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URGENT CHOICES: EVALUATING THE IMPACT OF HOUSING AND WASH PROGRAMS IN INDONESIA

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ABSTRACT

This study evaluates the impact of Indonesian government programs in the housing and water, sanitation, and hygiene (WASH) sectors on social welfare, specifically targeting poverty reduction and health improvement. The primary hypothesis is that enhanced progress in housing and WASH programs correlates with lower poverty rates and improved health outcomes. Using data from SUSENAS and the Ministry of Development Planning, we employ a fixed effects model to mitigate endogeneity concerns and accurately assess program impact. Findings reveal that while advancements in WASH programs are significantly associated with improved public health, no strong evidence links these programs to poverty reduction. The study recommends prioritizing WASH program expansion and refining housing program strategies to address health outcomes more effectively and promote targeted poverty alleviation measures. These recommendations offer insights into optimizing development programs to enhance Indonesia's socio-economic landscape.

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Introduction

Development programs addressing housing and water, sanitation, and hygiene (WASH) have demonstrated significant impacts on poverty alleviation and health improvement in various countries. In emerging economies, these sectors are particularly essential to foster

social welfare and support sustainable development. In Indonesia, where socioeconomic inequalities and access disparities are pronounced, the government has placed housing and WASH at the forefront of its 2020-2024 National Medium-Term Development Plan (RPJMN). As part of its commitment to the Sustainable Development Goals (SDGs), Indonesia aims to improve living standards, reduce poverty, and enhance public health through targeted interventions in these areas. However, with the 2024 target year approaching, Indonesia faces a critical challenge: determining which sector—housing or WASH—offers the most immediate impact to meet its socioeconomic goals within the limited timeframe and resource constraints.

This study contributes novel insights by rigorously evaluating the relative impact of Indonesia's housing and WASH programs on poverty and health outcomes. Unlike prior studies that examine these sectors in isolation, this research directly compares the effectiveness of each in achieving Indonesia's broader social welfare objectives. This is particularly urgent as Indonesia's socioeconomic context features unique geographic disparities and population density issues, requiring policies that can be adapted effectively across its diverse regions. Previous studies have underscored the general benefits of improved housing and WASH access but often lack country-specific evaluations that consider the integrated effects on multiple socioeconomic indicators. This research, therefore, fills a critical gap by providing an evidence-based framework to guide Indonesia's development strategy, helping policymakers prioritize interventions where they can yield the most significant social impact.

The study is guided by two primary hypotheses: (1) advancements in housing and WASH infrastructure are associated with lower poverty rates, and (2) improved access to adequate housing and WASH facilities correlates with better public health outcomes. Using a rich dataset from SUSENAS for poverty and health indicators, and program disbursement data from the Ministry of Development Planning, this study employs a fixed effects model to address potential endogeneity and accurately estimate program impacts. Additionally, descriptive statistical analysis is utilized to highlight regional disparities and assess progress gaps, providing insights into local challenges in meeting program targets.

By addressing these questions, this study seeks to provide actionable recommendations for Indonesia's policymakers, helping to refine program strategies and optimize resource allocation. The findings will not only inform Indonesia's efforts to meet its development goals but also contribute to the broader discourse on prioritizing development interventions in similarly diverse, resource-constrained settings.

Literature Review

The literature on development programs, particularly those focusing on housing and WASH, consistently highlights their significant positive impacts on public health, economic stability, and social equity. Secure housing is frequently associated with improved health outcomes, as it provides a stable environment that reduces exposure to health hazards. For instance, Evans et al. (2003) and Newman & Holupka (2014) emphasize that secure housing leads to better mental health, lower healthcare costs, and enhanced educational outcomes for children, underlining the critical role housing plays in promoting social welfare.

WASH programs have similarly demonstrated substantial benefits in improving public health outcomes. Research by Fewtrell et al. (2005) and Wolf et al. (2018) underscores the critical role of WASH programs in reducing waterborne diseases, improving child mortality rates, and enhancing overall community health. These findings support the continued investment in WASH infrastructure as a means to improve public health and contribute to

broader development objectives. In Indonesia, the government's housing and WASH programs are part of a broader development strategy outlined in the 2020-2024 RPJMN. These programs aim to address disparities in access to essential services, particularly in rural and underserved urban areas. According to evaluations conducted by the Ministry and Local Governments, these programs have made progress in several key areas, although significant challenges remain in achieving all target indicators.

Comparative studies on similar programs in other countries offer valuable insights for Indonesia. Research on housing programs in Latin America, as discussed by Gilbert (2014) and Smets (2017), shows that such initiatives can lead to significant reductions in poverty and improvements in social inclusion. These findings suggest that housing programs, when aligned with national development goals, can serve as effective tools for social transformation and economic stability. The impact of WASH interventions is well-documented in the literature, particularly in regions such as Sub-Saharan Africa. Studies by Prüss-Ustün et al. (2014) and Hutton & Chase (2016) demonstrate that WASH programs can significantly reduce the prevalence of diarrheal diseases and lower child mortality rates. These outcomes highlight the importance of WASH programs in achieving health-related development goals, underscoring their relevance for Indonesia's development agenda.

One of the key transmission mechanisms through which housing and WASH programs affect socioeconomic outcomes is their impact on health. Improved health outcomes lead to higher productivity, better educational attainment, and reduced healthcare costs, which in turn foster economic development. Krieger & Higgins (2002) and Sandel et al. (2018) discuss how secure housing and access to clean water and sanitation can disrupt the cycle of poverty by improving the overall well-being of individuals and communities, thus making these investments critical for sustainable growth. However, the success of these programs depends heavily on their adaptation to local contexts. Moser & Dani (2008) argue that development programs must be tailored to the specific needs and cultural practices of the communities they serve. In Indonesia, the diversity of cultural practices and varying levels of community engagement present significant challenges to the uniform implementation of housing and WASH programs. Ahmad and Islam (2024) emphasize the need for a nuanced approach that considers local socioeconomic conditions and actively involves communities in program design and execution.

Effective policy-making and governance are crucial for the successful implementation of development programs. Ravallion (2001) and Deaton (2003) highlight the importance of a strong institutional framework and coordinated efforts across different levels of government. In Indonesia, the success of housing and WASH programs is closely tied to the government's ability to allocate resources efficiently and ensure that programs are implemented in a manner that addresses local needs.

The literature also underscores the importance of monitoring and evaluation in ensuring the effectiveness of development programs. Shahidi et al. (2019) and Gadisi et al. (2020) discuss the role of impact assessments in identifying areas for improvement and ensuring that development programs achieve their intended goals. In the Indonesian context, more localized studies are needed to assess the specific outcomes of housing and WASH programs across different regions. Such studies would provide critical feedback for policymakers and help refine these programs to better meet the population's needs.

