Research Paper

Sustainability Assessment of Stunting Management through Multidimensional Scaling

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Abstract

Stunting remains a major challenge in Indonesia, requiring assessments that extend beyond prevalence to sustainability. This study evaluates the sustainability of stunting prevention in Batu Rakit Village, North Lombok, using RAPFISH-MDS across five dimensions: economy, ecology, health, social, and governance. Data from 68 households with stunted children were analyzed using validated attributes drawn from policy frameworks and literature. Findings reveal disparities: governance was highly sustainable (81.75%), social (60.28%), and health (56.57%) were moderately sustainable, while ecological (41.16%) and economic (28.86%) remained less sustainable. Key leverage factors included access to social assistance, sanitation, maternal education, exclusive breastfeeding, and cross-sector coordination. The findings underscore that sustainable stunting management depends on synergizing governance and social participation to address economic-ecological vulnerabilities, coupled with the integration of health and social interventions. The Batu Rakit experience offers a relevant model for sustainable stunting reduction in rural Indonesia.

Keywords: Stunting management; Sustainability; Batu Rakit Village; Multidimensional Scaling; RAPFISH.

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1.   Introduction

Stunting is still the most public health challenge in Indonesia despite sustained government interventions. In 2022, one of five children under two years was stunted, with a prevalence of 21.6%, the second highest in ASEAN after Timor-Leste (Nareswari, 2023; Titaley et al., 2019). Although the Indonesia Health Survey (2023) reported a modest decline from 22.6% in 2022 to 21.5% in 2023, in fact, progress falls short of the national target of 14% by 2024 and the World Health Organization's threshold of below 20% (Phitra et al., 2023). Therefore, these trends highlight the limited effectiveness of existing interventions and the need for more context-specific, sustainable approaches (Purnomo et al., 2023).

Within this national context, West Nusa Tenggara stands out with a prevalence rate above the national average. In 2023, stunting in West Nusa Tenggara reached 24.6%, representing an 8.1 percentage point decline from the previous year but still higher than the national rate of 21.5% (Ministry of Health of the Republic of Indonesia, 2024). At the district level, North Lombok recorded one of the province's highest rates, at 33.5%, highlighting its persistent vulnerability. Socioeconomic indicators further reflect this disadvantage: North Lombok reported a poverty rate of 25.8% nearly double the provincial average of 13.85% and the lowest Human Development Index (HDI) in West Nusa Tenggara, at 68.02 in 2023 (Statistics Indonesia, 2024b, 2024a). These conditions illustrate substantial developmental gaps across health, education, and living standards.

Batu Rakit Village, recently established following its administrative separation from Sukadana Village, represents a particularly critical case in North Lombok. Based on data from the Provincial Health Office of West Nusa Tenggara (2024), the village recorded the highest stunting prevalence in the regency, reaching 29.15 percent. This condition reflects the convergence of multiple structural and socio-cultural factors, including low educational attainment, widespread child marriage, and entrenched cultural practices. These patterns are documented through field observations and supported by previous studies on child nutrition and social vulnerability (Mulyaningsih et al., 2021; Sulaiman et al., 2025).

Field observations further suggest that early marriage practices, occasionally involving children of school age, are reinforced by local traditions that facilitate close social interaction between boys and girls. Many of these marriages reportedly end in divorce, resulting in inadequate parental care and increased vulnerability among children. Ineffective parenting, defined as parents' limited capacity to nurture, guide, and support their children, has been identified in the literature as a critical driver of stunting (Badawi et al., 2023). Consistent with these findings, evidence from Batu Rakit indicates that limited parenting knowledge and skills among adolescent parents may exacerbate childcare challenges and elevate the risk of stunting, helping to explain the village's relatively higher prevalence compared to other areas in North Lombok (Atamou et al., 2023; Rahayuwati et al., 2025).

Taken together, the village's status as a newly established administrative unit, combined with intersecting challenges such as low educational attainment, culturally rooted child marriage, and high divorce rates leading to inadequate parental care (Statistics Indonesia, 2024a, 2024b), creates a critical context in which stunting and broader child welfare issues converge. This makes Batu Rakit a particularly relevant case for examining the interplay between health and social determinants of child nutrition.

In essence, while national and provincial programs have focused on reducing prevalence, less attention has been given to the sustainability of interventions at the community level (Bappenas, 2018; UNICEF, 2024). Previous studies have examined determinants of stunting including maternal education, sanitation, and food insecurity (Islam et al., 2025; Muche et al., 2021; Vaivada et al., 2020). However, only a limited number of studies have assessed how interventions can remain effective across multiple dimensions namely economy, ecology, health, social, and governance over time (FAO et al., 2023; UNICEF, 2024). Addressing this gap is essential, as sustainable reduction requires integrated strategies that extend beyond short-term prevalence targets.

Hence, this study examines the sustainability of stunting management in Batu Rakit Village, North Lombok, using a quantitative approach with RAPFISH-MDS analysis based on questionnaire data. Batu Rakit was purposively selected due to its high stunting prevalence, socioeconomic disadvantage, and widespread incidence of child marriage. These characteristics position the village as a critical case for identifying root causes and evaluating the sustainability of interventions. This study evaluates the sustainability of stunting management in Batu Rakit Village across five dimensions: economic, ecological,

health, social, and governance. Using the RAPFISH-MDS framework, it provides a comprehensive assessment of sustainability status and identifies the weakest dimensions alongside key leverage attributes. The novelty of this approach lies in moving beyond single-cause explanations to highlight priority areas for intervention. The results are expected to inform local decision-making and guide broader policy strategies for sustainable stunting reduction in Indonesia.

