Nativa, Sinop, v. 12, n. 4, p. 665-672, 2024.
Pesquisas Agrárias e Ambientais
DOI: https://doi.org/10.31413/nat.v12i4.17810

ISSN: 2318-7670

Quantifying sanitation water quality index and progress towards SDG target in the socio-economic

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Submitted on: 07/10/2024; Accepted on: 10/21/2024; Published on: 11/13/2024.

ABSTRACT: This study aims to measure the sanitation water quality index towards the SDG target in the socio-economic field. The difficulties faced by urban communities in obtaining sanitation water needs, and the quality of water used by the community from dug well water sources with ineffective management so that it is necessary to maintain the importance of groundwater supply sources. The method used was descriptive quantitative with laboratory tests of sanitation water quality based on the Regulation of the Ministry of Health of the Republic of Indonesia in 2017 and 2023 to determine the water quality index, surveys, and questionnaires. The research location was in Bandung City, West Java, Indonesia. 24 points of the research location were conducted to collect data from 400 respondents. The time in this study is 2022-2024. The results showed that the WQI of 24 samples of water quality status values for sanitation differ. Permenkes RI number 2 of 2023 has a higher value than Permenkes RI number 32 of 2017. Therefore, based on these findings, the socio-economics of residents in densely populated urban settlements impacts the environment, especially water quality.
Keywords: dense settlement; sanitation; water supply.

Quantificação do índice de qualidade da água sanitária e do progresso em direção às metas dos ODS na área sócio-econômica

RESUMO: Este estudo tem como objetivo medir o índice de qualidade da água de saneamento em direção à meta dos ODS no campo socio-econômico. As dificuldades enfrentadas pelas comunidades urbanas na obtenção das necessidades de água para saneamento e a qualidade da água utilizada por essas comunidades proveniente de fontes de água de poços escavados com gestão ineficaz de modo que é necessário manter a importância das fontes de abastecimento de água subterrânea. O método utilizado foi quantitativo descritivo com testes laboratoriais da qualidade da água de saneamento com base no Regulamento do Ministério da Saúde da República da Indonésia, entre 2017 e 2023, visando determinar o índice de qualidade da água, além do emprego de questionários. O local da investigação foi na cidade de Bandung, Java Ocidental, Indonésia. Foram avaliados 24 pontos de amostragens, com dados de 400 entrevistados, no período de 2022 a 2024. Os resultados mostraram que o WQI de 24 amostras do índice de qualidade da água foram diferentes. Permenkes RI número 2 de 2023 apresentou valor mais alto em comparação com Permenkes RI número 32 de 2017. Portanto, com base nesses resultados, a socioeconomia dos residentes em assentamentos urbanos densamente povoados tem um impacto no meio ambiente, especialmente na qualidade da água.
Palavras-chave: povoamento denso; saneamento; abastecimento de água.

1. INTRODUCTION

Environmental sanitation safety is a highly relevant topic within the sustainable development framework. It is being researched in depth by experts on its impact on biodiversity, conservation of non-renewable resources, and the economy and society (ZLATI et al., 2024). Global public health access to water, sanitation, and health (WASH) is emphasized in the Sustainable Development Goal (SDG) (IDDI et al., 2021). WASH access is critical to improving human health and meeting the fundamental need for daily water supply at the household level (MANISHA et al., 2023). Promoting good sanitation practices is essential for water resource recovery and community participation (TWAGIRAYEZU et al., 2023). Water demand and supply needs, both current and future, suggest that water resources will not be sufficient for future urban growth (LUSTIG et al., 2018). Initiatives rely on limited resources but have a limited impact (LUTETE LANDU et al., 2023).

The importance of maintaining open sewerage infrastructure before the start of the rainy season (LEBU et al., 2024). Houses on the city's periphery, especially newly built ones, are more vulnerable to flood risks (NGU et al., 2023). Uncontrolled domestic sewerage and using rivers as the final disposal of sewage create pollution problems. There is a substantial association between vulnerable zones based on cross-verified contamination levels and vulnerability indices, and more than 3.82 million people in urban areas are concerned about contamination and vulnerability to groundwater contamination (ORTIZ-MOYA; REGGIANI, 2023). Water is a basic need in human life (KARON et al., 2017). Domestic waste pollutes rivers from sanitation activities. River water pollution from upstream to downstream contributes to groundwater quality in dense settlements in Bandung City. The availability of access to sanitation and domestic waste management does not match the increase in population. There is great pressure on the environment due to population growth but low domestic waste management.