Finally, the potential for scaling up successful programs is a key consideration in development planning. Kakwani et al. (2021) suggest that once a program has demonstrated

effectiveness, it can be expanded to benefit a larger population. In Indonesia, scaling up successful housing and WASH programs requires careful planning and resource allocation to ensure that the quality of services is maintained as the programs reach more regions and communities.

While the literature strongly supports the positive impact of housing and WASH programs on socioeconomic outcomes, their success in Indonesia depends on addressing the country's specific challenges. This study builds on existing research by providing a detailed analysis of the impact of these programs in Indonesia, with a focus on poverty reduction and health outcomes. The insights gained from this research will contribute to the broader discourse on development policy, offering evidence-based recommendations for improving the design and implementation of such programs.

This study examines the relationship between access to essential public services, such as housing, drinking water, and sanitation, and two key socioeconomic outcomes: the poverty rate and the percentage of individuals reporting health complaints. The hypothesis development is grounded in established research and theoretical frameworks that link improvements in public services to better economic and health outcomes. The independent variables in this study include the percentage of households with access to adequate housing, adequate drinking water, and adequate sanitation, while the control variables—per capita gross regional domestic product (GRDP), geographical area, and the Human Development Index (HDI)—are incorporated to account for regional variations in economic and developmental factors.

Adequate housing is widely recognized as a fundamental component of social welfare, with numerous studies highlighting its impact on both economic conditions and public health. Housing stability contributes to poverty alleviation by providing individuals with a secure environment, reducing economic vulnerability, and enabling better productivity and educational outcomes. Research by Nicol et al. (2021) suggests that improvements in housing quality and access lead to reductions in poverty by enhancing living conditions and promoting greater economic participation. Furthermore, housing security reduces the risk of poor health outcomes by limiting exposure to environmental hazards and improving overall mental and physical well-being (Braveman et al., 2020).

Access to adequate drinking water and sanitation facilities is essential for reducing the burden of diseases and improving public health outcomes. The World Health Organization has repeatedly emphasized that clean water and sanitation are among the most cost-effective health interventions in developing countries. A recent study by Mahler et al. (2021) confirmed that access to clean water and improved sanitation significantly reduces the prevalence of waterborne diseases, such as diarrhea, which disproportionately affect low-income populations. By reducing disease incidence, communities can reallocate resources toward education, labor, and economic activities, thus lowering poverty rates. Additionally, enhanced water and sanitation infrastructure alleviates the health burden by preventing the spread of infectious diseases, improving quality of life, and increasing productivity (Wolf et al., 2018).

While the independent variables focus on housing, water, and sanitation, it is necessary to account for broader regional differences that may influence poverty and health outcomes. This study includes three control variables—per capita GRDP, geographical area, and HDI—each of which captures important contextual factors.

Per capita GRDP reflects the economic productivity of a region, which directly influences the population's living standards and access to essential services. Higher GRDP levels are often

associated with better infrastructure, healthcare, and education, contributing to both poverty reduction and improved health outcomes. For instance, Ferre (2023) found that higher economic productivity leads to lower poverty rates, particularly in regions with more inclusive economic growth. Accordingly, regions with higher per capita GRDP are expected to have lower poverty rates and fewer health complaints due to greater access to public services and improved living conditions.

Geographical characteristics, such as urbanization and remoteness, significantly affect access to public services, including housing, drinking water, and sanitation. Urban areas typically benefit from economies of scale and better service provision, while rural and remote areas often experience infrastructure deficits that contribute to higher poverty rates and poorer health outcomes. Recent research by Moore et al. (2003) confirmed that urbanization is associated with improved access to water, sanitation, and healthcare, resulting in lower poverty rates and better health. Conversely, rural areas often suffer from inadequate infrastructure, leading to disparities in service provision and socioeconomic outcomes (Jha et al., 2021).

HDI provides a comprehensive measure of a region's socioeconomic development, incorporating indicators of life expectancy, education, and income. Regions with higher HDI scores typically exhibit better living standards, reduced poverty, and lower disease prevalence. Wang et al. (2024) demonstrated that improvements in HDI are closely linked to reductions in poverty and health complaints, as regions with higher development levels benefit from better education, healthcare, and social services. As such, HDI is expected to be negatively correlated with both poverty and health complaints.

Data and Research Methods

Table 1: Variable Description

Variables	Description	Sources
Outcome Variables		
Poverty	Poverty rate	SUSENAS (Data period: 2019 to 2021)
Healthcomp	Percentage of individuals with health complaints	
Indicator Variables for Development Program Achievements		
Housing	Percentage of household's access to adequate housing	SUSENAS (Data period: 2019-2021)
Dwater	Percentage of household's access to adequate drinking water	
Sanitation	Percentage of household's access to adequate sanitation	
Control Variables		
Pcgdrp	Per capita gross regional domestic product	BPS (Data period: 2022)
Area	Geographical area	
HDI	Human Development Index	

This study draws upon the socioeconomic data extracted from the Indonesian National Socioeconomic Survey (SUSENAS) dataset spanning the years 2019 to 2021. The dataset serves as a robust foundation for our analysis, offering comprehensive insights into various facets of the Indonesian population's social and economic characteristics as well as the relevant indicator variables for development programs achievements in the housing, drinking water, and sanitation sectors. To ensure a granular exploration, the analysis is conducted at the regency/city level, enabling us to capture localized trends and disparities. Table 1 presents the description of the variables used in this study.

In this study, estimation is conducted by performing econometric modeling on the impact of achieving targets in the areas of housing, drinking water, and sanitation on outcome variables and measurable impacts. The outcome variables that will be measured in this study are: (i) poverty rate and (ii) percentage of individuals with health complaints. The estimation will be carried out using the following general model:

$$Y_{i,t} = \alpha + \beta_1 I_{it} + \sum \gamma_n X_{it} + \varepsilon \quad (1)$$

where $Y_{i,t}$ is the outcome variable, which in this case contains of the poverty rate and the percentage of individuals with health complaints for regency/city i and year j. Variable I_{it} is the indicator variable for achievements of development programs in the housing, drinking water, and sanitation sectors. In this case, the indicators used are the percentage of households with adequate housing, drinking water, and sanitation for regency/city i and year j. Meanwhile, β_1 is the coefficient indicating the magnitude of the correlation between housing, drinking water, and sanitation indicators and outcome variables. The X_{it} component consists of a set of control variables included in the model, and ε is the error term.