2.   Methods

2.1.   Variables

To comprehensively evaluate the sustainability of stunting management in Batu Rakit Village, this study adopts a multidimensional framework encompassing five key dimensions: economy, ecology, health, social, and governance. This framework is informed by integrated sustainability assessment approaches and draws on the RAPFISH methodology (Fauzi, 2019), which emphasizes multidimensional analysis. It is also aligned with global frameworks such as the Sustainable Development Goals (Walsh et al., 2022) and the FAO's SAFA guidelines (FAO, 2014). These frameworks highlight that reducing stunting sustainably requires the synergistic integration of economic security, ecological resilience, health systems, social inclusion, and governance structures, reflecting the multifactorial etiology of stunting and the necessity of cross-sectoral strategies.

Within this framework, attributes for each dimension were operationalized through a synthesis of stunting-related literature, Indonesian national policy documents, and the specific local context of Batu Rakit Village. These attributes form the basis for the subsequent RAPFISH-MDS analysis and are presented in Table 1.

Table 1. Research Variables

Dimensions	Attributes	Sources
Economy	Household Income	Mulyaningsih et al. (2021)
	Nutrition Expenditure	Winarti (2024)
	Utilization of Household Food Garden	Azriani et al. (2024)
	Access to Social Assistance	Winarti (2024)
	Health Insurance	Mulyaningsih et al. (2021) and Vaivada et al. (2020)
	Degree of Economic Hardship	Mulyaningsih et al. (2021) and Vaivada et al. (2020)
	Access to Credit Facilities	Vaivada et al. (2020)
	Ownership of Productive Assets	Vaivada et al. (2020)
Ecology	Access to Safe Drinking Water	Mulyaningsih et al. (2021) and Winarti (2024)
	Basic Sanitation Facilities	Mulyaningsih et al. (2021)
	Household Waste Management	Mulyaningsih et al. (2021)
	Personal and Domestic Hygiene Practices	Mulyaningsih et al. (2021) and Winarti (2024)
	Drainage Infrastructure Condition	Ayelign & Zerfu (2021)
	Flooring and Housing Quality	Yani et al. (2023)
	Proximity to Animal Pens	Yani et al. (2023)
	Use of Solid Fuels for Household Energy	Ayelign & Zerfu (2021)
Health	Frequency of Antenatal Care (ANC) Visits	(WHO, 2016)
	Consumption of Iron and Folic Acid Supplements	(Sartika et al., 2021)
	Completion of Basic Immunization	Amaha (2021)
	Use of Contraceptive Methods	Amaha (2021)
	Provision of Complementary Feeding (MPASI)	Ayelign & Zerfu (2021)
	History of Infectious Diseases	Mulyaningsih et al. (2021)
	Consumption of Animal Protein	Haryani et al. (2023)
	Exposure to Household Smoking	Yani et al. (2023)
	Exclusive Breastfeeding	Azriani et al. (2024)
Social	Mother's Educational Attainment	Mulyaningsih et al. (2021)
	Father's Role in Childcare and Nutrition	Yani et al. (2023)
	Adherence to Traditional Practices	Hastuti (2023)
	Mother's Participation in Posyandu	Yani et al. (2023)
	Perceptions and Stigma Toward Stunting	Hastuti (2023)
	Nutrition Literacy of Caregivers	Hastuti (2023)
	Childcare by Non-Parental Caregivers	Yani et al. (2023)
	Mother's Age at First Marriage	Hastuti (2023)
Governance	Cross Sector Coordination	Azriani et al. (2024)
	Role of Kader Posyandu	Winarti (2024) and Suratri (2023)
	Role of Penyuluh Keluarga Berencana	Winarti (2024) and Suratri (2023)

Role of Bidan Desa	Winarti (2024) and Suratri (2023)
Partnership with External Institutions	Azriani et al. (2024)
Budget Allocation and Transparency	Azriani et al. (2024)
Program Evaluation	Azriani et al. (2024)
Commitment of Village Leaders	Azriani et al. (2024)
Participation of Vulnerable Groups	Azriani et al. (2024)
Access to Capacity Building	Azriani et al. (2024)
Integration of Programs into Village Development Plans	Azriani et al. (2024)
Local Innovation	Azriani et al. (2024)

2.2. Data Collections

Primary data were collected through direct observation and structured household surveys administered to parents of stunted children under five, using purposive sampling. Secondary data, including household listings, were obtained from the community-based nutrition monitoring system (e-PPGBM) managed by the North Lombok District Health Office. The survey instrument was designed to operationalize the five sustainability dimensions into measurable attributes. This process was informed by a tripartite framework to ensure both theoretical robustness and contextual relevance. First, a comprehensive review of scientific literature (e.g., Mulyaningsih et al., 2021; Vaivada et al., 2020) identified established determinants of stunting and sustainability indicators. Second, key national policy documents, such as Indonesia's Stunting Reduction Acceleration Strategy and the Sustainable Development Goals (SDGs) framework, were analyzed to align the attributes with governmental priorities and metrics. Finally, and crucially, these globally and nationally derived factors were refined through an understanding of the local context of Batu Rakit Village. Preliminary field observations and consultations with local health cadres (Kader) ensured that the attributes were applicable and meaningful to the specific socio-economic and cultural realities of the community. For instance, attributes like Adherence to Traditional Practices and Proximity to Animal Pens were included specifically to capture local ecological and social dynamics. This rigorous process resulted in a total of 45 attributes, which are detailed in Table 1.

According to e-PPGBM records (March 2025), 287 children were assessed for nutritional status, of whom 74 (25.78%) were classified as stunted. From this group, 68 households were purposively selected as respondents, recognizing that some households included more than one stunted child. This sampling strategy ensured adequate representation of families most directly affected by the issue under study.