The community is not yet convinced that sanitation services are fully effective, even though statutory regulations guarantee this (FAGANELLO; NETO, 2021). Treatment of blackwater and greywater for reuse has a greater impact than the reference scenario in all urban configurations due to the high energy consumption of greywater treatment (BESSON et al., 2024). The goals of the SDGs focus on efforts to overcome problems: climate change, ecosystems and environmental pollution, and urban infrastructure (ZHAO et al., 2022). Adopting the SDGs or insufficient resources to meet daily (JAIN; ESPEY, 2022). Cities are engines for the implementation of the SDGs; there is a lack of quantitative assessment of the progress made in achieving sustainable development goals in cities of different sizes (LIU et al., 2023). National economic policy planning that supports the achievement of multiple sustainability goals is hampered by multidisciplinary economic complexity and often conflicting policies (D'ADAMO et al., 2021; BASHEER et al., 2022). Change only in countries with adequate access to resources, administrative capacity, economic development, policies, community self-help, and external support (HICKMANN et al., 2023). Countries are limited by their institutions, so economics influences the attainability of programs (BISBEE et al., 2019) and the interaction of political, social, and multi-sectoral policy factors that influence it (RUDUCHA et al., 2017). Even though Indonesia has access to improved drinking water (71.0%) and sanitation (62.1%), most households have large disparities between and within provinces (AFIFAH et al., 2018).

In maintaining good hygiene, access to proper collection and disposal of domestic waste is equally important (REQUEJO-CASTRO et al., 2020; ODJEGBA et al., 2021; ANUARDO et al., 2022). Water and sanitation facilities and domestic waste management are equally important components of hygiene that impact health (GINÉ-GARRIGA et al., 2021). Hygiene practices remain challenging in underprivileged populations due to living conditions and hazardous household waste management among vulnerable populations, including poor and minority groups (KONG et al., 2020). Classifying and evaluating surface water quality, the Water Quality Index (WQI) of important freshwater resource management is carried out ALDREES et al., 2024; EHTERAM et al., 2024; (EJAZ et al., 2024). According to the evaluation, there are noticeable seasonal variations in the water quality, with the spring and summer months having worse conditions (SANG et al., 2024).

The main reasons for households' good response to this sanitation innovation were the technology's flushing, cleanliness, odor-free features, functionality, previous sanitation experience, and understanding of water scarcity (SUTHERLAND et al., 2021). Socio-economic drought information (SEDI) data comes from 20,999 news articles, which are processed into 4 categories, namely water deficit, water security and support, economic damage and impact, environmental impact, and sanitation (LEE et al., 2022). 69.6% of public toilets have inadequate hygiene and are prone to danger when used. Developing and finding a Sustainable Sanitation System (SSS) in the face of global sanitation and resource problems is very difficult in most places if traditional solutions are used (HU et al., 2021). Investment in flush toilets should be encouraged (NYI et al., 2023). Rapid urbanization means that more and more cities are starting to use various water supply patterns, such as desalinated seawater, external surface water, external reservoir water, local groundwater, and local surface water, but this can create new and varied dangers (LIN; HU, 2022). The regulation of hydrological flow on the land surface is determined by Ecosystem Services (ES), which regulates water flow. The cause of environmental problems such as heavy rainwater runoff and waterlogging in cities is that the ES that regulates water flow is lacking, so flooding affects the welfare of dense cities (XIONG; WANG, 2022). The significance of residents' quality of life and welfare is the impact of water, an important sector in urban areas, in the context of sustainable urban development (GARAJEH et al., 2024).

This study aims to measure the sanitation water quality index and progress towards the socio-economic targets of the SDGs. The difficulties urban communities face in obtaining sanitation water needs and the quality of water used by communities from dug well water sources with ineffective management require maintaining the importance of groundwater supply sources. Specifically, this study evaluated the sanitation water quality index based on the regulation of the Ministry of Health of the Republic of Indonesia Number 2 of 2023. The results highlight the need to test sanitary water quality and implement effective measures to ensure urban residents have access to safe water. This has significant implications for researchers, policymakers, and other stakeholders.

