Prediction of SDG 6.2 Achievement in Indonesia Using Double Exponential Smoothing

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***Abstrak*— This research aims to forecast Indonesia's progress in achieving Sustainable Development Goal (SDG) 6.2, which targets 100% access to adequate sanitation and elimination of open defecation (OD) by 2030. The Double Exponential Smoothing (DES) method was used on provincial time series data from 2013–2024 (sanitation) and 2020–2024 (OD), with performance evaluated using Mean Absolute Percentage Error (MAPE). Results showed consistently high forecasting accuracy, with DKI Jakarta (0.99%), South Sulawesi (1.87%), and DI Yogyakarta (2.21%) among the most accurate for sanitation, and Maluku (2.79%), Papua (3.03%), and Gorontalo (4.49%) for OD. Spearman correlation analysis revealed a strong national negative correlation ($r = -0.991$, $p < 0.001$) between sanitation access and OD. However, provinces like DKI Jakarta (+0.36) and DI Yogyakarta (+0.86) showed positive anomalies, indicating behavioral gaps despite infrastructure growth. These findings clearly highlight the importance of integrating behavioral interventions and localized strategies to effectively accelerate progress toward SDG 6.2.**

Keywords*— *Sanitation Access, Open Defecation, Double Exponential Smoothing, Spearman Correlation, SDGs 6.2 Indonesia

I. INTRODUCTION

Access to good sanitation is a key indicator in achieving *Sustainable Development Goal* (SDG) 6.2 in Indonesia. The SDGs serve as a global framework aimed at achieving sustainable development by 2030, emphasizing inclusive economic growth, social equity, environmental protection, and accountable governance to enhance quality of life across generations[1]. Among the 17 goals, SDG 6 is central, focusing on ensuring universal access to clean water and sanitation. Specifically, Target 6.2 aims to provide equitable sanitation and hygiene for all and to eliminate open defecation by 2030[2].

In Indonesia, progress toward Target 6.2 remains uneven, especially among vulnerable groups such as low-income populations, individuals with disabilities, and those living in remote areas[3]. Sanitation access is essential for public health. It involves infrastructure and services that ensure the hygienic management of human waste, including wastewater, to maintain a disease-free environment[4]. According to Statistics Indonesia (2024), 83.60% of households have access to adequate sanitation, while 16.40% still lack proper facilities. The World Health Organization (WHO) defines environmental sanitation as the control of environmental factors that may negatively affect human health. Poor sanitation is closely linked to the spread of waterborne diseases such as cholera, typhoid, hepatitis A, and diarrhea[5].

The practice of open defecation poses serious health risks and remains widespread in Indonesia. Globally, inadequate sanitation contributes to an estimated 2.4 million deaths annually, or about 4.2% of all deaths[6]. A lack of awareness regarding proper sanitation is a key contributing factor, as individuals unaware of the health risks are more likely to engage in open defecation[7]. According to the World Bank (2020), around 100 million Indonesians still lack access to proper sanitation, and 60 million continue to defecate in open areas such as fields and rivers[8].

To address this, the Indonesian Ministry of Health issued Regulation No. 3 of 2014, mandating household access to safe sanitation, with implementation supported by local governments. However, prior research shows that *Open Defecation Free* (ODF) status has not been uniformly achieved, revealing persistent gaps in environmental sanitation[9]. Alarmingly, an estimated 150,000 children die each year in Indonesia from preventable diseases like diarrhea. Moreover, national access to safely managed sanitation declined from 7.64% to 7.25% in 2022[10]. These statistics highlight not only the urgency of sanitation improvement efforts but also the need for data-driven and region-specific strategies.

Public engagement is thus critical in resolving these issues. Communities must understand the health risks of open defecation, the benefits of safe sanitation, and actively participate in sanitation improvement programs[11]. Proper sanitation not only reflects household hygiene but also serves as a key indicator of national health status. A household is considered to have adequate sanitation if it uses a private, hygienic toilet with safe waste management[12]. When combined with sound environmental practices, sanitation can significantly reduce disease risk.

This research aims to project Indonesia's progress toward SDG Target 6.2 using the Double Exponential Smoothing (DES) method, a forecasting technique well-suited for time series data without seasonal patterns[13]. *Forecasting*, in this context, refers to a quantitative approach used to predict future events based on relevant and interrelated data [14]. This method

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is essential to support strategic decision-making, particularly in the formulation of effective policies to ensure the achievement of established development goals [15]. Given that *Target 6.2* emphasizes improving sanitation access and eliminating open defecation, accurate projections are vital to assess the likelihood of its fulfillment by 2030.