2.3. Analysis Method

This study adapts the RAPFISH (Rapid Appraisal for Fisheries) method, originally developed by the Fisheries Centre at the University of British Columbia for fisheries sustainability assessment (Pitcher & Preikshot, 2001). The core philosophy of RAPFISH a rapid, multidimensional appraisal is considered relevant for stunting due to the complexity of its management, which requires a multidisciplinary approach. Following its expanded application beyond fisheries by Alder et al. (2002), this research modifies RAPFISH indicators to evaluate stunting management sustainability across five key dimensions: economic, ecological, health, social, and governance.

The method employs a Multidimensional Scaling (MDS) algorithm to map sustainability status on a scale from 0% (not sustainable) to 100% (highly sustainable) (Fauzi, 2019). The analytical framework is illustrated in Figure 1. The operational procedure involved three main stages: (1) identifying assessment attributes for each dimension, (2) scoring these attributes based on field data gathered from questionnaires, (3) validity and reliability test using IBM SPSS Statistics software, and (4) processing the scores using MDS to generate a sustainability index for each dimension.
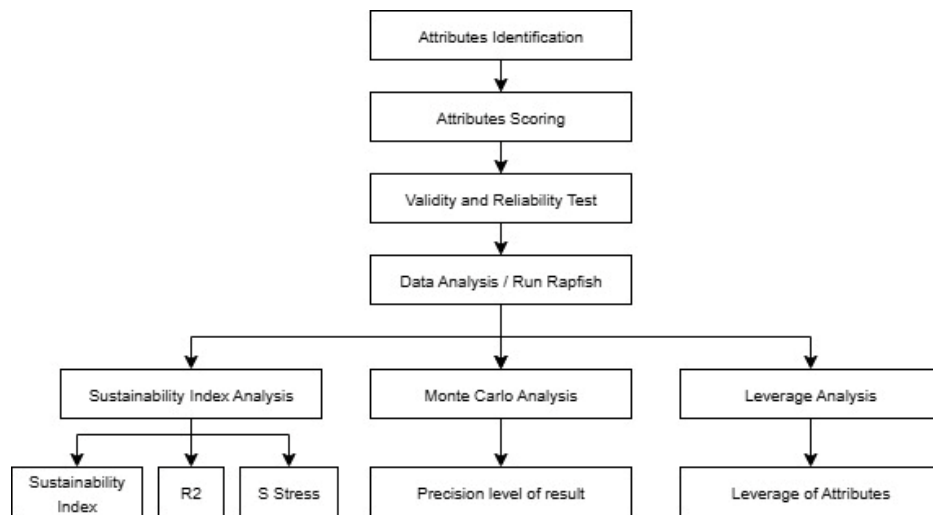
Figure 1. Analytical Framework for Determining the Sustainability Index and Status of Stunting Management
in Batu Rakit Village, North Lombok Regency
Source. Modified from Fauzi (2019)

A total of 45 attributes were defined for the five dimensions (Table 1), selected based on literature review and local context relevance. Each attribute was scored on a three-point ordinal scale (0-2). Validity and reliability were evaluated in IBM SPSS Statistics by calculating Pearson correlation coefficients and comparing them to a critical threshold of r = 0.235. Items were considered acceptable when the Pearson r exceeded 0.235 and the two-tailed significance test returned $p < 0.05$, with the association in the expected positive direction. The attribute scores were processed using the MDS algorithm to generate a sustainability index for each dimension. The model's goodness of fit was assessed with RSQ (R-Square) > 0.90 and Stress < 0.25. Leverage analysis identified the most critical attributes (those with the highest Root Mean Square shift), and Monte Carlo analysis tested the results' stability. The MDS outcome was considered robust if the discrepancy with the Monte Carlo result was less than 5%, a common threshold in sensitivity analysis (Fauzi, 2019). The resulting sustainability status was classified according to the index value (Table 2).

Table 2. Categories of Sustainability Status Based on MDS Index Values

Index Value	Category	Description
0,00 – 25,00	Bad	Not Sustainable
25,01 – 50,00	Less	Less Sustainable
50,01 – 75,00	Simply	Moderately Sustainable
75,01 – 100	Good	Highly Sustainable

Source: Fauzi (2019)

3. Results and Discussions

3.1 Results

3.1.1 Description of the Research Area

Batu Rakit Village, located in Bayan Subdistrict, North Lombok Regency, lies on the northern slopes of Mount Rinjani (Figure 2) and is characterized by fertile volcanic soils, abundant river networks, and a mountainous landscape that presents both opportunities and sustainability challenges. The community's reliance on agriculture and natural resources is closely linked to the economic and ecological dimensions, where food security, household income, and environmental management are key factors in supporting nutritional status. Limitations in infrastructure and accessibility affect the health dimension through access to basic services, while also influencing the social dimension in terms of community interaction, perceptions of stunting, and caregiving practices. At the same time, the governance dimension is crucial, as effective stunting management requires cross-sectoral coordination, integrated policy, and active community participation. Thus, the geographical context of Batu Rakit Village not only shapes local