2. MATERIAL AND METHODS

2.1. Research location

Bandung is the capital city of West Java province in the country of Indonesia; Southeast Asia. Bandung is also the third largest city in Indonesia, after Jakarta and Surabaya. This study was conducted in Bandung City with 24 sampling locations spread across 4 sub-districts, including Andir sub-district, Astana Anyar sub-district, Sukajadi sub-district, and Bojongloa Kaler sub-district. The selection of research locations was based on the level of population density in Bandung City and the location of the dug wells, which are the main water source used jointly by the community as a sanitation water supply in communal toilets.

Based on the research location map in Figure 1, samples were obtained in Bojongloa Kaler sub-district 8 samples, Astana Anyar 5 samples, Andir sub-district 6 samples, and Sukajadi sub-district 5 samples. This is shown in Table 1.

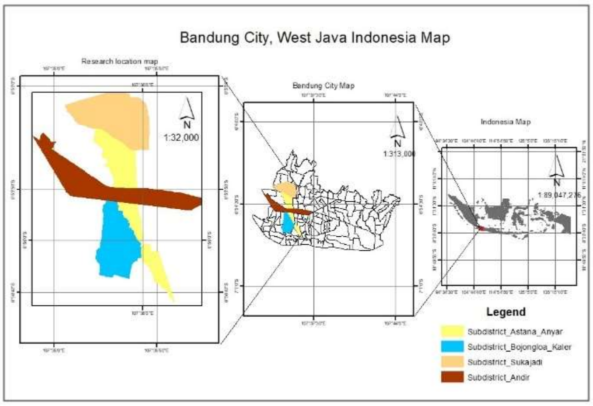

Figure 1. Map of study areas.
Figura 1. Mapa das áreas de estudo.

Table 1. Distribution of samples at the research location.
Tabela 1. Distribuição de amostras no local da pesquisa.

No.	Regency	Sample Location Point
1	Bojongloa Kaler	8
2	Astana Anyar	5
3	Andir	6
4	Sukajadi	5
	Total	24

Source: Survey, 2022.

2.2. Sampling and analysis sample

The study was conducted from May 2022 to May 2024. Water samples in this study were taken from dug wells in November 2022 during the dry season, and there was a water shortage in the community. Researchers used the research time to survey the research location, questionnaires, and water sampling for testing at the Environmental Quality Control Laboratory (LPKL) of Perumda Tirtawening Bandung City. Taking into account the availability of data, this study used data from BPS (Central Bureau of Statistics) of Bandung City in 2022 and for sanitary water quality parameters, physical, microbiological, and chemical parameters by the Regulation of the Ministry of Health of the Republic of Indonesia (Permenkes RI) number 32 of 2017 and number 2 of 2023. Sampling in the questionnaire used simple random sampling) (BIRAWIDA et al., 2021; KIPKOECH et al., 2023; TCHOUCHU; AHENKAN, 2023). The study population was 399.740 people. The total sample in this study was 400 community respondents at the research site.

2.3. Water quality index and data analysis

Analysis of sanitary water quality to measure groundwater quality index in dug wells in communal toilets with sanitary water quality parameters, depth, and distance to the source of good pollution (PRABOWO et al., 2021). The Pollution Index research method is the Indonesian National Standard based on the Minister of Environment No. 115 Decree of 2003, namely the Water Quality Index (WQI). WQI combines a lot of qualitative water data to assess water quality. The WQI process consists of four main steps: parameter selection, sub-index (SI) calculation, weighting, and final aggregation to determine the final WQI. To assess the water quality in the study area, the Sub-index (SIi) was selected:

$$Sli = \frac{C_i}{Si} \times 100 \quad (01)$$

Sli; sub-index for the parameter, Ci; a value of each parameter in mg/L. *Si* is the standard set for each parameter in mg/L. The WQI method evaluates water quality based on various parameters. The importance of each parameter is assigned a relative weight (Wi), and the weight (wi) for each parameter. The final WQI score is obtained by multiplying each parameter's calculated WQI value (SIi) with its relative weight (Wi) and summing the results.

$$WQI = \sum_{i-1}^{n} Si \times Wi \quad (02)$$

Qi= Rating for the i-the parameter; Wi= Weight for i-the parameter; Mi= Measurement value for the i-the parameter; Ii= Ideal value for the i-the parameter; Si= Quality standard for the i-the parameter. Station= sampling location point; A1-A24= sample code

Table 2. Quality standard values for sanitary water quality.
Tabela 2. Valores padrão de qualidade para qualidade de água sanitária.