In addition to the econometric modeling, this study also employs descriptive statistical analysis to examine the gap between the intended goals and the actual achievements in the housing, drinking water, and sanitation sectors. Moreover, the evaluation will also entail charting the governmental requirements against the backdrop of attaining the 2020-2024 RPJMN targets within a Cartesian graph. This visualization aids in effectively prioritizing the attainment of 2020-2024 RPJMN targets in the domains of housing, drinking water, and sanitation.

Additionally, planning document review has been conducted to acquire data regarding the planning and achievements of housing and settlement development that have been undertaken by various relevant stakeholders. This activity has also been carried out as a foundation and reference for monitoring and evaluation endeavors. The literature study is executed by collecting planning documents and accountability reports from each ministry/ governmental agency responsible for achieving indicators in the housing, drinking water, and sanitation sectors.

The Current State of the Housing and WASH Development Program Implementation in Indonesia

Based on the 2020-2024 RPJMN, at the program level, there are four target indicators from the 2020-2024 RPJMN that can be evaluated. These indicators include: (1) The percentage of households occupying dwellings with sufficient floor area per capita, (2) The percentage of households occupying dwellings with building resilience (roof, floor, walls), (3) The percentage of households with land ownership certificates for housing, and (4) The ratio of outstanding housing loans (Kredit Pemilikan Rumah/KPR) to gross domestic product (GDP).

According to evaluations from various program reports conducted by the Ministry and Local Governments, two out of the four priority program indicators in the field of housing and settlements have achieved the set targets for the year 2021. These two indicators are: (i) The percentage of households occupying dwellings with building resilience (roof, floor, walls), which has reached 85.41% of the target figure of 83.50%, and (ii) The ratio of outstanding KPR to GDP, which has reached 3.37% of the target figure of 3.10%. However, two indicators have not reached the targets for the year 2021: (i) The percentage of households occupying dwellings with sufficient floor area per capita, which has only reached 90.93% of the target

figure of 93.44%, and (ii) The percentage of households with land ownership certificates for housing, which has reached 49.54% of the target figure of 56.85%. For a more comprehensive overview, these progress indicators are detailed in Figure 1.

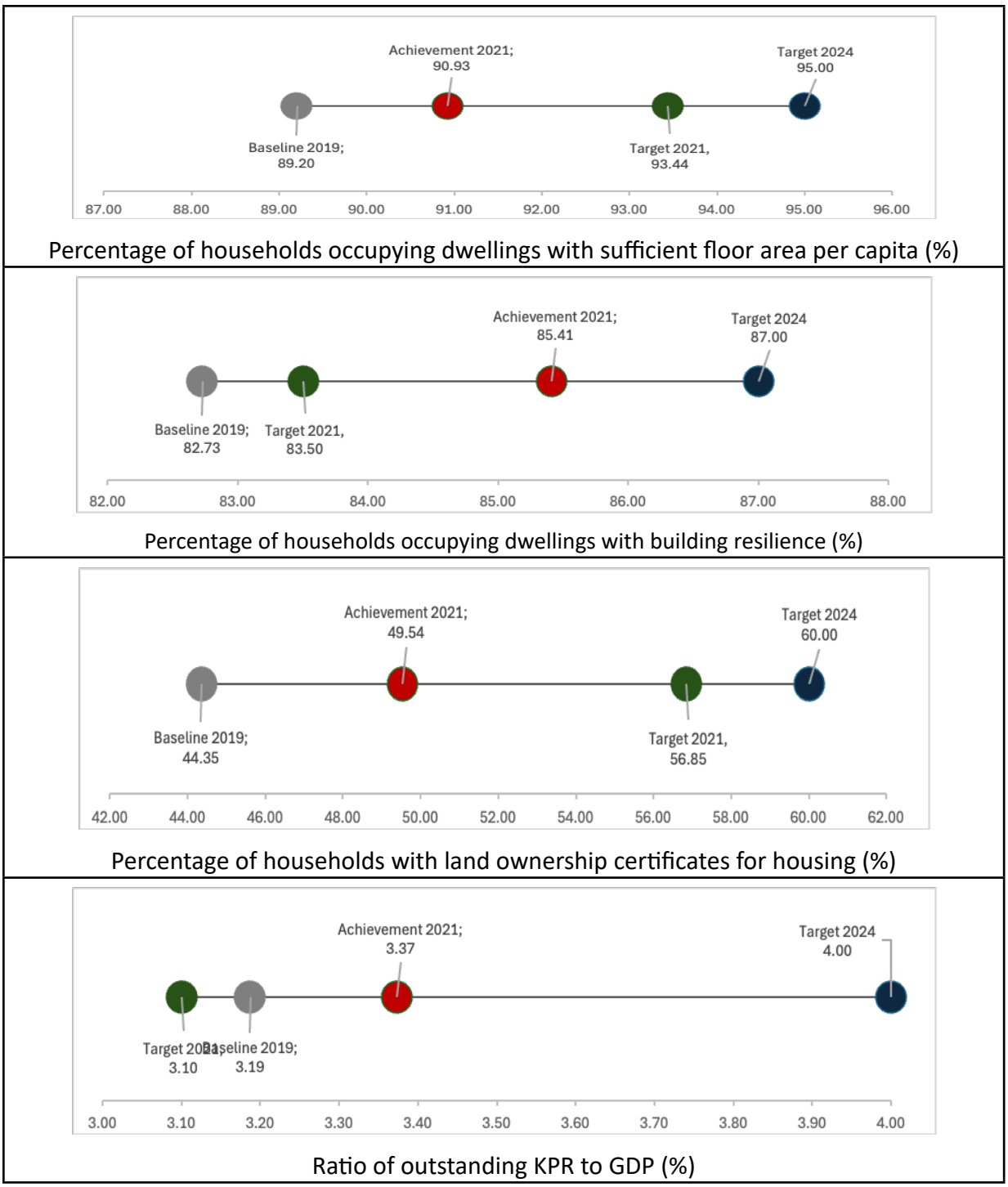


Figure 1: Progress of Housing Indicators in the 2020-2024 RPJMN

Regarding the spatial aspects within program interventions, in general, the majority of regencies/cities in Indonesia that have achieved a level of access to adequate housing above 50%, or an average of 57.37%. Broadly speaking, the level of access to suitable housing in the Java-Bali region has reached 65.15%, whereas for areas outside Java-Bali, it stands at 54.77%. There are four regencies/cities with rates of access to adequate housing surpassing 90% in 2021, spread across three provinces: Banda Aceh City, Tabanan Regency, Badung Regency, and

Ternate City. On the other hand, there are still several regencies/cities with levels of access to proper housing below 20%, distributed across various provinces, namely: Papua (15), West Papua (1), West Sulawesi (1), West Nusa Tenggara (2), Jakarta Special Capital Region (1), Riau Islands (3), Bangka Belitung (3), and North Sumatra (2).