What makes this research unique is its dual approach: it not only forecasts future trends but also examines the strength and consistency of the relationship between sanitation access and open defecation behavior across provinces. This offers a more comprehensive perspective that goes beyond simple descriptive statistics. Given that Target 6.2 emphasizes improving sanitation access and eliminating open defecation, accurate projections are vital to assess the likelihood of its fulfillment by 2030.

This research offers a novel contribution by combining DES forecasting with Spearman correlation analysis to examine the relationship between sanitation access and open defecation behavior across Indonesian provinces. Unlike prior studies that relied on descriptive or cross-sectional analysis, this study adopts a predictive and spatial approach, offering evidence-based insights for identifying regional disparities and assessing the likelihood of SDG 6.2 achievement by 2030.

II. METHODOLOGY

This reserach adopts a quantitative approach to analyze development indicator trends based on numerical data. This approach enables the researcher to measure changes over time, make interregional comparisons, and generate forecasts regarding the attainment of sustainable development goals.

Province	2020	2021	2022	2023	2024
ACEH	13,21	12,75	13,41	9	7,78
SUMATERA UTARA	7,26	7,1	7,03	4,78	4,43
SUMATERA BARAT	14,56	11,6	12,74	9,31	7,04
RIAU	4,77	4,38	4,14	2,64	1,32
JAMBI	9,29	7,22	9,58	5,45	4,86
SUMATERA SELATAN	8,18	7,92	7,99	5,38	4,68
BENGKULU	9,09	7,16	7,64	5,12	4,4
LAMPUNG	3,1	2,59	2,62	1,64	1,06
KEP. BANGKA BELITUNG	5,43	3,29	4,16	1,85	1,78
KEP. RIAU	1,02	0,52	0,56	0,46	0,58
DKI JAKARTA	0,04	0,12	0,59	0,13	0,19
JAWA BARAT	2,84	3,53	3,66	2,52	1,36

Fig. 1 Percentage of Households Still Practicing Open Defecation

Double Exponential Smoothing (DES) method is employed due to its ability to model linear trends in time series data without seasonal patterns. DES is suitable for modeling development indicators that exhibit gradual increases or decreases over time. Additionally, the method is adaptive, making it appropriate for handling data from multiple provinces with varying characteristics.

A. Research Flow

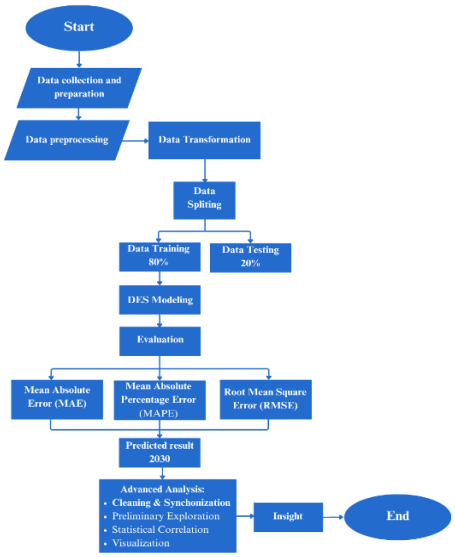

Fig. 2 Research flow

The DES method is applied through a structured process, as shown in Figure 1.

B. Data Collection and Preparation

Data used in this study were obtained from Central

data used in this study were obtained from the Central Statistics Agency (BPS) through its official portalhttps://www.bps.go.id/id, consisting of publicly available datasets from annual national reports.

The types of data and their annual coverage are as follows:

- Percentage of households with access to proper sanitation (period: 2013–2024)
- Percentage of households still practicing open defecation (period: 2020–2024)

Province	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
ACEH	53,47	33,68	54,68	62,68	63,38	67,09	73,16	77,06	77,55	77,48	78,85	81,10
SUMATERA UTARA	61,92	66,92	67,89	72,86	73,00	74,60	79,59	81,08	82,02	82,30	84,18	85,73
SUMATERA BARAT	46,13	42,34	45,02	53,24	52,77	56,85	63,98	68,11	68,68	69,27	70,97	72,82
RIAU	63,44	48,74	51,30	71,36	70,04	71,48	80,04	83,99	83,64	84,06	84,58	86,32
JAMBI	58,53	58,58	58,21	65,65	64,20	63,99	75,60	77,82	80,36	79,54	83,04	83,97
SUMATERA SELATAN	51,66	59,79	61,30	65,05	66,36	68,60	74,67	76,94	77,29	78,62	80,54	82,36
BENGKULU	32,37	33,18	39,22	49,75	42,71	44,31	75,91	78,10	79,81	79,58	80,28	83,01
LAMPUNG	45,86	37,27	44,83	58,58	52,89	52,48	79,22	78,81	83,89	83,65	84,58	85,44
KEP. BANGKA BELITUNG	77,95	75,67	80,80	83,16	83,56	85,64	90,32	92,58	92,24	91,63	93,21	94,16
KEP. RIAU	71,35	63,45	71,97	79,55	86,33	85,07	89,13	89,19	91,62	87,74	91,10	91,23
DKI JAKARTA	86,57	87,05	89,28	91,13	91,13	90,73	92,89	93,04	95,17	92,79	93,50	94,01
JAWA BARAT	60,18	61,00	59,43	63,79	64,40	64,73	69,64	71,40	71,66	74,02	74,88	75,10