No	Parameters	Standard quality value
1	Temperature	Temperature ± 3
2	Total Dissolve Solid	1000
3	Turbidity	25
4	Color	50
5	Total Coliform	50
6	pH	6.5- 8.5
7	Iron	1
8	Fluoride	1.5
9	Calcium	500
10	Manganese	0,5
11	Nitrate	10
12	Nitrite	1
13	Sulfate	400
14	Permanganate Value	10

Source: Permenkes RI No 32 year 2017

Tables 2 and 3 show that the standard values for measuring water quality in the 2017 and 2023 regulations differ.

Table 3. Quality standard values for sanitary water quality.
Tabela 3.Valores padrão de qualidade para qualidade de água sanitária.

No	Parameters	Standard quality value
1	Temperature	Temperature ± 3
2	Total Dissolve Solid	< 300
3	Turbidity	< 3
4	Color	10
5	pH	6.5- 8.5
6	Iron	0,2
7	Manganese	0,1
8	Nitrate	20
9	Nitrite	3

Source: Permenkes RI No 2 year 2023

The determination of the sub-index score for each parameter is based on the sub-index curve equation using Equation (1), and the WQI is calculated using Equation (2), while the water quality status is determined using a classification system (MARSELINA et al., 2022).

The research questionnaire to the community in the research location explored information on respondents' work type, including State Civil Apparatus (ASN), Private sector employees, self-employed, Traders, Labourers, and Others. In addition, the questionnaire asked about the status of the residents, whether they were private or rented. This data collection is related to the socio-economy of the community, environmental pollution, groundwater quality, and SDG.

3. RESULTS

3.1. Water quality test data

The research used wells dug by hand or conventional collection to sample water in dense residential areas of Bandung City. A total of 24 location points were sampled. WHO recommends that water quality analysis tests be carried out to assess the risk of contamination of sanitary water sources (KELLY et al., 2021) (Table 4). Physical, microbiological, and chemical characteristics influence water quality (EFFIONG et al., 2022).

Table 4. Water quality analysis physical parameters.
Tabela 4. Análise da qualidade da água parâmetros físicos.

Sample	Turbidity (NTU)	Color (TCU)	TDS (mg/L)	Temperature (^{0}C)
A1	0.870	10	284	28.7
A2	0.710	5	230	29.5
A3	0.810	10	212	29.9
A4	1.48	15	17	3.,4
A5	1.4	25	206	30.9
A6	0.9	5	234	28.1
A7	0.88	5	302	28.2
A8	0.69	5	232	28.4
A9	0.7	5	258	28.4
A10	0.95	5	274	28.5
A11	1.72	5	304	28.7
A12	2.01	5	266	28.7
A13	1.52	5	182	28.9
A14	1.05	5	224	29
A15	1.22	5	210	25.6
A16	0.83	5	250	28
A17	1.53	5	350	28.1
A18	1.89	5	210	28.1
A19	2.43	5	182	28
A20	0.82	5	454	28
A21	1,00	5	222	28
A22	1.22	5	208	28.1
A23	1.08	10	148	28.1
A24	0.78	5	206	28.1

Source: laboratory test data, 2023

Based on Table 4, for the sanitation water quality of physical parameters based on the provisions of Permenkes RI number 32 of 2017, the laboratory test results state that 24 samples are below the quality standard number, which means they are safe or not polluted. However, based on the regulation of Permenkes RI number 2 of 2023, there are 3 samples with TDS values exceeding the quality standard number, which means they are polluted, namely samples 7, 11, 17, and 20. Changes in water quality can have major health implications and negative impacts on important community livelihood processes such as water treatment procedures (OPERE et al., 2020).

Sanitary water quality with microbiological parameters is based on the 2017 Indonesian Minister of Health Regulation with a standard value of 50 CFU, while the Indonesian Minister of Health Regulation has a standard value of 0 CFU. Quality standard values using the 2017 Minister of Health laboratory test of 24 samples, four samples in 4 locations were contaminated with Total Coliform (Table 6).

Sanitary water quality standardsand chemical parameters from laboratory tests showed that some values, including iron, manganese, fluoride, and permanganate, were above the quality standards.

Table 5. Microbiology parameters test analysis.
Tabela 5. Análise de teste de parâmetros microbiológicos.