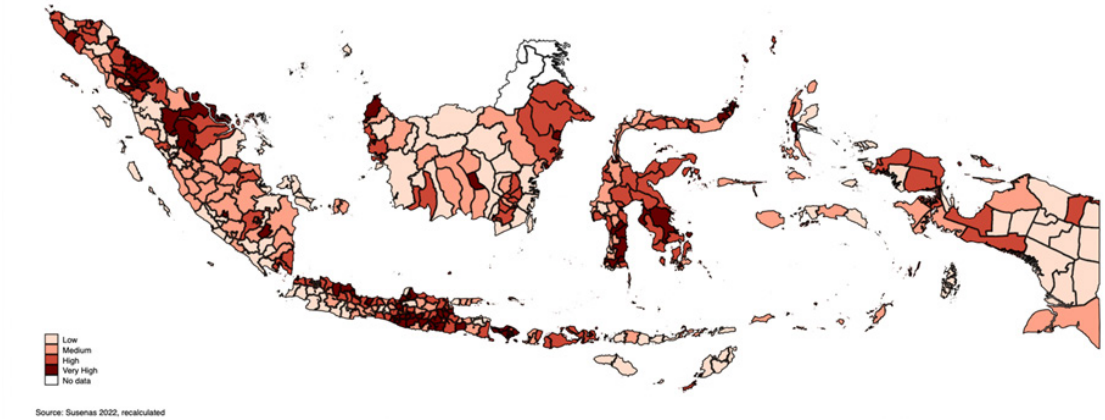
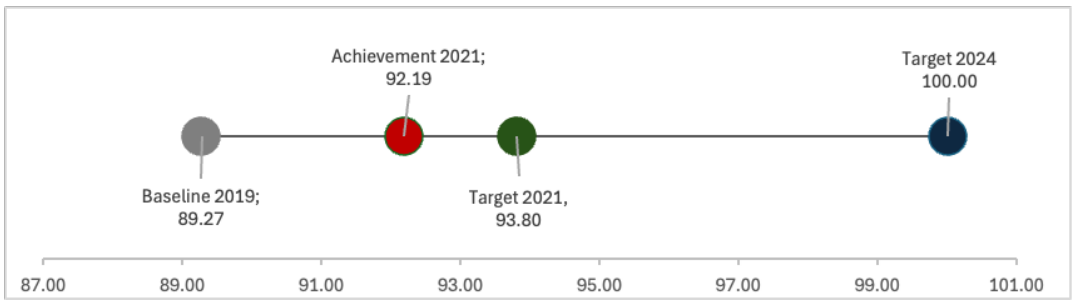


Figure 2: Access to Adequate Housing by Regency/City, 2021

As for drinking water, based on the 2020-2024 RPJMN, three target indicators of the 2020-2024 RPJMN can be evaluated. These indicators are as follows: (1) Percentage of households with access to clean drinking water, (2) Percentage of supervised/inspected drinking water facilities complying with quality standards, and (3) Number of initiatives for the guidance and supervision of drinking water development at the regency/city level.

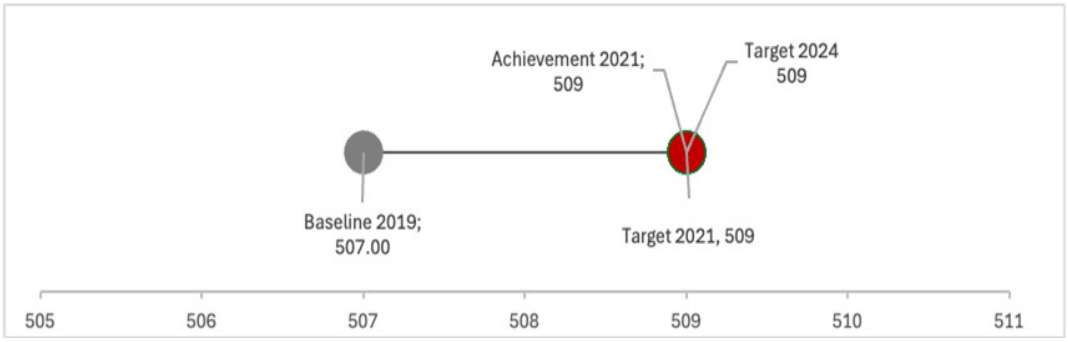
Through an evaluation of various program reports conducted by Ministries and Local Governments, it has been determined that two out of the three indicators related to the field of drinking water have achieved the set targets for the year 2021. The indicator that did not reach its designated target for 2021 is the percentage of households with access to clean drinking water. The realized performance for the year 2021 was 92.19% of the target 93.80%, resulting in an overall achievement of 98.85% in 2021. On the other hand, two indicators that have met their targets for the year 2021 are the percentage of supervised/inspected drinking water facilities complying with quality standards and the number of initiatives for the guidance and supervision of drinking water development at the regency/city level. For the indicator concerning the percentage of supervised/inspected drinking water facilities complying with quality standards, the realized performance for the year 2021 reached 72.97% of the target 64%, demonstrating an achievement rate of 114% in 2021. Furthermore, for the indicator related to the number of initiatives for the guidance and supervision of drinking water development at the regency/city level, the realized performance for the year 2021 encompassed 509 regencies/cities out of the target 509 regencies/cities, resulting in a complete attainment of 100% in 2021. For a more comprehensive overview, these progress indicators are detailed in Figure 3.

Regarding the spatial aspects within program interventions, in general, the majority of regencies/cities in Indonesia have achieved a potable water coverage rate exceeding 50%. There are 21 regencies/cities with a 100% potable water coverage rate, distributed across 8 provinces, namely: West Sumatra (1), West Java (2), Central Java (6), DI Yogyakarta (1), East Java (3), Banten (1), Bali (5), and North Maluku (2). This also underscores that the higher rates of adequate potable water coverage are predominantly found in the Java-Bali Island region. On the other hand, regencies/cities with lower levels of adequate potable water coverage are generally located in rural areas, characterized by challenging geographical features and limited transportation infrastructure. For instance, several regencies/cities with the lowest rates of adequate potable water coverage include Dogiyai Regency (0.87%), Tolikara Regency (6.60%), and Nduga Regency (13.34%), which are distant from major transportation routes.