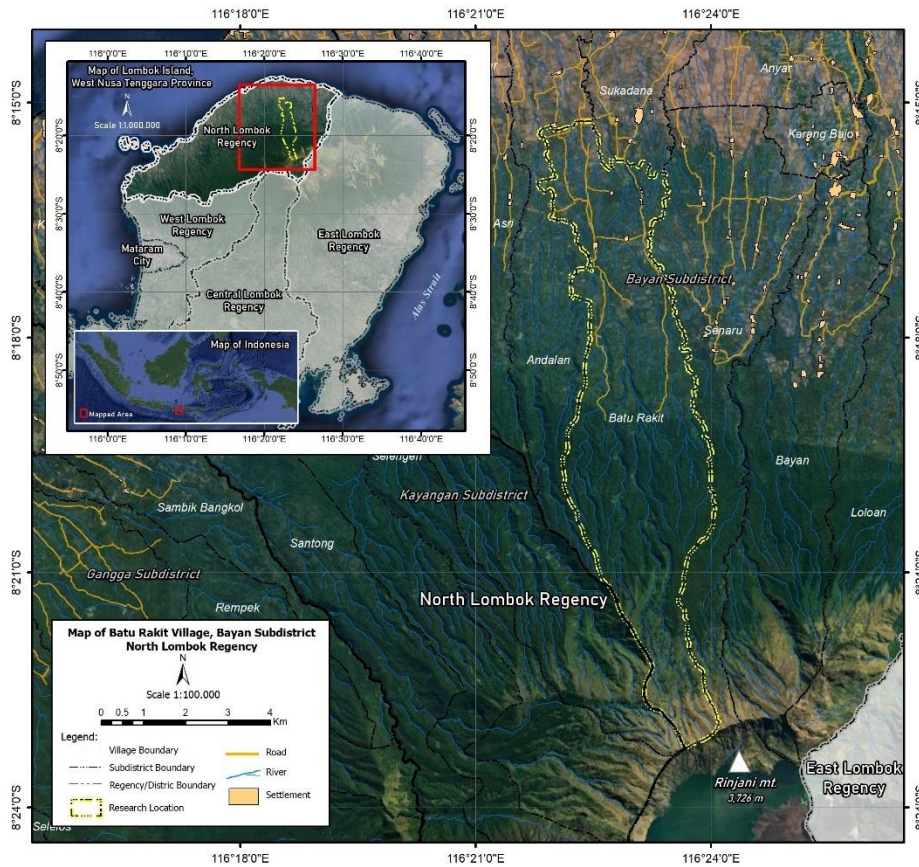conditions but also influences all dimensions of sustainability in stunting management analyzed in this study.

Figure 2. Map of the study area: Batu Rakit Village, North Lombok, Indonesia
Source: Topographic Map of Indonesia, Geospatial Information Agency (2023)

3.1.2. Validity and Reliability Result

Based on the statistical test results, Table 3 presents item total Pearson correlations and two tailed significance levels; items with r > 0.235 and p < 0.05 were considered valid. The table also reports Cronbach's α as an index of internal consistency, with items failing either criterion highlighted for possible revision.

Table 3. Validity and Reliability Result

Indicator	Questioner Statement	Remark	Pearson Correlation	R-Table	α
Economical Dimension					**0,703**
ECO1	Please indicate your total average monthly household income from all sources.	below minimum wage (0); at minimum wage (1); above minimum wage (2)	0.585	0.235	
ECO2	Please estimate the proportion of your total monthly household spending that is dedicated to the purchase of nutritious food.	<60% of monthly expenditure (0); 60% of monthly expenditure (1); >60% of monthly expenditure (2)	0.540	0.235	
ECO3	Does your household engage in home gardening of vegetables or fruits for domestic consumption?	None/Negligible Use (0); Partial/Occasional Use (1); Regular/Full Use (2)	0.546	0.235	
ECO4	How would you characterize your household's access to government social assistance?	No/Minimal Access (0); Irregular Access (1); Full/Reliable Access (2)	0.622	0.235	

Indicator	Questioner Statement	Remark	Pearson Correlation	R-Table	α
ECO5	What is your household's membership status in Indonesia's National Health Insurance?	No Coverage (0); Government-subsidized Coverage (PBI) (1); Independent Coverage (2)	0.586	0.235	
ECO6	Over the past 12 months, how would you characterize the level of economic hardship experienced by your household?	Low/No Hardship (0); Moderate Hardship (1); Severe Hardship (2)	0.638	0.235	
ECO7	Please indicate your household's financial preparedness for an urgent need	No Access (0); Limited/Informal Access (1); Adequate/Formal Access (2)	0.629	0.235	
ECO8	Does your household own any income generating assets?	No Ownership (0); 1 Asset (1); (>1 Asset (2)	0.563	0.235	
Ecological Dimension					**0.703**
ECL1	What is your household's primary source of drinking water?	Unimproved Source (0); Basic Improved Source (1); Adequate Access (2)	0.464	0.235	
ECL2	What type of sanitation facility does your household primarily use?	Open Defecation (0); communal latrine (1); private sanitation facilities (2)	0.363	0.235	
ECL3	How would you characterize your household's primary method for managing daily waste?	Poor/No Management (0); Partial/Shared Management (1); Adequate/Independent Management (2)	0.745	0.235	
ECL4	How would you generally characterize the personal hygiene practices of household members?	Poor Practices (0); Partial/Inconsistent Practices (1); Adequate Practices (2)	0.731	0.235	
ECL5	How would you characterize the drainage conditions immediately surrounding your residence?	Poor/No Drainage (0); Partial/Inadequate Drainage (1); Adequate/Functional Drainage (2)	0.747	0.235	
ECL6	How would you characterize the quality of your dwelling's primary flooring material and overall structural condition?	Poor Quality (0); Moderate Quality (1); Adequate/Good Quality (2)	0.761	0.235	
ECL7	What is the approximate distance between your main dwelling and the nearest livestock enclosure or animal shelter?	≤ 5 meters (0); 6-10 meters (1); >10 meters (2)	0.474	0.235	
ECL8	What is the primary type of energy or fuel used for cooking in your household?	firewood, charcoal, crop residues, dung (0); Mixed Use, combination of solid fuels and cleaner energy sources (1); Clean Energy Use: LPG, natural gas, electricity, biogas (2).	0.446	0.235	
Health Dimension					**0.702**
HLT1	For your most recent pregnancy, how many Antenatal Care (ANC) visits did you complete?	≤ 4 visits (0); 5-7 visits (1); ≥8 visits (2)	0.517	0.235	
HLT2	During your last pregnancy, did you consume Iron-Folic Acid (IFA) supplements?	< 90 IFA tablets during pregnancy (0); 90-180 tablets during pregnancy (1); > 180 tablets (2)	0.732	0.235	
HLT3	What is your child's status regarding the basic immunization schedule?	Incomplete (0); Partial Completion (1); Complete Immunization (2)	0.615	0.235	
HLT4	Is the mother/couple using any form of contraception to delay or prevent future pregnancies?	No use (0); Use of Traditional or Non-Regular/Intermittent Methods (1); Regular Use of Modern Methods (2)	0.480	0.235	
HLT5	How would you characterize your child's complementary feeding practices in terms of the timeliness of introduction, dietary diversity, and meal frequency?	Inadequate Provision (0); Sub-optimal Provision (1); Optimal Provision (2)	0.670	0.235	
HLT6	How frequently has your child experienced common infectious illnesses in the past six months?	>2 respiratory infections in past 6 month (0); 1-2 respiratory infections (1); No/Minimal Burden (2)	0.473	0.235	
HLT7	On average, how often does your child consume animal source foods (such as eggs, dairy, fish, poultry, or meat)?	≤1 time per week (0); 2–3 times per week (1); ≥4 times per week (2)	0.539	0.235	
HLT8	Does any member of your household smoke tobacco inside the home?	High Exposure (0); Moderate Exposure (1); No Exposure (2)	0.427	0.235	
HLT9	Was your child exclusively breastfed for the first six months of life?	<3 months (0); 3-5 months (1); 6 months (2)	0.526	0.235	
Social Dimension					**0.703**