Sample	Total Coliform (CFU/100 ml)	*E. Coli* (CFU/100 ml)
A1	1	1
A2	1	1
A3	0	0
A4	21	21
A5	4	4
A6	9	9
A7	6	6
A8	0	0
A9	7	7
A10	64	64
A11	92	92
A12	113	113
A13	6	6
A14	43	43
A15	1	0
A16	9	9
A17	1	0
A18	69	69
A19	71	71
A20	9	9
A21	0	0
A22	0	0
A23	12	12
A24	18	18

Source: laboratory test data, 2023

3.2. Socio-economic profile analysis

From the BPS data, the researchers found that the people of Bandung have heterogeneous jobs. The respondents who obtained the data provided information according to the grouping of the type of work the researcher asked in the questionnaire question sheet, among other such answers.

Researchers obtained research results from 400 respondents; 293 lived in private houses, while 107 lived in rental houses.

Table 7. Type of work of research respondents.
Tabela 7. Tipo de trabalho dos entrevistados da pesquisa

Description	Frequency	Percentage (%)
State Civil Apparatus	7	1.8
Private sector employees	90	22.5
Work alone	17	4.3
Trader	120	30
Laborer	138	34.5
Other	28	7
Total	400	100

Source: Questionnaire results, 2023.

Table 8. Respondent's residence status.
Tabela 8. Situação de residência do respondente

Description	Unit	Percentage (%)
Private house	293	73.3
House for rent	107	26.7
Total	400	100

Source: Survei, 2022.

Table 6. Quality standard values for sanitary water quality.
Tabela 6. Valores padrão de qualidade para qualidade de água de abastecimento.

No	Ph	Fe (mg/L)	F (mg/L)	$CaCO_3$ (mg/L)	Mn (mg/L)	NO_3-N (mg/L)	NO_2-N (mg/L)	SO_4^{2-} (mg/L)	$KMnO_4$ (mg/L)	Al (mg/L)	Cl (mg/L)
A1	6.56	0.458	0.2	184.8	0.13	0.14	0.04	19.67	1.39	0.427	62.38
A2	6.58	0.054	0.35	170.94	1.14	0.0044	0.02	17.46	2.53	0.228	54.48
A3	6.82	0.026	0.13	176.4	0.02	0.0044	0.01	14.18	1.33	0.038	38.48
A4	7.20	0.07	0.44	154.6	0.03	0.6	0.18	11.3	2.43	0.046	20.7
A5	7.37	0.187	0.41	124.74	0.13	0.61	0.29	12.13	7.9	0.08	94.61
A6	7	0.035	1.93	177.76	0.04	0.71	0.71	23.99	3.05	0.026	27.57
A7	6.82	0.022	0.56	189.88	0.02	1.34	0.28	30.27	11.94	0.069	46.81
A8	7.03	0.024	0.38	137.36	0.02	0.36	0.04	25.55	0.48	0.049	36.29
A9	6.8	0.025	0.58	148.27	0.024	0.39	0.06	25.23	1.85	0.052	41.6
A10	6.7	0.023	0.52	166	0.02	0.86	0.25	25.19	5.62	0.089	39.31
A11	7.1	0.024	0.54	165.64	0.02	1.75	0.26	14.47	12.93	0.283	41.86
A12	7.8	0.029	0.83	162.81	0.30	1.01	0.02	28.46	2.68	0.051	39.82
A13	6.95	0.036	1.01	141.4	0.03	0.21	0.03	21.72	0.48	0.04	20.42
A14	7.35	0.025	0.38	126.05	0.023	0.58	0.79	28.57	2.46	0.072	32.42
A15	7.2	0.021	0.47	125.24	0.23	0.93	0.19	26.22	5.72	0.039	28.99
A16	6.81	0.035	0.064	178.57	0.067	0,34	0.5	29.86	2.87	0.204	24.86
A17	7.58	0.026	0.74	219.37	0.028	1.14	0.18	21.11	5.75	0.012	51.3
A18	7.45	0.027	0.68	161.6	0.029	0.37	0.56	19.98	3.55	0.037	22.87
A19	6.63	0.034	0.86	121.2	0.108	1.46	0.11	19.93	0.48	0.03	21.18
A20	6.6	0.092	0.75	263.81	0.141	0.93	0.13	51.41	1.81	0.175	88.57
A21	7.18	0.028	0.756	143.42	0.034	0.51	0.18	29.15	1.5	0.026	40.33
A22	7.07	0.027	0.49	154.73	0.149	0.51	0.05	32.28	0.48	0.033	28.59
A23	7.58	0.023	0.38	78.38	0.038	1.41	0.41	16.44	4.04	0.077	24.25
A24	7.22	0.027	0.75	123.62	0.021	0.49	0.24	31.57	0.67	0.052	29.25

Source: laboratory test data, 2023.

