Analysis of Ground Water Quality Status in Tambakboyo Hamlet, Tikung District, Lamongan Regency Using Storet Method

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DOI: https://doi.org/10.31284/j.jtm.2024.v5i1.5314
Received 28 November 2023; Received in revised 18 January 2024; Accepted 22 January 2024; Available online 25 January 2024
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Abstract

Leachate from the Tambakrigadung Final Disposal Site has potential to contaminate ground water of residents in Tambakboyo Hamlet, Tambakrigadung Village, Tikung District, Lamongan Regency. Tambakboyo Hamlet is a residential area close to the Tambakrigadung TPA. This study was aimed at determining the effects of the distance between the well and the Tambakrigadung landfill on the water quality of the Tambakrigadung residents' wells. The sampling employed a purposive technique by taking water samples from dug wells belonging to residents. Sampling occurred at 7 points within 3 repetitions, taking into account the distance of the well from the landfill. To determine the level of contamination in the wells being studied, the researcher applied the STORET method. Water quality status based on storet method at points A, F and G has score -19, -11. -15, and poiytnt B,C,D,E has a score of -7,-5,-7,-5. The results of this study indicated that 3 wells belonged to moderately polluted, and 4 wells were categorized as having a lightly polluted.

Keywords: *Storet Method, Water Quality Status, Ground Water.*

1. Introduction

Communities in Tambakboyo Village, Tambakrigadung Hamlet, Tikung District, Lamongan Regency use groundwater or wells for their daily needs. Abundant quantity of groundwater to be used for drinking, cooking, simple hygiene, etc. H2O or water however one would like to call it is such an important factor for life to continue. Water is so important that without it, a human being can on survive for a matter of a few days [1]. Proper clean water is the key to achieving sustainable development goals.

Groundwater is an essential resource and it exists almost everywhere under most landscapes including in Tambakboyo Hamlet. Groundwater is one of the sources of fresh water and constitutes about 0.3% of usable water, thought of small amount, ground water is the source of safe water supply for many parts of the world: water should be clear, colorless, tasteless, odorless, and devoid of suspended matter or turbidity [2]. Dug wells are one of the most common wells used to collect ground water for individual houses for clean water and drinking water with a depth of 7-10 meters from the ground. Dug wells provide water derived from a layer of soil relatively close to the surface of the soil, therefore easily exposed to contamination through seepage [3]. The quality of groundwater depends on the various chemical constituents and their concentrations in the water, and they are mostly derived from the geology of the particular location. Although ground water is the purest naturally occurring water, it is still readily contaminated by industrial waste and municipal waste in their various forms [4].

Based on the results of interviews and field observations, there were complaints about an unpleasant odor from the people in Tambakboyo Hamlet. Wells located 100 m to 900 m from the landfill found groundwater that was cloudy, yellow in color, tasted and smelled. According to the Minister of Health Regulation Republik Indonesia No. 32 of 2017 the quality of clean water is colorless, odorless and has turbidity below 25 NTU. In order to meet the standards for clean water acceptable to the community, it is necessary to analyze the status of the quality of groundwater in the area.To determine water quality status, Storet is one of method that basically is to compare between water quality data with water quality standard.comparing water quality and standard adjust for the function to determine water quality status [5]. Ground water quality will be analyzed using the Storet (Storage and Retrieval of Water Quality Data System) Method to determine water level contaminants.

2. Method

Samples in this research are digging a well which is 100m from Tambakrigadung landfill, Lamongan Regency. Figure 1 shows the sampling point location Tambakrigadung landfill.

Figure 1. Sampling point

There are 7 points dug well to analyze water quality. Sample A is 100m, sample B is 216 m, sample C is 395 m, sample D is 550m, sample E is 635m, sample F is 740 m and sample G is 850m from landfill, The sampling method is done by purposive sampling with following recruitment: a) the location from groundwater flow as seen from the contour of the land, b) The owner of the dug well that still uses the groundwater as the clean water daily (bathing and washing), c) The well owner is willing to have the well to be sampled.

In determining the value of water quality status in the Storet method, time series data is needed. Time series data is 3 times, and there are 21 samples. Samples Water quality parameters analyzed were physic and chemical. Physical parameters: odor, taste, color, temperature, turbidity, total dissolved solid (TDS) and chemical parameters: pH, Iron (Fe), Organic matter. The results of the parameter quality values will be compared with the clean water quality standards in the Minister of Health Regulation no 32 of 2017 [6].