Indicator	Questioner Statement	Remark	Pearson Correlation	R-Table	α
SOC1	What is the highest level of formal education you have completed?	Elementary school (0); Secondary School (1); High School (2)	0.566	0.235	
SOC2	How often does the child's father take an active and supportive role in daily childcare and nutrition-related activities?	Rarely (0); Occasionally (1); Frequently (2)	0.530	0.235	
SOC3	Are there any traditional beliefs or practices in your household that influence the types of food or feeding patterns for your child?	No (0); Yes, but not restrictive (1); Yes, and restrictive (2)	0.535	0.235	
SOC4	How often do you or your child participate in Posyandu?	Rarely/Never (0); Inconsistent (1); Regularly (2)	0.505	0.235	
SOC5	Which of the following statements best reflects your view on stunting?	Stunting is not a dangerous condition and is largely unavoidable (0); Neutral (1); Stunting is a serious nutritional problem that can and should be prevented (2)	0.659	0.235	
SOC6	Rate your knowledge of these nutrition topics: exclusive breastfeeding, complementary feeding, dietary diversity, animal source foods, and malnutrition signs.	Low Knowledge (0); Moderate Knowledge (1); High Knowledge (2)	0.640	0.235	
SOC7	How often is your child primarily cared for by someone other than their biological parents?	Rarely (0); Occasional (1); Frequent (2).	0.588	0.235	
SOC8	How old were you at the time of your first marriage?	<18 (0); 18 – <21 (1); ≥21 (2)	0.577	0.235	
Governance Dimension					**0.702**
GOV1	Cross sectoral coordinated stunting prevention program in villages	Not coordinated (0); Partially coordinated (1); Routinely and effectively coordinated (2)	0.436	0.235	
GOV2	Posyandu Cadres assist your household with child care and stunting-related activities	(0) None; (1) Present but not active; (2) Present and actively supportive	0.338	0.235	
GOV3	Penyuluh KB extension workers engage with and support your household	None (0); Present but not active (1); Present and actively supportive (2)	0.681	0.235	
GOV4	Midwives or other health professionals conduct monitoring at the Posyandu you attend	Never (0); Occasionally (1); Routinely (monthly) (2)	0.681	0.235	
GOV5	NGOs, universities, or private companies involved in stunting related activities in your village	Not involved (0); Limited involvement (1); Active and sustained involvement (2)	0.697	0.235	
GOV6	The village budget used transparently for stunting-related programs and activities	Not clear (0); partially transparent (1); Adequate and transparent (2)	0.692	0.235	
GOV7	The village government conduct routine evaluations of stunting programs and follow up on the results	Never (0); Rarely (1); Routinely with follow up actions (2)	0.436	0.235	
GOV8	The village government has a strong and consistent commitment to supporting stunting prevention and mitigation	Minimal (0); Present but inconsistent (1); Strong and consistent (2)	0.342	0.235	
GOV9	To what extent are you involved in stunting prevention programs or activities in the village?	Not involved (0); Symbolically involved (1); Actively involved (2)	0.472	0.235	
GOV10	The service providers who deliver services to your household routinely trained	Never (0); Trained but training is suboptimal (1); Routinely trained and improving (2)	0.415	0.235	
GOV11	The stunting program integrated into the village's formal development plans	No (0); Present but not aligned (1); Fully integrated (2)	0.381	0.235	
GOV12	There are local innovations in your village that support stunting prevention, and are these innovations sustainable?	None (0); Present but benefits limited (1); Present and sustainable (2)	0.474	0.235	

Source: Author (2025)