Percentage of households with access to adequate drinking water (%)

Percentage of drinking water facilities complying with quality standards (%)



Number of regencies/cities implementing initiatives for the guidance and supervision of drinking water development

Figure 3: Progress of Drinking Water Indicators in the 2020-2024 RPJMN

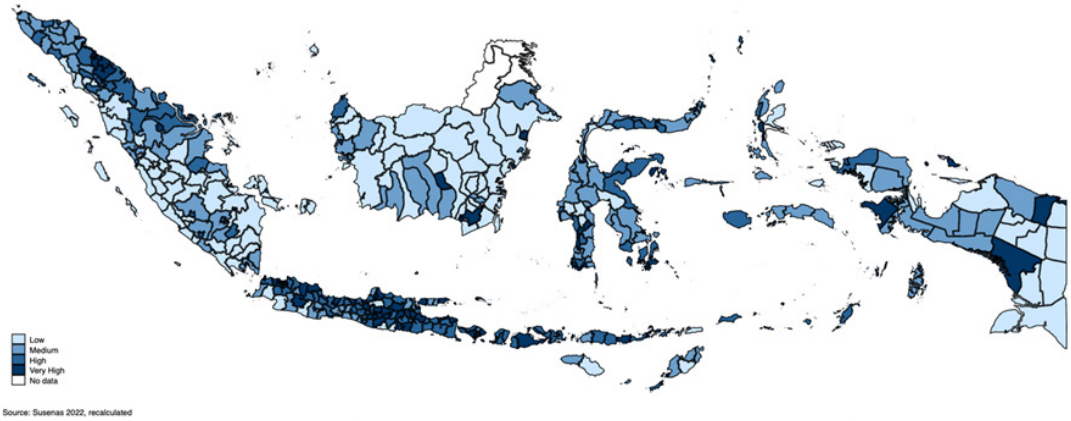
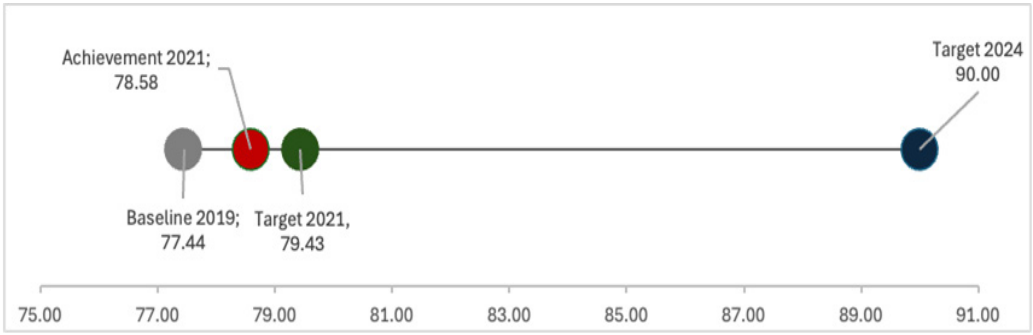


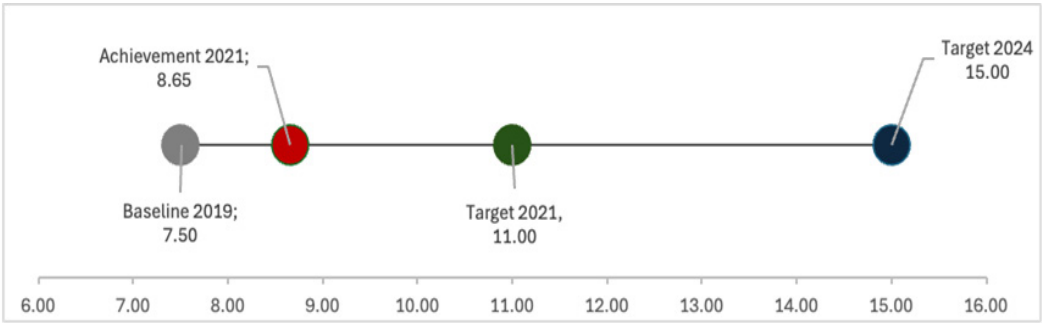
Figure 4: Access to Adequate Drinking Water by Regency/City, 2021

For sanitation, the targets outlined in the 2020-2024 RPJMN in the field of sanitation consist of four indicators spanning two priority programs. Within the priority program of Basic Service Infrastructure, the sanitation indicator pertains to the percentage of households

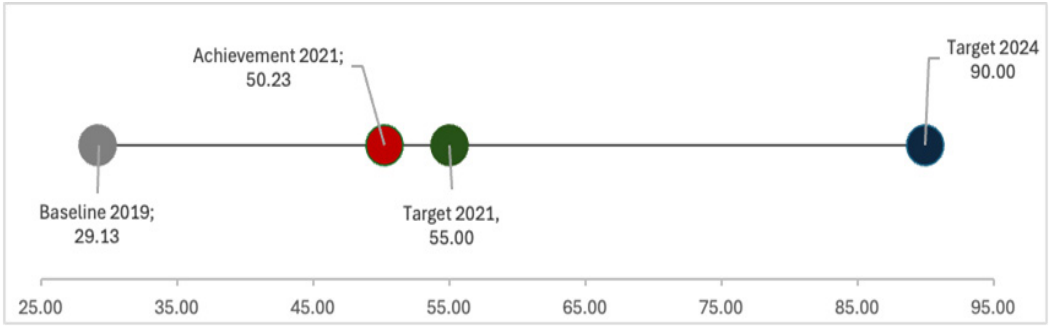
residing in dwellings with access to safe and adequate sanitation facilities. Similarly, within the same program, for the priority activity of Providing Access to Safe and Adequate Drinking Water and Sanitation, the achievement indicator specified is the percentage of villages/ communities practicing the Open Defecation-Free initiative. An additional priority program in the sanitation domain is the Enhancement of Health Access and Quality. Under the priority activity of Strengthening the Healthy Community Movement (Gerakan Masyarakat Hidup Sehat/GERMAS), the listed achievement indicator is the percentage of open defecation incidents in open areas.



