |
|------------|-------|--------|-------|-------|-------|
| X1         | 0.967 | –      | –     | –     | –     |
| X2         | 0.263 | 0.908  | –     | –     | –     |
| X3         | 0.034 | –0.386 | 0.929 | –     | –     |
| Y          | 0.719 | 0.201  | 0.394 | 0.952 | –     |
| Z          | 0.479 | –0.031 | 0.563 | 0.762 | 0.956 |

Note: Diagonal values are the square root of each construct's AVE. Off-diagonal values are inter-construct correlations. Discriminant validity is supported when each diagonal value exceeds the correlations in its row and column, consistent with the cross-loading and HTMT results reported in Table 3 and Table 4. X1 = Collaborative governance; X2 = Human resource capacity; X3 = Local government support; Y = Village funds optimization; Z = Village SDG achievement.

**Table A4.** Inner VIF values

| Predictors | X1 | X2 | X3 | Y     | Z     |
|------------|----|----|----|-------|-------|
| X1         | –  | –  | –  | 1.100 | –     |
| X2         | –  | –  | –  | 1.291 | –     |
| X3         | –  | –  | –  | 1.203 | –     |
| Y          | –  | –  | –  | –     | 1.000 |
| Z          | –  | –  | –  | –     | –     |

Note: Inner VIF values assess collinearity among the exogenous predictors of each endogenous construct (columns Y and Z). All values are well below the conventional threshold of 5, indicating no critical collinearity in the structural model. X1 = Collaborative governance; X2 = Human resource capacity; X3 = Local government support; Y = Village funds optimization; Z = Village SDG achievement.

**Table A5.** Bootstrapping detail: Total effects (direct and indirect)

| Path   | O     | SE    | t-statistic | p-value | 95% CI (BCa)    |
|--------|-------|-------|-------------|---------|-----------------|
| X1 → Y | 0.650 | 0.072 | 9.026       | < .001  | [0.499, 0.787]  |
| X1 → Z | 0.495 | 0.060 | 8.241       | < .001  | [0.362, 0.603]  |
| X2 → Y | 0.204 | 0.101 | 2.009       | 0.045   | [–0.013, 0.386] |
| X2 → Z | 0.155 | 0.076 | 2.035       | 0.042   | [–0.010, 0.278] |
| X3 → Y | 0.451 | 0.076 | 5.912       | < .001  | [0.298, 0.591]  |
| X3 → Z | 0.343 | 0.064 | 5.368       | < .001  | [0.214, 0.467]  |
| Y → Z  | 0.762 | 0.061 | 12.423      | < .001  | [0.629, 0.872]  |

Note: SE = standard deviation of the bootstrap distribution. 95% CI (BCa) = bias-corrected and accelerated bootstrap confidence interval. These figures correspond to, and provide full bootstrap detail for, the direct effects in Table 6 and the indirect effects in Table 7 of the main manuscript. X1 = Collaborative governance; X2 = Human resource capacity; X3 = Local government support; Y = Village funds optimization; Z = Village SDG achievement.

**Table A6.** Bootstrapping detail: Outer loadings

| Indicator | O     | SE    | t-statistic | p-value | 95% CI (BCa)   |
|-----------|-------|-------|-------------|---------|----------------|
| X1.1 ← X1 | 0.954 | 0.010 | 95.332      | < .001  | [0.932, 0.970] |
| X1.2 ← X1 | 0.967 | 0.008 | 120.129     | < .001  | [0.948, 0.979] |
| X1.3 ← X1 | 0.965 | 0.012 | 81.168      | < .001  | [0.935, 0.982] |
| X1.4 ← X1 | 0.980 | 0.004 | 243.297     | < .001  | [0.971, 0.987] |
| X2.1 ← X2 | 0.891 | 0.110 | 8.133       | < .001  | [0.781, 0.951] |
| X2.2 ← X2 | 0.911 | 0.126 | 7.248       | < .001  | [0.727, 0.952] |
| X2.3 ← X2 | 0.925 | 0.113 | 8.188       | < .001  | [0.625, 0.963] |
| X2.4 ← X2 | 0.903 | 0.120 | 7.554       | < .001  | [0.720, 0.939] |
| X3.1 ← X3 | 0.941 | 0.013 | 71.936      | < .001  | [0.922, 0.959] |

**Table A6 (cont.).** Bootstrapping detail: Outer loadings

| Indicator | O     | SE    | t-statistic | p-value | 95% CI (BCa)   |
|-----------|-------|-------|-------------|---------|----------------|
| X3.2 ← X3 | 0.929 | 0.019 | 49.326      | < .001  | [0.873, 0.951] |
| X3.3 ← X3 | 0.949 | 0.012 | 78.649      | < .001  | [0.914, 0.965] |
| X3.4 ← X3 | 0.895 | 0.023 | 39.763      | < .001  | [0.846, 0.930] |
| Y.1 ← Y   | 0.944 | 0.010 | 95.274      | < .001  | [0.918, 0.960] |
| Y.2 ← Y   | 0.967 | 0.007 | 141.261     | < .001  | [0.951, 0.977] |
| Y.3 ← Y   | 0.957 | 0.010 | 93.390      | < .001  | [0.934, 0.973] |
| Y.4 ← Y   | 0.938 | 0.012 | 77.097      | < .001  | [0.913, 0.959] |
| Z.1 ← Z   | 0.960 | 0.008 | 122.034     | < .001  | [0.939, 0.973] |
| Z.2 ← Z   | 0.947 | 0.011 | 83.142      | < .001  | [0.916, 0.963] |
| Z.3 ← Z   | 0.951 | 0.008 | 119.013     | < .001  | [0.933, 0.965] |
| Z.4 ← Z   | 0.966 | 0.006 | 167.059     | < .001  | [0.953, 0.975] |