3.1.3 Results of the Sustainability Assessment Stunting Management in Batu Rakit Village

The RAPFISH analysis reveals that the sustainability of stunting management in Batu Rakit Village exhibits considerable variation in index values across dimensions (Figure 3). Governance recorded the highest score (81.75%), categorized as highly sustainable, while the economic dimension scored the lowest (28.86%), indicating less sustainability. The ecological dimension (41.16%) is also less sustainable, whereas health (56.57%) and social (60.28%) fall within the moderately sustainable. These results highlight governance as a key strength, but also reveal persistent challenges in economic, ecological, and social aspects.
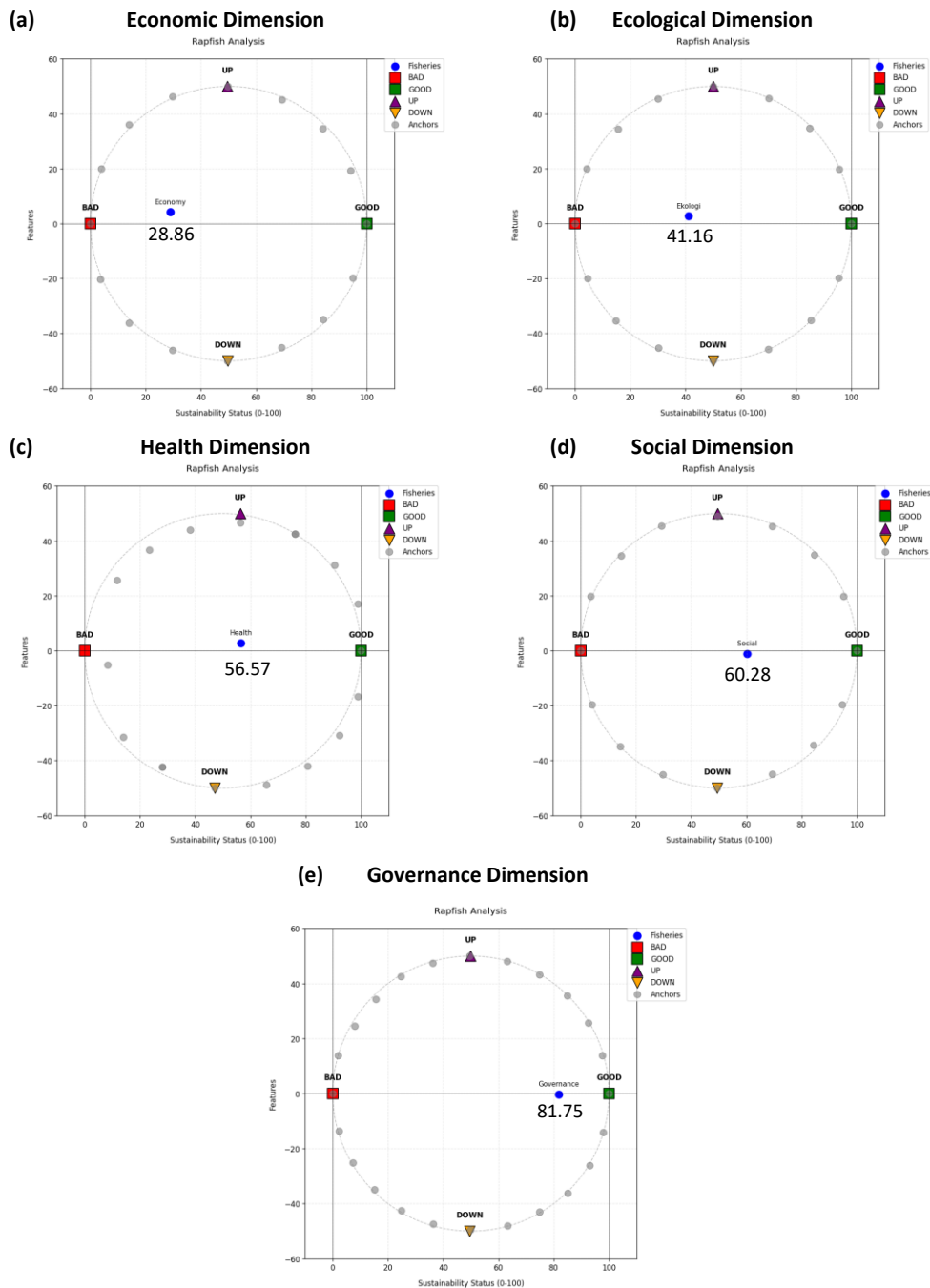

Figure 3. Ordination of the Sustainability Status of Stunting Management in Batu Rakit Village: a) economic, (b) ecological, (c) health, (d) social, and (e) governance dimension.

Table 4. RAPFISH-MDS Results of Sustainability Assessment across Five Dimensions in Batu Rakit Village

Dimensions	Index Scores (%)		S-Stress (S)	Squared Correlation (RSQ)
	MDS	**Monte Carlo**		
Economic	28,86	28,50	0,107	0,988
Ecological	41,16	40,69	0,107	0.988
Health	56,57	58,41	0,113	0.987
Social	60,28	58,60	0,107	0.988
Governance	81,75	80,43	0,114	0.987

Source: Author's (2025).

Table 4 show the diagnostic statistics confirm the reliability of the RAPFISH-MDS model. The differences between MDS and Monte Carlo results ranged from 1.1% (ecological) to 2.8% (social), remaining within the acceptable threshold (<5%). Stress values were consistently low across all dimensions (0.107-0.114), well below the 0.25 cutoff, while RSQ values ranged from 0.987 to 0.988, indicating a strong fit between the ordination and the data. These findings demonstrate the statistical robustness of the model and support the interpretability of the sustainability indices with high confidence.