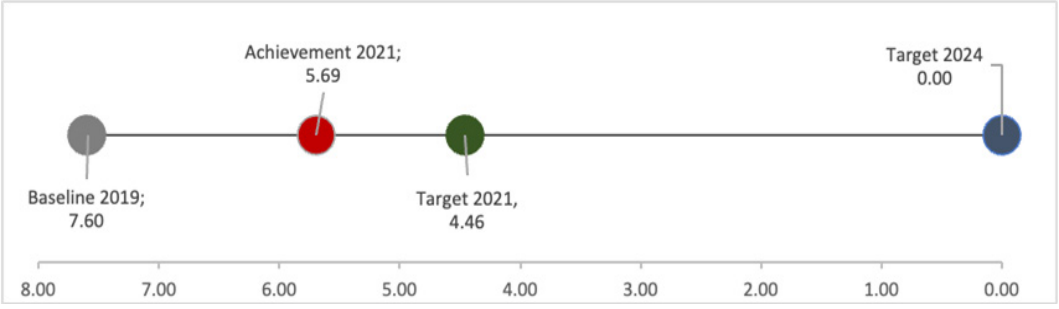
Percentage of households with access to adequate sanitation facilities (%)



Percentage of households with access to safe sanitation facilities (%)



Percentage of villages/communities practicing Open Defecation-Free initiative (%)



Percentage of Open Defecation incidents in open areas (%)

Figure 5: Progress of Sanitation Indicators in the 2020-2024 RPJMN

Based on various reports from the Ministries and Local Governments regarding program implementation, the overall attainment of sanitation indicators still falls short of the predetermined targets for the year 2021. For the indicator measuring the percentage of households with access to adequate sanitation, the targeted figure for 2021 was set at 79.43%, yet the actual achievement by 2021 reached only 78.58%. Regarding households with access to safe sanitation, the 2021 target was 11%, but the realized achievement was merely 8.65%. Similarly, for the percentage of villages/communities practicing Open Defecation-Free initiative, the 2021 target was established at 55%, yet the attainment by 2021 only reached 50.23%. Finally, for the indicator pertaining to the percentage of Open Defecation incidents, the target for 2021 was 4.46%, but the achievement by the end of 2021 stood at a higher 5.69%. For a more comprehensive overview, these progress indicators are detailed in Figure 5.

Regarding the spatial aspects within program interventions, in general, there remains a significant disparity in the level of proper sanitation in Indonesia. Regions exhibiting satisfactory sanitation levels are primarily concentrated within the metropolitan areas of Indonesia, such as Jabodetabek, Bandung, Surabaya, Medan, Denpasar, and Makassar. Conversely, regions with lower levels of acceptable sanitation are those situated in more rural areas, characterized by challenging geographical features and limited transportation infrastructure. To illustrate, several locations with sanitation levels below 50% include the Central Mountains area in Papua, remote islands like the Aru Islands, the hinterlands of Central Kalimantan, as well as the southern regions of Banten and West Java, which are considerably distant from major transportation routes.

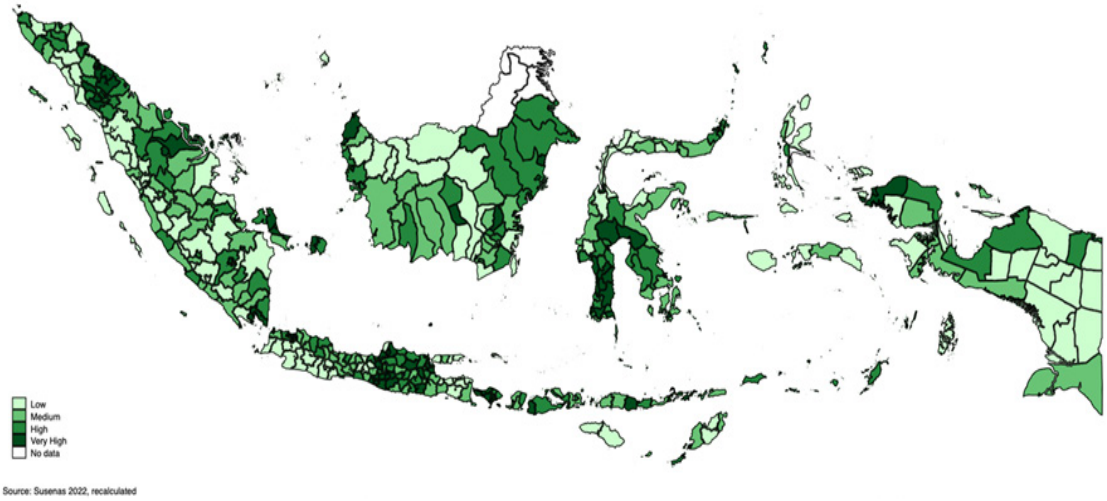


Figure 6: Access to Adequate Drinking Water by Regency/City, 2021

Finding and Discussion

Impact on Poverty Indicators

Regarding the correlation between access to adequate housing and estimated outcomes in the full model specification, the preliminary results of this study indicate a lack of substantial evidence for a correlation between the level of adequate housing and the poverty rate in general (refer to Table 2, column 2). The same pattern is observed for the subsample estimations pertaining to the non-Java region (refer to Table 2, columns 3 and 4). The presence of a positive correlation for the Java region is a noteworthy point of consideration for both this study and potential subsequent investigations, particularly given that the estimations do not demonstrate a causal relationship between access to adequate housing and the poverty rate

Table 2: Access to Adequate Housing and Poverty Rate

Dependent Variable	Poverty Rate			
	Baseline Estimation		Sub-Sample Estimation	
	Unconditional	Conditional	Java	Non-Java
	1	2	3	4
Percentage of Household with Adequate Housing	0.007**	-0.003	0.030***	-0.005
	(0.003)	(0.004)	(0.008)	(0.003)
Control Variables	No	Yes	Yes	Yes
Observations	1524	1524	339	1185
Number of Groups	508	508	113	395
Within-R2	0.006	0.075	0.666	0.026

Note: The notations ***, **, and * represent statistical significance levels of 1%, 5%, and 10% respectively. The control variables in the model encompass: per capita GDP, geographical area, and Human Development Index.

Regarding access to safe drinking water, preliminary estimation results indicate that, overall, this study does not find sufficient evidence for a correlation between the level of access to safe drinking water and the poverty level (refer to Table 3, columns 1 and 2). Similarly, the estimation results for the sub-sample of the non-Java region also show no substantial evidence for a correlation between the level of access to safe drinking water and the poverty level (refer to Table 3, columns 3 and 4). The positive correlation result for the Java Region serves as a noteworthy observation for this study and potential future studies, considering that the estimation outcomes do not demonstrate causality between access to safe drinking water and the poverty level.

Table 3: Access to Adequate Drinking Water and Poverty Rate

Dependent Variable	Poverty Rate			
	Baseline Estimation		Sub-Sample Estimation	
	Unconditional	Conditional	Java	Non-Java
	1	2	3	4
Percentage of Household with Adequate Drinking Water	0.004	-0.001	0.031***	-0.001
	(0.003)	(0.003)	(0.011)	(0.003)
Control Variables	No	Yes	Yes	Yes
Observations	1524	1524	339	1185
Number of Groups	508	508	113	395
Within-R2	0.002	0.074	0.655	0.021

Note: The notations ***, **, and * represent statistical significance levels of 1%, 5%, and 10% respectively. The control variables in the model encompass: per capita GDP, geographical area, and Human Development Index.