Fig. 3 Percentage of Households with Access to Proper Sanitation

Data covers all provinces in Indonesia, as can be seen in Figure 2 and Figure 3.

C. Data Pre-Processing

Before modeling is carried out, the data that has been obtained is processed first. Pre-processing steps include:

1) *Data Availability Check*

This step ensures that each province has complete data for the entire time period.

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2) Missing Value Check and Handling

Provinces that have missing values (NaN) on the analyzed indicators are removed from the dataset. This is done to maintain the validity of the forecasting results and avoid distortion due to imputation of values that do not represent the actual conditions. Provinces with incomplete data can be seen in Figure 4.

33	PAPUA BARAT DAYA	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
34	PAPUA	27.89	21.66	28.04	31.43	33.06	33.75	38.27	40.31	40.81	40.34	43.00	80.57
35	PAPUA SELATAN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
36	PAPUA TENGAH	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
37	PAPUA PEGUNUNGAN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

Fig. 4 Removed empty data

3) Outlier Detection and Handling

After removing missing values (NaN) from several provinces, the next step was to identify extreme values (outliers) in the sanitation access and *open defecation* (OD) data. These values were found in some provinces and could affect the accuracy of the analysis due to irregular fluctuations. This process is shown in Figure 5 for sanitation data and Figure 6 for OD data.

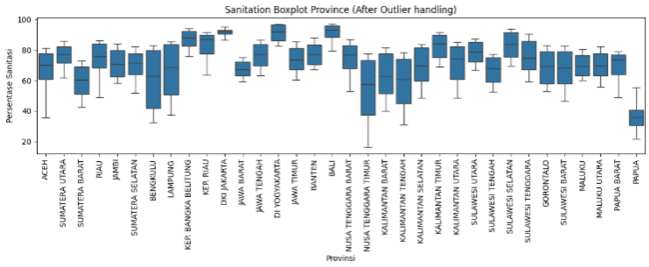

Fig. 5 Results of handling sanitation data outliers

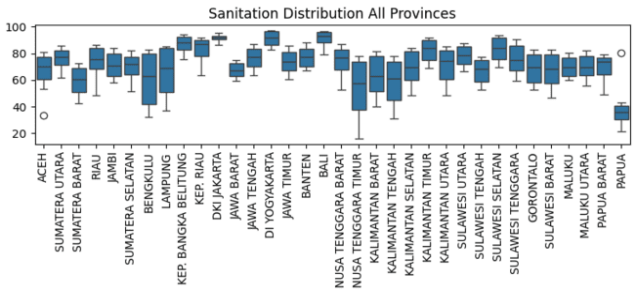

Fig. 6 Detecting outliers in sanitation access percentage data

To address this, adjustments were made using *log transformation* and *winsorizing*. These methods help reduce the influence of extreme values so that the data becomes more stable and easier to analyze. The adjustments were applied only to provinces with irregular values, without changing the data from other regions. The final results can be seen in Figure 7 and 8.