4. DISCUSSION

4.1. Socio-Economic Profile of Society

The densely populated settlements in the city of Bandung mostly belong to the lower middle class, which desperately needs access to sanitation. Communal toilets with water quality that meets quality standards will support public health. The research data shows that the community's economy, awareness of waste management, and ability to fulfill access to sanitation are limited. The community can utilize the water supply source in the form of dug wells in communal toilet facilities to reduce each household's financial expenditure.

Data is obtained that 7 respondents work as civil servants out of 400 respondents. Meanwhile, there are 90 private employees. 17 people work as entrepreneurs, 120 as traders, and 138 as traders. Meanwhile, there were 28 respondents for other types of work. Based on the respondent's type of work, among others, for jobs as civil servants, there were 1.8% of the total 400 respondents. For private employees, 22.5%; self-employed, 4.3%; traders, 30%; and laborers, 34.5%. Meanwhile, respondents with other types of work accounted for 7%. Researchers concluded that at the research location, the respondents with the largest type of work were laborers, with a percentage of 34.5%. The lowest percentage is for civil servants, with 1.8%. The respondents' residence status is only categorized into private or owned and rented or rented houses. The percentage of respondents with private residence status is 73,3%, and the percentage of respondents with rental residence is 26,7%.

4.2. Water Quality and Sanitation Water Supply Index

Density settlements city location sampling of well water and analysis in the laboratory obtained data water quality index. The WQI and Human Health Risk Assessment are important environmental health science tools that help determine water quality's impact on human health. From the 2017 regulations to 2023, there are differences in the quality standard values, with these differentiating changes, there is an evaluation for improving sanitation water quality. With the change in regulations, the latest regulations become the basis and guidelines for water quality.

Table 9. Water quality index analysis and criteria.
Tabela 9. Tipo de trabalho dos entrevistados da pesquisa

Station	2017	Criteria	2023	Criteria
A1	27.42	Very good	83.87	Good
A2	45.99	Very good	191.62	Good
A3	20.37	Very good	39.31	Very good
A4	26.49	Very good	41.96	Very good
A5	29.81	Very good	78.16	Good
A6	33.49	Very good	44.03	Very good
A7	28.09	Very good	42.03	Very good
A8	20.68	Very good	36.72	Very good
A9	23.56	Very good	39.95	Very good
A10	43.11	Very good	40.64	Very good
A11	47.22	Very good	46.74	Very good
A12	55.98	Good	85.17	Good
A13	24.11	Very good	40.31	Very good
A14	35.67	Very good	42.13	Very good
A15	25.92	Very good	67.76	Good
A16	25.48	Very good	46.93	Good
A17	27.53	Very good	48.92	Good
A18	41.58	Very good	45.18	Very good
A19	40.51	Very good	51.17	Good
A20	31.84	Very good	68.84	Good
A21	23.59	Very good	40.61	Very good
A22	27.16	Very good	56.39	Very good
A23	26.75	Very good	42.67	Very good
A24	27.03	Very good	37.24	Very good

Source: WQI water well sanitation facility data process, 2023

WQI is obtained from the laboratory test values of well water with microbiology and chemistry parameters. The water used is for sanitation needs. The data show that the

WQI regulations of 2017 and 2023 are different because the regulations have changed values.

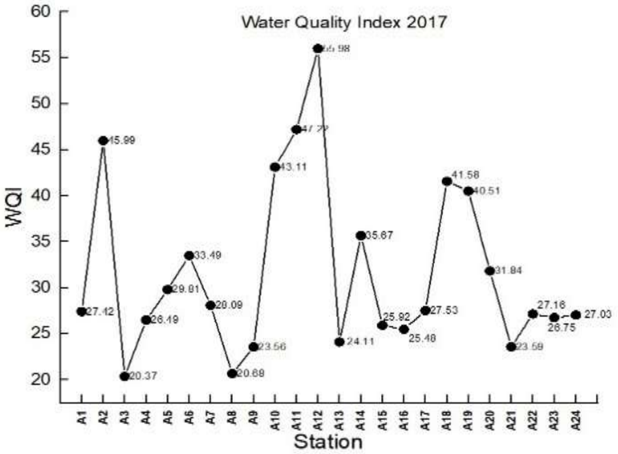

Figure 2. WQI values according to Ministry of RI 2017.
Figura 2. Valores do IQA de acordo com o Ministério de RI 2017.