Leverage analysis (Figure 4) identified key attributes with high sensitivity across the five sustainability dimensions of stunting management in Batu Rakit Village.
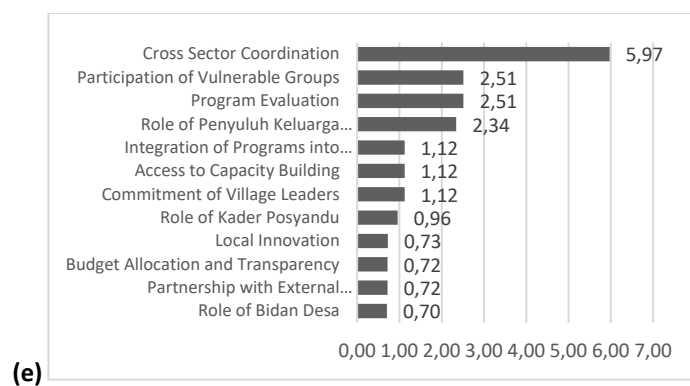
(a)

(b)

(c)

(d)
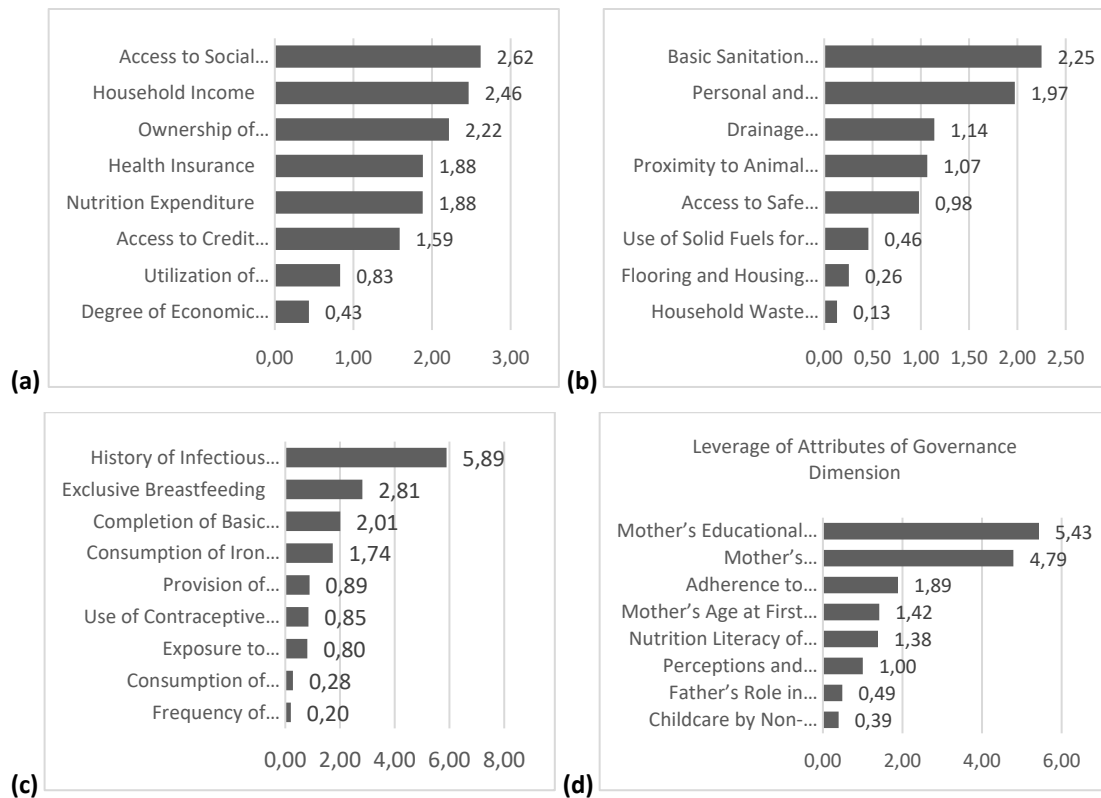
Figure 4. Leverage of attributes: (a) economic, (b) ecological, (c) health, (d) social, and (e) governance

In the economic dimension, three attributes were identified as the most sensitive, namely access to social assistance with Root Mean Square Value (RMS) 2.62, household income (RMS = 2.46), and ownership of productive assets (RMS = 2.22) (Figure 4a). Field data indicated that 40 of the 68 mothers of stunted children had never received social assistance, while 22 were still active beneficiaries. A total of 59 households reported monthly incomes below the regional minimum wage, although 49 households possessed at least one productive asset such as farmland or gardens, with some combining agricultural and livestock resources.

Within the ecological dimension, the most influential attributes were basic sanitation (RMS= 2.25) and hygiene practices (RMS = 1.97). Other attributes, such as drainage conditions (RMS= 1.14), proximity of houses to animal pens (RMS = 1.07), and access to safe water (RMS = 0.98), showed moderate sensitivity, while energy sources (RMS= 0.46), housing and flooring quality (RMS = 0.26), and waste management (RMS = 0.13) had limited influence. Field observations confirmed persistent sanitation and hygiene problems: 17 households practiced open defecation, 25 relied on shared toilets, and 10 lacked access to safe drinking water. In addition, handwashing with soap at critical times remained inconsistent across households.

The health dimension was primarily shaped by two attributes: history of infectious diseases (RMS = 5.36) and exclusive breastfeeding (RMS = 3.52). Survey results revealed that 75% of stunted children experienced illness more than three times in the previous year, while only three children reported no illness. With regard to breastfeeding practices, 53 children (78%) received exclusive breastfeeding during the first six months, 10 were given a combination of breast milk and formula, and five did not receive breastfeeding at all.

In the social dimension, maternal education (RMS = 5.43) and participation in Posyandu (RMS = 4.79) were the most sensitive attributes. A total of 47 mothers of stunted children had completed only primary education or had never attended school. Participation in Posyandu was relatively high, with 50 of the 68 mothers regularly attending sessions, while nine mothers reported irregular attendance.