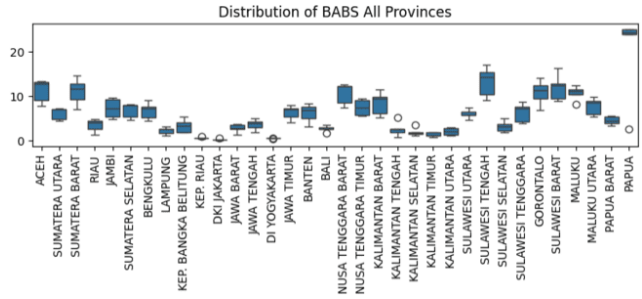

Fig. 7 Detecting outliers in open defecation percentage data

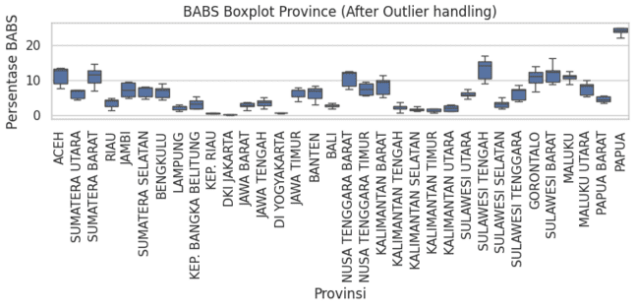

Fig. 8 Results of handling open defecation data outliers

4) Data Transformation

Data is transformation into a uniform format, such as converting a date column to a time type. The goal is to ensure that the data is ready to be processed by the forecasting algorithm consistently.

D. Data Splitting

To maintain validity and generalizability, the dataset was split into training (80%) and testing (20%) subsets per province, preserving time series continuity. This approach supports region-specific modeling by capturing local temporal patterns. As shown in Table I and II, the split was applied consistently across all provinces to ensure methodological consistency.

TABLE I. DISTRIBUTION PROVINCE (SANITATION ACCESS)

Province	**Best** (α)	**Best** (β)	**MAPE**
Maluku	0.7	0.4	0.027860
Papua	0.5	0.9	0.030298
DI Yogyakarta	0.6	0.9	0.039903
Gorontalo	0.9	0.1	0.044861
Jawa Tengah	0.9	0.1	0.081871

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TABLE II. DISTRIBUTION PROVINCE (OPEN DEFECATION)

Province	Lots of data	Data Training	Data Testing
Aceh	5	4	1
Bali	5	4	1
Banten	5	4	1
Bengkulu	5	4	1
DI Yogyakarta	5	4	1

TABLE IV. 5 PROVINCES WITH THE LOWEST MAPE (BABS)

Province	Best (α)	Best (β)	MAPE
DKI Jakarta	0.5	0.3	0.009909
Sulawesi Selatan	0.7	0.2	0.018736
DI Yogyakarta	0.6	0.8	0.022050
Jawa Barat	0.9	0.1	0.022590
Sumatera Utara	0.5	0.9	0.026643

E. DES Modelling and Evaluation

DES is used in this study to model and forecast trends in sanitation access and *open defecation* (OD) indicators at the provincial level. This method works with two main parameters α (alpha) for level smoothing and β (beta) for trend smoothing that are individually adjusted for each province. This approach allows the model to capture local dynamics more accurately through modeling that is carried out separately per region.

The level smoothing equation at time *t* is defined as follows:

- Level (*Lt*): the current smoothed value
- Trend (*Tt*): the estimated rate of change over time

Forecasting is done using the following formula:

$$Yt + h = Lt + h \cdot Tt \quad (1)$$

Explanation:

$Yt + h$: forecast value for *h* next period

Lt: level value at time-*t*

Tt: trend value at time *t*

h: the number of periods into the future to be forecasted

α, β: smoothing parameters (0 < value < 1)

The optimal combination of α and β is determined through a grid search process that minimizes the evaluation matrix using the Mean Absolute Percentage Error (MAPE) on the test data for each province. This ensures that each model is tailored to the specific trend patterns in each region.

The forecasting results for the 5 best performing provinces (based on the lowest MAPE) are presented in Tables III and IV, covering indicators of sanitation access and OD practices.

TABLE III. 5 PROVINCES WITH THE LOWEST MAPE (SANITATION)

Province	Lots of data	Data Training	Data Testing
Aceh	12	9	3
Bali	12	9	3
Banten	12	9	3
Bengkulu	12	9	3
DI Yogyakarta	12	9	3

F. Prediction until 2030

Predictions are made until 2030 to see the direction of development of the sanitation access and *open defecation* (OD) indicators, based on forecasting results with an accuracy level measured using MAPE in each province. This projection provides an overview of how close each province is to the target of the *Sustainable Development Goals* (SDGs), namely 100% of households have access to proper sanitation and 0% open defecation practices in 2030.

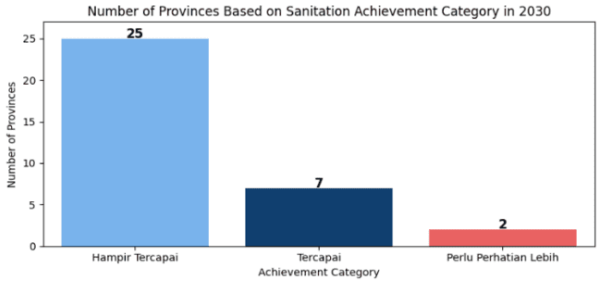

Fig. 9 Number of sanitation data achievement categories

As shown in Figure 9, seven provinces are projected to achieve 100% access to adequate sanitation by 2030. In addition, there are 25 other provinces that have shown significant progress and are approaching the target, while two provinces still require special attention and intervention to catch up.