The WQI value, according to the Ministry of RI 2017, in the chart can be explained by the fact that of the 24 water sampling stations, only 1 well, i.e., at A12 Station, meets the good criteria. The excellent criteria are obtained from the analysis at 23 stations.

The WQI value, according to the Ministry of RI 2017, is shown in the graph. Of the 24 water sampling stations, 9 stations have good rating criteria, and 15 wells have very good score criteria.

Based on a graphic image showing WQI values based on the Rules of the Minister of Health of RI No. 37 of 2017 with the RI Kemenkes Rules No. 2 of 2023 on WQI criteria. The WQI value is small, so the WQI criteria are very good.

5. CONCLUSIONS

The research data results show that WQI shows the value of water quality status for different sanitation. Permenkes RI regulation number 2 of 2023 has a higher value than Permenkes RI number 32 of 2018. With the latest regulatory guidelines in 2023, it tends to have a WQI and water quality status that needs continuous water quality monitoring to improve.

The WQI obtained for each parameter shows fluctuations. Therefore, based on these findings, the socio-economics of residents in densely populated urban settlements impacts the environment, especially water quality. This will update and extend the findings presented and offer a more holistic understanding of water supply from urban wells with regularly measured water quality indices, reducing public health risks.

The socio-economics of the population will be influenced by sanitation behavior in municipal facilities and hygiene awareness.

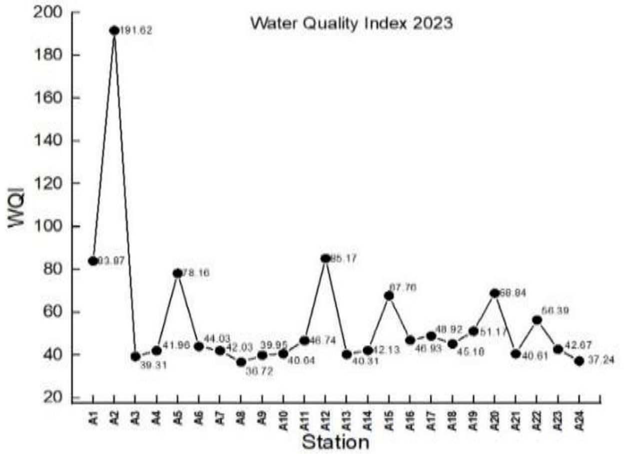

Figure 3. WQI values according to Ministry of RI 2023.
Figura 3. Valores do IQA de acordo com o Ministério de RI 2023.

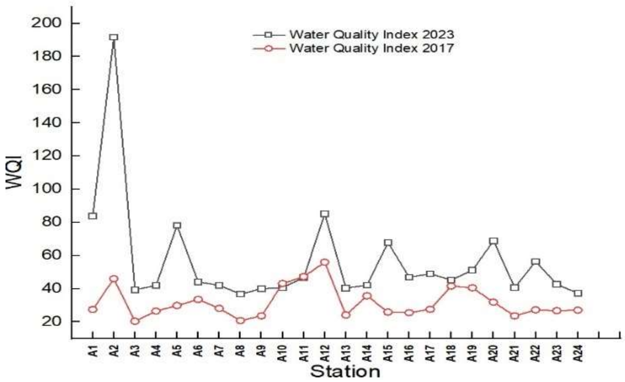

Figure 4. WQI values according to the Ministry of RI 2017 and 2023.
Figura 4. Valores do IQA segundo o Ministério do RI 2017 e 2023

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Acknowledgements: The authors would like to express their deep appreciation to the Indonesian Ministry of Research, Technology, and Ability for the financial support provided under the doctoral dissertation research program, with the contract for the research fiscal year 2022 No SP DIPA 023.17.1.690523/2022, No SPK 187.51/UN7.6.1/PP/2022.

Authors' contributions: D.D.A. and Y.S.S.: developed and performed the experiments, calculations, and simulations, analyzed the data and wrote the manuscript.; C.O.: contributed to the final version of the manuscript; I.S. and H.R.S.: supervised the project. All authors discussed the results and commented on the final manuscript.

Data availability: The corresponding author can obtain study data by e-mail.

Conflicts of Interest: The authors declare no conflict of interest.