For the governance dimension, cross-sectoral coordination emerged as the most influential attribute. Although the Stunting Reduction Acceleration Team had not yet been formally established in Batu Rakit Village due to the absence of an official decree (SK), specific interventions were implemented effectively. This was supported by the active involvement of Kader Posyandu, Bidan Desa, and Penyuluh KB, ensuring the continuity of interventions addressing the main causes of stunting, particularly undernutrition, through regular Posyandu activities.

3.2 Discussion

The sustainability analysis of stunting prevention efforts in Batu Rakit Village highlights the complex interplay of strengths and weaknesses across five critical dimensions. Although governance demonstrates the strongest performance, closer examination reveals that program sustainability continues to face interconnected multidimensional challenges. This discussion explores the systemic interrelations among dimensions and identifies strategic opportunities for strengthening, drawing on existing best practices at the village level.

From an economic perspective, structural vulnerability is manifested in the high proportion of households earning below the minimum wage. This situation is exacerbated by the poor reach and inaccurate targeting of social assistance programs. In response, various village level initiatives have emerged as potential solutions. These include the establishment of a Village Owned Enterprise (BUMDesa) for poultry, designed to ensure affordable access to animal protein for toddlers. Another initiative involves a partnership with women farmers' groups to manage community nutrition gardens, representing a collective effort to strengthen food security, although the effectiveness of both programs requires further enhancement. These field findings align with the research of (Sari & Zelharsandy, 2022), who underscore the significance of local economic empowerment strategies in addressing nutritional challenges.

The ecological and health dimensions further underscore the interdependence between environmental determinants and child growth outcomes. The high prevalence of recurrent illness among young children (75%) reflects the persistent burden of infection associated with inadequate sanitation, consistent with evidence from Arini et al. (2020) linking frequent infections to impaired growth. This is also supported by large-scale studies in Indonesia showing that poor sanitation and unsafe water are among the strongest predictors of child stunting (Torlesse et al., 2016), and that access to improved sanitation is significantly associated with lower odds of stunting among children under three (Rah et al., 2020). In response, the village government has allocated IDR 300 million from village funds over recent years, signaling strong political will to address these challenges. This allocation has supported supplementary feeding initiatives, including educational programs and nutrition-specific interventions such as honey and eggs during the first 1,000 days of life an approach aligned with global best practices in child nutrition (Siswati et al., 2022).

The social dimension presents both opportunities and limitations. Although maternal participation in Posyandu is relatively high (50 of 68 mothers), the quality of engagement remains constrained by low educational attainment. Similar patterns have been confirmed in a multilevel analysis of the Indonesian Family Life Survey, which found that maternal education and household socioeconomic status are strong predictors of child stunting, with particularly pronounced effects in rural areas (Siramaneerat et al., 2024). Addressing this gap requires capacity-building strategies tailored to local contexts, including the adoption of innovative health education methods and the provision of cadre incentives through village funds. Such measures not only enhance participation but also strengthen the long-term sustainability of community-based interventions.

In the domain of governance, significant progress has been achieved through consistent budgetary commitment, the integration of BUMDesa programs, and support for cadre capacity. Nonetheless, the absence of a formal Stunting Reduction Acceleration Team (TPPS) remains a critical institutional gap. Establishing TPPS through village regulations would provide a clear mandate, organizational structure, and defined responsibilities, thereby improving coordination and accountability across sectors. Evidence suggests that the effective use of village funds, combined with sufficient administrative capacity, significantly contributes to reducing stunting prevalence in Indonesian districts (Indra & Khoirunurrofik, 2022).

Taken together, these findings underscore that sustaining stunting prevention efforts requires the integration of multisectoral programs and the optimization of local innovations already in place. The Batu Rakit case offers valuable insights into the centrality of local leadership, consistent fiscal commitment, and community resource mobilization in fostering sustainable stunting reduction programs lessons that may be adapted to other rural contexts with similar characteristics across Indonesia.

Conclusion

The sustainability of stunting management in Batu Rakit Village is shaped by five interrelated dimensions. Governance is the strongest, supported by consistent budget allocation and effective sectoral coordination, though the absence of a formal TPPS limits institutionalization. The economic dimension poses the greatest challenge, as low household incomes, unequal social assistance, and underutilized assets highlight structural vulnerability. The ecological dimension remains constrained by poor sanitation, limited access to clean water, and inadequate hygiene practices, which drive recurrent infections. The

health dimension shows mixed progress: exclusive breastfeeding is relatively strong, yet high child morbidity reduces the impact of nutrition programs. The social dimension demonstrates high Posyandu participation but limited maternal education weakens health literacy.

A key policy implication is the need to optimize governance and community participation to address socioeconomic and environmental challenges, while ensuring health and social interventions are mutually reinforcing. The Batu Rakit model serves as contextual, replicable evidence for accelerating sustainable stunting reduction in rural areas.

Limitations

This study has several limitations that should be acknowledged. First, the research was conducted in a single village with unique socioeconomic and cultural conditions, which may restrict the generalizability of the findings to other contexts. Comparative studies across multiple villages or provinces are needed to validate the applicability of the sustainability index at a broader scale. Second, the cross-sectional design captures conditions at only one point in time and does not reflect seasonal fluctuations or long-term trends in household welfare and child nutrition. Future research employing longitudinal designs could provide a more dynamic understanding of sustainability. Third, the RAPFISH-MDS method relies on scoring and expert judgment, which, despite standardized criteria and validation, may introduce subjectivity. Incorporating mixed method approaches, including qualitative participatory methods, would help to contextualize scoring and capture cultural practices influencing stunting. Addressing these limitations will enrich the robustness of sustainability assessments and strengthen their policy relevance.

Acknowledgments

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