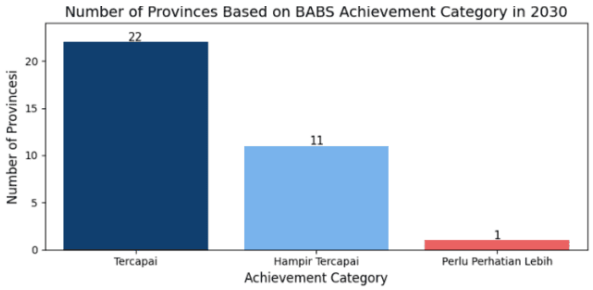

Fig. 10 Number of categories of achievement of open defecation data

Figure 10 shows the projection of Open Defecation (OD) elimination by 2030. The forecast estimates that 27 provinces will fully achieve the 0% target. Eleven provinces are expected to be close to the target, while one province still faces major challenges and requires more intensive efforts to meet national

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and SDG targets.

III. DISCUSSION AND RESULT

Correlation analysis between indicators was conducted to evaluate the extent to which increasing sanitation access can contribute to reducing open defecation practices in various regions to understand whether increasing sanitation access is related to reducing open defecation behavior, as well as to identify areas that require more attention in achieving national sanitation targets and SDGs.

To understand the relationship between sanitation access and Open Defecation (*BABS*) behavior, the analysis begins with visual exploration using *scatterplots* and *pairplots*. This approach aims to identify initial patterns of relationships between the two indicators at the provincial level, as well as detect general trends and anomalies that can enrich interpretation in the next stage of correlation analysis.

1) Initial Exploration

a) Scatterplot

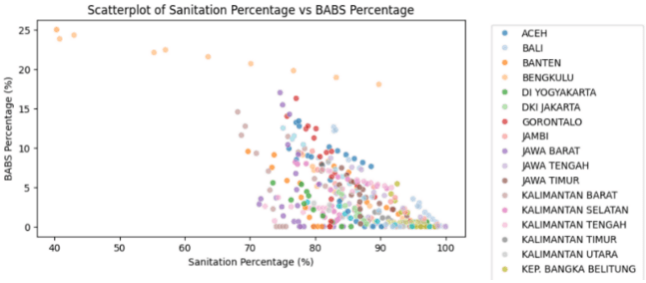

Fig. 11 Scatterplot of Sanitation Percentage vs OD Percentage

Results shown in Figure 11 through a scatter diagram show several important patterns regarding the relationship between *sanitation access* and *open defecation* (OD) behavior across provinces in Indonesia:

- A negative correlation is visually apparent: provinces with higher *sanitation access* tend to have lower *OD* percentages.
- Most provinces are clustered in the range of 75%–100% sanitation access with less than 10% *OD*, indicating general progress in sanitation development.
- A few outliers exist, particularly provinces with *sanitation access* below 60% and *OD* above 20%, suggesting regional disparities that require targeted intervention.
- No provinces show both high sanitation coverage and high *OD* prevalence, reinforcing the inverse relationship between the two indicators.
- This pattern supports the hypothesis of a monotonic association, which justifies the application of Spearman's rank correlation in the next analysis stage, as it is suitable for assessing non-linear yet consistently ordered relationships.

b) Pairrplot

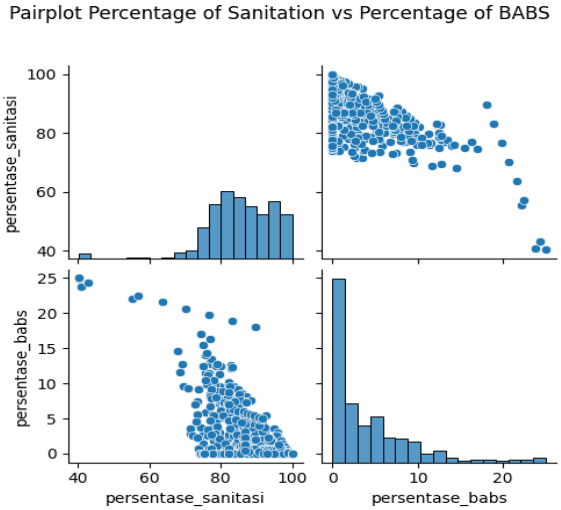

Fig. 12 Pairplot of Sanitation Percentage vs OD Percentage

Figure 12 shows that as sanitation access increases, *open defecation* (OD) rates tend to decrease, supporting a clear negative relationship between the two indicators. Most provinces are concentrated within the range of 80%–100% sanitation access and less than 10% OD, reflecting notable national progress. This pattern reinforces the view that improved sanitation infrastructure is strongly associated with healthier behavior and better public health outcomes. Additionally, the pairplot highlights some outlier provinces where relatively high sanitation access still coexists with notable OD rates, suggesting the need for complementary non-infrastructure interventions.