Note: Full bootstrap detail for the standardized loading factors summarized in Figure 1 and reported on the diagonal of Table 3 (cross-loadings) in the main manuscript. X1 = Collaborative governance; X2 = Human resource capacity; X3 = Local government support; Y = Village funds optimization; Z = Village SDG achievement.

**Table A7.** Bootstrapping detail: Outer weights

| Indicator | O     | SE    | t-statistic | p-value | 95% CI (BCa)    |
|-----------|-------|-------|-------------|---------|-----------------|
| X1.1 ← X1 | 0.256 | 0.009 | 27.025      | < .001  | [0.238, 0.276]  |
| X1.2 ← X1 | 0.254 | 0.009 | 28.350      | < .001  | [0.238, 0.272]  |
| X1.3 ← X1 | 0.272 | 0.008 | 32.514      | < .001  | [0.260, 0.292]  |
| X1.4 ← X1 | 0.252 | 0.009 | 28.733      | < .001  | [0.233, 0.268]  |
| X2.1 ← X2 | 0.282 | 0.167 | 1.687       | 0.092   | [0.084, 0.675]  |
| X2.2 ← X2 | 0.281 | 0.199 | 1.415       | 0.158   | [-0.202, 0.512] |
| X2.3 ← X2 | 0.208 | 0.257 | 0.810       | 0.418   | [-0.594, 0.483] |
| X2.4 ← X2 | 0.332 | 0.203 | 1.636       | 0.103   | [0.219, 0.905]  |
| X3.1 ← X3 | 0.306 | 0.028 | 11.086      | < .001  | [0.257, 0.364]  |
| X3.2 ← X3 | 0.237 | 0.044 | 5.340       | < .001  | [0.126, 0.296]  |
| X3.3 ← X3 | 0.292 | 0.037 | 7.907       | < .001  | [0.252, 0.415]  |
| X3.4 ← X3 | 0.239 | 0.042 | 5.762       | < .001  | [0.162, 0.315]  |
| Y.1 ← Y   | 0.278 | 0.006 | 43.212      | < .001  | [0.267, 0.293]  |
| Y.2 ← Y   | 0.251 | 0.004 | 60.014      | < .001  | [0.243, 0.258]  |
| Y.3 ← Y   | 0.276 | 0.006 | 43.318      | < .001  | [0.265, 0.290]  |
| Y.4 ← Y   | 0.246 | 0.005 | 44.937      | < .001  | [0.234, 0.256]  |
| Z.1 ← Z   | 0.278 | 0.011 | 25.391      | < .001  | [0.258, 0.302]  |
| Z.2 ← Z   | 0.238 | 0.012 | 19.638      | < .001  | [0.212, 0.258]  |
| Z.3 ← Z   | 0.290 | 0.014 | 21.191      | < .001  | [0.268, 0.323]  |
| Z.4 ← Z   | 0.240 | 0.010 | 23.381      | < .001  | [0.218, 0.256]  |

Note: Outer (Mode A) weights are reported by SmartPLS for all constructs by default. Because every construct in the final model is specified reflectively (Table 5), these weights are supplementary diagnostic information rather than primary estimates, which for a reflective construct are the outer loadings in Table A5. X1 = Collaborative governance; X2 = Human resource capacity; X3 = Local government support; Y = Village funds optimization; Z = Village SDG achievement.

**Table A8.** Village SDGs achievement (Z) formative re-specification: Robustness check

| Indicator                           | Outer Weight | Outer Loading | Outer VIF | 95% CI (Weight)  | Assessment                       |
|-------------------------------------|--------------|---------------|-----------|------------------|----------------------------------|
| Z.1<br>Access to basic services     | 1.031        | 0.913         | 8.539     | [0.746, 1.902]   | Weight significant; high VIF     |
| Z.2<br>Basic infrastructure         | -0.567       | 0.886         | 12.310    | [-3.543, -0.272] | Sign-reversed weight; high VIF   |
| Z.3<br>Community welfare            | -0.869       | 0.788         | 8.574     | [-2.228, 1.924]  | Weight not significant; high VIF |
| Z.4<br>Environmental sustainability | 1.336        | 0.932         | 15.123    | [0.869, 2.933]   | Weight significant; high VIF     |

Note: Reported for the robustness check described in the Results section, in which Village SDGs Achievement was estimated as a formative construct. Outer VIF values above 5 indicate critical collinearity among the four indicators. The sign-reversed weight for Z.2 relative to its own outer loading is a further symptom of this collinearity. On this evidence, the formative re-specification was not adopted and Village SDGs Achievement is retained as reflective throughout the main analysis (Table 5).