Further regarding access to adequate sanitation, preliminary estimated results indicate that overall, this study does not find sufficient evidence for a correlation between the level of adequate sanitation and the poverty rate. Nevertheless, results from sub-sample estimates for the non-Java region indicate that a 1 percentage point increase in households with proper sanitation correlates negatively with the poverty rate by 0.009 percentage points (see Table 4, column 4). In other words, for regencies/cities in the non-Java region with a high proportion of households having access to proper sanitation, they are situated in areas with low poverty rates. The positive correlation results for Java serve as a note for this study and future research, given that the estimated results do not demonstrate causality between access to adequate sanitation and the poverty rate.

Table 4: Access to Adequate Sanitation and Poverty Rate

Dependent Variable	Poverty Rate			
	Baseline Estimation		Sub-Sample Estimation	
	Unconditional	Conditional	Java	Non-Java
	1	2	3	4
Percentage of Household with Adequate Sanitation	0.005	-0.004	0.029***	-0.009***
	(0.004)	(0.004)	(0.009)	(0.003)
Control Variables	No	Yes	Yes	Yes
Observations	1522	1522	339	1185
Number of Groups	508	508	113	395
Within-R2	0.003	0.077	0.661	0.027

Note: The notations ***, **, and * represent statistical significance levels of 1%, 5%, and 10% respectively. The control variables in the model encompass: per capita GDP, geographical area, and Human Development Index.

Impact on Health Indicators

The study offers more intuitive estimations regarding health indicators, leveraging SUSENAS data to quantify the percentage of individuals reporting health complaints within the past month. The primary findings reveal that for every 1 percentage point increase in households with access to proper housing, there is a correlated 0.081 percentage point decrease in the rate of health complaints at the individual level. This suggests that improved housing conditions are associated with better health outcomes. Additionally, when examining specific sub-samples, the analysis reveals particularly significant results among the non-Javan population. In this group, a 1 percentage point increase in households with access to suitable housing correlates with a more pronounced 0.155 percentage point decrease in the rate of health complaints. These findings underscore the varying impact of housing access across different demographic groups and emphasize the importance of tailored housing policies to address specific community needs effectively.

Table 5: Access to Adequate Housing and Health Indicators

Dependent Variable	Percentage of Individuals with Health Complaints in the last month			
	Baseline Estimation		Sub-Sample Estimation	
	Unconditional	Conditional	Java	Non-Java
	1	2	3	4
Percentage of Household with Adequate Housing	-0.286***	-0.081**	0.001	-0.155***
	(0.034)	(0.040)	(0.129)	(0.039)
Control Variables	No	Yes	Yes	Yes
Observations	1542	1524	339	1185
Number of Groups	514	508	113	395
Within-R2	0.054	0.200	0.411	0.161

Note: The notations ***, **, and * represent statistical significance levels of 1%, 5%, and 10% respectively. The control variables in the model encompass: per capita GDP, geographical area, and Human Development Index.

In terms of access to safe drinking water, preliminary estimated results reveal a negative correlation between the percentage of households with access to safe drinking water and the level of public health complaints. The estimation outcomes demonstrate that a 1 percentage point increase in households with access to safe drinking water is negatively correlated with a public health complaint rate ranging from 0.068 to 0.18 percentage points

(Table 6, columns 1 and 2). This implies that communities in regencies/cities with a higher proportion of households having access to safe drinking water tend to experience fewer health complaints (such as diarrhea, coughing, etc.). Significant findings are also evident within the Java sub-sample, where a 1 percentage point rise in households with access to safe drinking water correlates with a 0.102 percentage point decrease in individual-level health complaints.

Table 6: Access to Adequate Drinking Water and Health Indicators

Dependent Variable	Percentage of Individuals with Health Complaints in the last month			
	Baseline Estimation		Sub-Sample Estimation	
	Unconditional	Conditional	Java	Non-Java
	1	2	3	4
Percentage of Household with Adequate Drinking Water	-0.180***	-0.068**	-0.071	-0.102***
	(0.037)	(0.035)	(0.173)	(0.035)
Control Variables	No	Yes	Yes	Yes
Observations	1524	1524	339	1185
Number of Groups	508	508	113	395
Within-R2	0.020	0.199	0.411	0.151

Note: The notations ***, **, and * represent statistical significance levels of 1%, 5%, and 10% respectively. The control variables in the model encompass: per capita GDP, geographical area, and Human Development Index.

Further regarding access to adequate sanitation, preliminary estimated results indicate the presence of a negative correlation between the percentage of households with proper sanitation and the level of public health complaints. The estimation outcomes reveal that a 1 percentage point increase in households with adequate sanitation is negatively correlated with the level of public health complaints by approximately 0.084 to 0.289 percentage points (Table 7, columns 1 and 2). In essence, communities in regions where a higher proportion of households have access to proper sanitation tend to experience fewer health complaints (such as diarrhea, coughing, and the like). The estimation results also demonstrate a significant estimate for the non-Java region, approximately 0.122 percentage points.

Table 7: Access to Adequate Sanitation and Health Indicators

Dependent Variable	Percentage of Individuals with Health Complaints in the last month			
	Baseline Estimation		Sub-Sample Estimation	
	Unconditional	Conditional	Java	Non-Java
	1	2	3	4
Percentage of Household with Adequate Sanitation	-0.289***	-0.084*	-0.091	-0.122***
	(0.044)	(0.047)	(0.169)	(0.046)
Control Variables	No	Yes	Yes	Yes
Observations	1540	1522	339	1185
Number of Groups	514	508	113	395
Within-R2	0.039	0.199	0.412	0.151

Note: The notations ***, **, and * represent statistical significance levels of 1%, 5%, and 10% respectively. The control variables in the model encompass: per capita GDP, geographical area, and Human Development Index.

Discussion

The findings of this study provide a nuanced understanding of the efficacy of Indonesian Government programs in the housing and WASH sectors in enhancing social welfare. The

observed correlation between the advancement of these programs and improved health outcomes aligns with the existing literature, which highlights the critical role of adequate housing and WASH interventions in fostering better public health (Evans et al., 2003; Fewtrell et al, 2005; Krieger & Higgins, 2002). The improvement in health conditions can be attributed to several factors such as enhanced access to clean water, improved sanitation facilities, and secure housing, which collectively mitigate health risks and prevent diseases, consistent with findings from previous studies (Newman & Holupka, 2014; Wolf et al., 2018).