2) Statistical Correlation Analysis

a) National Spearman Correlation

The correlation matrix is used to identify statistically significant linear and non-linear relationship patterns. To understand the relationship between access to proper sanitation and the prevalence of *open defecation* (OD) at the national level, a Spearman correlation analysis was conducted on annual aggregate data.

Quantitative analysis produced a Spearman correlation coefficient value of -0.991 with a significance level of $p < 0.001$, indicating a very strong and statistically significant negative relationship between the two variables. This indicates that increasing access to adequate sanitation facilities nationally tends to be associated with a decrease in open-defeat practices.

b) National Heatmap Province

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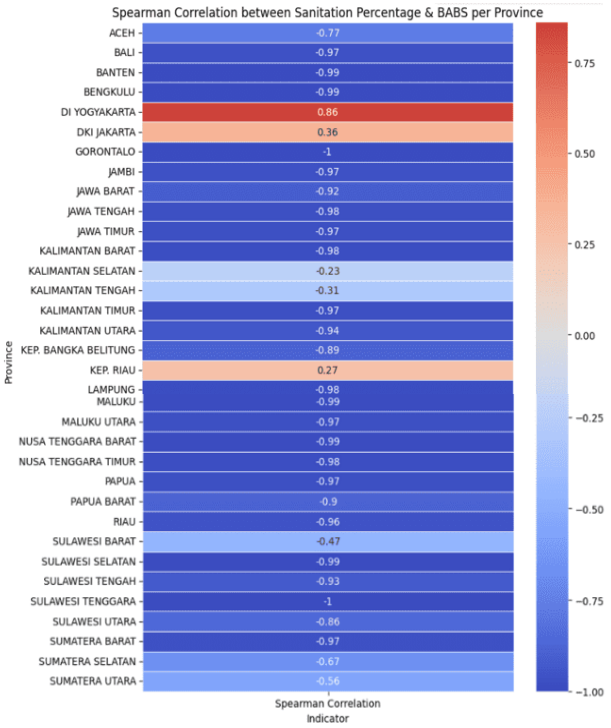

Fig. 13 National Heatmap Province

Figure 13 shows the Spearman correlation between access to improved sanitation and open defecation rates across provinces in Indonesia. Most show a strong negative correlation (−0.9 to −1.0), indicating that increased access to sanitation is associated with lower prevalence of open defecation. However, anomalies such as DKI Jakarta (0.36) and DI Yogyakarta (0.86) and Riau Islands (0.27) show positive correlations. The observed anomalies suggest that the availability of infrastructure does not always lead to changes in community behavior. Such conditions highlight the importance of implementing a more comprehensive strategy one that not only prioritizes physical development but also combines behavioral interventions, community education, and increased accessibility for vulnerable populations.

These findings offer a valuable foundation for formulating policies that are more responsive to local contexts, especially in areas where gaps in sanitation access and practices persist. Such context-sensitive approaches are expected to accelerate progress towards achieving 100% access to improved sanitation and the elimination of open defecation, in line with the goals set out in the sustainable development agenda.

3) Data Visualization

To gain a more comprehensive understanding of the relationship between sanitation access and the prevalence of open defecation (OD) at the provincial level, Figure 15 displays a visualization of the level of consistency of the relationship between the two indicators. This consistency shows how often the direction of changes in sanitation access is in line with changes in the number of BABS from year to year. The higher the consistency value, the more aligned the pattern of the relationship between increasing sanitation and decreasing OD during the observation period.

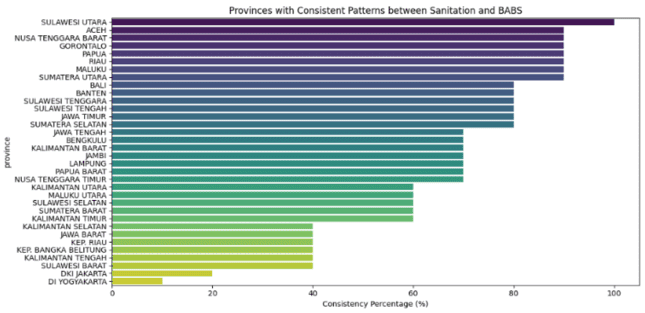

Fig. 14 Visualization of Consistent Patterns between Sanitation and OD

Based on the visualization in Figure 14, it can be seen that the level of conformity of the relationship pattern between increasing sanitation access and decreasing the prevalence of OD in various provinces in Indonesia varies greatly. Most provinces show a level of consistency above 80%, indicating a tendency for a stable relationship between the two indicators during the observation period. This shows that in many areas, improvements in sanitation infrastructure tend to be followed by changes in community behavior towards the better, which supports efforts to eliminate open defecation practices sustainably.

In contrast, provinces like DI Yogyakarta and DKI Jakarta show the lowest consistency levels. This is surprising, especially for DKI Jakarta, which usually has better sanitation infrastructure. The positive correlation suggests that higher access to sanitation doesn't always reduce open defecation. This may be due to factors like urban mobility, socio-economic gaps, or uneven outreach programs. It highlights the need for more holistic policies that combine infrastructure with education and community-based efforts.However, it is important to understand that these findings are influenced by a number of limitations that need to be considered. Differences in the quality and completeness of data between provinces can have a direct impact on the accuracy of measuring consistency patterns. If the available data does not reflect the actual conditions, the results of the analysis can provide a picture that is not entirely accurate.

In addition, the analysis used in this study is descriptive and has not considered other contextual factors, such as socio-economic conditions, population density, or the effectiveness of intervention programs at the local level. The absence of these variables limits the ability of the analysis to fully explain the causes of differences in patterns between regions.

These limitations indicate that the results obtained are still indicative and need to be developed further. Further research needs to combine a more comprehensive approach by considering local social, cultural, and economic factors. This will strengthen the understanding of the relationship between sanitation infrastructure development and changes in community behavior, and provide a stronger basis for formulating contextual and sustainable policies.

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IV. CONCLUSION

This study aimed to understand the extent to which increasing access to improved sanitation contributes to reducing open defecation (OD) practices across provinces in Indonesia, In support of achieving Sustainable Development Goal (SDG) 6.2 by 2030. Using Double Exponential Smoothing (DES), time series modeling and forecasting were applied to data on sanitation access (2013–2024) and OD prevalence (2020–2024). The forecasting models demonstrated high accuracy, with low MAPE values in most provinces. For sanitation access, the best performing provinces were DKI Jakarta (0.99%), South Sulawesi (1.87%), DI Yogyakarta (2.21%), West Java (2.26%), and North Sumatra (2.66%). For OD prevalence, the top-performing provinces were Maluku (2.79%), Papua (3.03%), DI Yogyakarta (3.99%), Gorontalo (4.49%), and Central Java (8.18%).

Correlation analysis using the Spearman coefficient shows a very strong negative relationship between the two indicators, with a value of -0.991 ($p < 0.001$) nationally. This shows that increasing access to sanitation in general tends to be followed by a decrease in the practice of OD. However, there are important anomalies found in several provinces. DI Yogyakarta, for example, shows a positive correlation of 0.86; DKI Jakarta by 0.36; and the Riau Islands by 0.27. This finding indicates that although quantitatively sanitation infrastructure has increased, it is not necessarily accompanied by changes in behavior evenly at the community level. This can be caused by social, economic factors, and limitations in educational and participatory approaches.

Based on these results, the main recommendation of this study is the need for more holistic and local context-based interventions. In areas with unusual correlations, such as DKI Jakarta and DI Yogyakarta, strategies to increase access to sanitation need to be complemented with education on clean and healthy living behavior (PHBS), massive public campaign programs, and local community involvement in sanitation program design. On the other hand, provinces such as Papua and Maluku which show high prediction accuracy but still have low levels of sanitation and BABS elimination achievement, require logistical support, funding, and local wisdom-based approaches to accelerate development acceleration.

Overall, this study has successfully demonstrated the close relationship between infrastructure and behavior in the context of sanitation development. These findings provide a strong basis for formulating policies and intervention strategies that are sharper, more targeted, and sensitive to regional conditions. With the right approach, it is hoped that all provinces can approach or achieve the target of 100% access to proper sanitation and 0% open defecation by 2030 as stated in the national SDGs agenda.

REFERENCES

[1] A. Mukhlishin, m. Ahmad baihaqi, h. Abdillah, i. A. Muharommah, and m. B. Yusuf, "jurnal informatika dan teknik elektro peramalan 7 target sdgs (sustainable development goals) 2030 dalam rangka mewujudkan masyarakat indonesia maju," 2023. [online]. Available: https://ejournal.upm.ac.id/index.php/intro.