However, the study's inability to establish a direct link between these government interventions and significant poverty reduction invites a deeper exploration of the underlying factors. While housing and WASH programs are essential components of social welfare, the lack of conclusive evidence supporting their impact on poverty alleviation might stem from structural economic challenges, such as income inequality and employment issues, that are not directly addressed by these programs (Gilbert, 2014; Ravallion, 2001). This finding is in line with other studies suggesting that while such programs can improve living conditions and health, their impact on poverty may be limited unless accompanied by broader economic reforms and targeted poverty reduction strategies (Smets, 2017; Sparrow et al., 2020).

The potential inefficiencies in program targeting and implementation also warrant attention. The study suggests that these programs may not be reaching the most vulnerable populations effectively, an issue echoed in previous research that emphasizes the importance of precise targeting and robust program delivery mechanisms (Ahmad & Islam, 2024). This points to a need for a more refined approach in the design and execution of development programs, ensuring that resources are directed toward those most in need and that the benefits of these programs are equitably distributed (Moser & Dani, 2008).

The recommendations proposed in light of these findings are crucial for addressing the identified gaps and enhancing the effectiveness of future initiatives. Strengthening regional administrative capacities and improving budget allocation to less-developed areas can help overcome the challenges of land acquisition and resource distribution in the housing sector (Salim & Negara, 2018). Additionally, building comprehensive housing databases at the local level could streamline planning processes and enhance the precision of program implementation.

In the WASH sector, the emphasis on institutional strengthening and the development of strategic plans for water supply and sanitation services is vital. The need to optimize idle capacities and reduce non-revenue water reflects a strategic approach to maximizing existing resources and enhancing service delivery (Hutton & Chase, 2016). Moreover, the call for improved coordination between central and local governments in the sanitation sector, along with increased involvement of non-public entities, underscores the importance of multi-stakeholder collaboration in achieving sustainable development goals (Jones, 2017).

Conclusion and Recommendation

This study comprehensively evaluated the effectiveness of the Indonesian Government's housing and WASH programs in enhancing social welfare, with a specific focus on reducing poverty and improving health outcomes. Through the analysis of data from SUSENAS and disbursement records from the Ministry of Development Planning, the study employed a fixed effect method to explore the relationship between these government initiatives and their impact on poverty rates and health indicators. The findings indicate a significant correlation between the progress of housing and WASH programs and improvements in overall health

conditions. This positive impact on health can be attributed to various factors, including better access to adequate housing and enhanced WASH practices, which collectively contribute to improved public health outcomes. However, the study did not find sufficient empirical evidence to conclusively link these programs to a significant reduction in poverty. This lack of evidence may be explained by underlying economic complexities and potential inefficiencies in the targeting and implementation of these programs. The findings suggest that while housing and WASH programs play a critical role in improving health conditions, their impact on poverty alleviation is less direct and may be influenced by broader economic factors that these programs alone cannot address.

In light of these findings, several strategic recommendations are proposed to enhance the effectiveness of future initiatives in the housing and WASH sectors. In the housing sector, it is crucial to empower regional administrative bodies to navigate the complexities of land acquisition more efficiently. Streamlining land acquisition processes will enable faster and more equitable distribution of housing resources. Additionally, there is a need to prioritize budget allocation, with a particular focus on targeting regions that are lagging behind the national average in development progress. By directing resources to these underserved areas, the government can help bridge the development gap and ensure more equitable access to housing.

Furthermore, providing substantial support to local governments in developing comprehensive housing databases is essential for streamlining planning and implementation efforts. These databases will enable local authorities to make informed decisions and allocate resources more effectively, ultimately leading to better outcomes for housing initiatives. In the WASH sector, there is an urgent need to strengthen institutional frameworks to support the effective delivery of water supply and sanitation services. Enhancing the commitment and capacity of local governments in planning and managing these services is critical to ensuring sustainable improvements in public health.

This enhancement includes encouraging local authorities to develop strategic plans for drinking water provision, with a focus on creating comprehensive master plans that cover both piped and non-piped water supply systems. Emphasis should also be placed on maximizing idle capacities and reducing non-revenue water within existing water supply networks, which will improve efficiency and service delivery. Additionally, the sanitation sector requires similar attention, with a focus on strengthening coordination between central and local governments. This coordination is vital to effectively target sanitation interventions and ensure that resources are used efficiently.

In this context, it is essential to clearly delineate the responsibilities of central and local entities, with the central government focusing on infrastructure development and local governments managing maintenance. By clearly defining these roles, the government can avoid overlaps and ensure that all aspects of sanitation infrastructure are adequately addressed. Moreover, there is a need to increase participation from non-public entities, including corporate social responsibility initiatives, public-private partnerships, and collaborations with international donors. Engaging these stakeholders will bring additional resources and expertise to the sector, further enhancing the effectiveness of sanitation programs.

Finally, improving program administration through refined tender processes, multi-year fiscal planning, and robust infrastructure maintenance protocols is recommended. These administrative improvements will ensure that programs are implemented more efficiently and that the benefits of these initiatives are sustained over the long term. By implementing these

recommendations, future programs in the housing and WASH sectors can be better aligned with the goals of reducing poverty and improving health outcomes, thereby contributing to the overall enhancement of social welfare in Indonesia.

This study has several limitations. First, the reliance on SUSENAS data and Ministry disbursement records may not fully reflect on-the-ground realities, particularly in remote areas, and the fixed effect method may not capture all influencing variables, leading to potential biases. Second, the study identifies correlations rather than causations, and establishing a direct causal link between these programs and outcomes would require more detailed data and advanced methodologies. Third, the broad poverty indicators used may not reveal localized or short-term impacts, necessitating more granular data and a longer timeframe. Additionally, external factors like economic shocks and regional disparities were not deeply explored, which could influence program effectiveness. Lastly, the findings may be context-specific to Indonesia, limiting their generalizability to other regions.

Declaration

In this part, authors should mention that: (1) The study does not conflict with anyone's interest (2) Availability of data and material, (3) Authors' contributions, (4) Funding Source and (5) Acknowledgments

Conflict of Interest

The authors declare that there is no significant competing financial, professional, or personal interests that might have affected the performance.

Availability of Data and Materials

Data and material research can be provided upon request. Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Authors' Contribution

MH and CED conceptualized the study; created the methodology; ERN wrote, reviewed, and edited the manuscript; SDP reviewed and partially wrote the Indonesian context section.

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