[2] N. K. Arora and i. Mishra, "sustainable development goal 6: global water security," *environmental sustainability*, vol. 5, no. 3, pp. 271–275, sep. 2022, doi: 10.1007/s42398-022-00246-5.

[3] S. N. Maulida, s. Nasution, d. Adiyaksa, u. Syarif, h. Jakarta, and b. Kabupaten bogor, "implementation of the sixth sustainable development goal (sdgs) in providing access to clean water and safe sanitation in bogor regency," *bina: jurnal pembangunan daerah*, 2023.

[4] F. Suryani jamin, e. Sugito, s. Adhi pramono, a. Aristanto, and e. Immamah, "pelatihan edukasi peningkatan kesadaran sanitasi lingkungan dalam menghadapi peningkatan pemanasan global dunia," *jurnal pengabdian kepada masyarakat nusantara*, vol. 5, no. 1, pp. 1500–1508, mar. 2024, doi: 10.55338/jpkmn. v5i1.3010.

[5] J. Bastira ginting, m. Siagian, and t. Suci, "faktor-faktor yang berhubungan dengan buang air besar sembarangan (babs) di desa kampung dalam kabupaten labuhan batu tahun 2023," *jurnal maternitas kebidanan*, vol. 9, no. 1, 2024.

[6] D. A. Kusumaningtiar, g. Vionalita, p. D. Samilaksita, n. W. Sangadji, and t. R. Anggara, "optimalisasi keberlanjutan water, sanitation and hygiene in school (wins) dalam meningkatkan kesehatan dan lingkungan yang bersih di sekolah," *i-com: indonesian community journal*, vol. 4, no. 1, pp. 387–395, mar. 2024, doi: 10.33379/icom. v4i1.4045.

[7] H. Pengetahuan dan sikap dengan perilaku buang air besar sembarangan di desa cipadang kecamatan gedong tataan *et al.*, "the relationship between knowledge and attitudes and open defecation behavior (babs) in cipadang village district gedong tataan," 2024.

[8] J. Kesehatan masyarakat *et al.*, "open defecation free melalui program sanitasi total berbasis masyarakat di puskesmas merauke," dec. 2024.

[9] W. Ode nurhidayati, l. M. Zainul, and p. Studi keselamatan dan kesehatan kerja universitas balikpapan, "faktor-faktor yang berhubungan dengan perilaku buang air besar sembarangan (babs) pada masyarakat di desa wakeakea kabupaten buton tengah factors associated with open defecation behavior in communities in wakeakea village, central buton regency," *miracle journal of public health (mjph)*, vol. 6, no. 1, 2023, doi: 10.36566/mjph/vol6.iss1/312.

[10] F. P. Gurning *et al.*, "faktor yang mempengaruhi perilaku buang air besar sembarangan (babs) di desa pulau sembilan kec. Pangkalan susu kab. Langkat," *an-nadaa jurnal kesehatan masyarakat*, vol. 11, no. 2, p. 215, dec. 2024, doi: 10.31602/ann. v11i2.13602.

[11] P. Kesdam and v. I. Banjarmasin, "jurnal promotif preventif faktor budaya terhadap kesadaran masyarakat dalam mengatasi masalah buang air besar sembarangan: literature review cultural factors on public awareness in addressing open defecation issues: a literature review indrayadi, yuhansyah, hastin atas asih," 2024. [online]. Available: http://journal.unpacti.ac.id/index.php/jpp

[12] A. S. Suryani, p. Penelitian, b. Keahlian, d. Ri, j. Jenderal, and g. Subroto, "pembangunan air bersih dan sanitasi saat pandemi covid-19 clean water and sanitation development during the covid-19 pandemic," *jurnal masalah-masalah sosial* |, vol. 11, no. 2, pp. 2614–5863, 2020, doi: 10.22212/aspirasi. v11i2.1757.

[13] R Ardian, a. Putra, h. Z. Zahro', and d. Rudhistiar, "penerapan metode double exponential smoothing untuk peramalan penjualan unit mobil," 2023.

[14] F. Ahmad, "penentuan metode peramalan pada produksi part new granada bowl st di pt.x," *jisi: jurnal integrasi sistem industri*, vol. 7, no. 1, p. 31, May 2020, doi: 10.24853/jisi.7.1.31-39.

[15] Y. Utami, d. Vinsensia, and e. Panggabean, "forecasting exponential smoothing untuk menentukan jumlah produksi," *jurnal ilmu komputer dan sistem informasi (jikomsi v*, vol. 7, no. 1, pp. 154–160, 2024.

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