Determination of quality status is calculated using the Storet method after obtaining test results for each environmental parameter. Laboratory test results determined minimum, maximum and average. These values are compared to Minister of Health Regulation no 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene, Swimming Pools, Solus Per Aqua, and Public Baths. These values are scored according to the minimum, maximum and average values. The total score obtained will determine the status of river water quality in a heavily polluted condition that still fulfills quality standards. The total score can be seen in table 2 and table 3.

Tabel 1. Clean water quality standards (Source: Minister of Health Regulation no 32 of 2017)

Parameters	Unit	Standard Value
Odor	-	Not smell
Taste	-	Not taste
Temperature	ºC	Air temperature ±3
Color	TCU	50
Turbidity	NTU	25
TDS	mg/L	1000
pH	mg/L	6,5-8,5
Iron (Fe)	mg/L	1
Organic matter ($KMNO_4$)	mg/L	10

Table 2: Score system to determine the status of water quality

Number of Parameter	Score	Parameters		
		Physical	Chemical	Biological
<10	Max	-1	-2	-3
	Min	-1	-2	-3
	Ave	-3	-6	-9
≥10	Max	-2	-4	-6
	Min	-2	-4	-6
	Ave	-6	-12	-18

Table 3: Classification of water quality based on the score of the Storet Method (Source: Minister of Environment Decree no 115 of 2003)

Class	Score	Status
A (Very well)	0	Fulfill quality standard
B (Well)	-1 s/d -10	Slightjly polluted
C (Moderate)	-11 s/d -30	Moderately polluted
D (Bad)	≥-31	Heavily polluted

3. Result and Discussion

3.1 Physical Parameters

Physical parameters in this study are odor, taste, temperature, color, TDS, and turbidity. The result of the analysis is known from the seven wells taken by water samples with 3 repetitions.

3.1.1 Odor and Taste

The results of the analysis of odor parameters of groundwater in the Tambakrigadung Village Dusun Tambakboyo indicates that of the samples tested are not smells at sampling point A,C,D,E, and G and smells at point B,F.

Table 4: Water Well Odor (Source: Minister of Health Regulation no 32 of 2017)

Point Well	Standard*	Day 1	Day 2	Day 3	Average
A	Not Smell	Not Smell	Not Smell	Not Smell	Not Smell
B		Smell	Smell	Smell	Smell
C		Not Smell	Not Smell	Not Smell	Not Smell
D		Not Smell	Not Smell	Not Smell	Not Smell
E		Not Smell	Not Smell	Not Smell	Not Smell
F		Smell	Smell	Smell	Smell
G		Not Smell	Not Smell	Not Smell	Not Smell

Table 4 explains that the wells that smell are at points B and F. Taste-odor may be caused by one or more of the many volatile organic compounds (VOCs) that are often present in source waters at any given time, although most odor events are caused by a relatively small number of volatiles [7]. Quality of the taste of groundwater is shown in Table 5. According to the analyzed point C,D,F,G have no taste in water and A,B, E are not taste.

Table 5: Water Well Taste (Source: Minister of Health Regulation no 32 of 2017)

Point Well	Standard*	Day 1	Day 2	Day 3	Average
A	Not taste	Taste	Taste	Taste	Taste
B		Taste	Taste	Taste	Taste
C		Not Taste	Not Taste	Not Taste	Not Taste
D		Not Taste	Not Taste	Not Taste	Not Taste
E		Taste	Taste	Taste	Taste
F		Not Taste	Not Taste	Not Taste	Not Taste
G		Not Taste	Not Taste	Not Taste	Not Taste

Odor and taste usually occur caused by decaying organic materials, certain types of microscopic organisms, and chemical compounds such as phenol [3]. The intensity of odor and taste can be increased when there is chlorination. Since the measurement of odor and taste is dependent on individual reactions the reported results are not absolute. For drinking water standards and clean water is expected water does not smell and does not taste.

3.1.2 Temperature

The results of the temperature analysis of ground water in Tambakboyo Hamlet, ranged from 27.4°C – 29.5°C. this temperature is indicating that in general, out of all the samples tested, nothing exceeded the allowable water quality standards for water. The temperature test results are shown in table 6.

Table 6: Water Well Temperature

Point Well	Standard*	Day 1	Day 2	Day 3	Average
A	Air Temperature	29	29,5	29,3	29,2
B		27,8	28	28,1	27,6
C		28,1	28,6	28	28,4
D		27,4	28	27,6	27,6
E		28,5	28,7	28,5	28,5
F		29	29,1	28	28,8
G		28	28,3	28	28,1

According to Saito et al [8], subsurface temperature change on groundwater quality due to changed physical, chemical, and microbial processes have received little attention.

3.1.3 Color

Analysis of color parameters in ground water from Tambakboyo Hamlet showed that the samples tested were generally deep normal conditions. Table 7 below shows color values in each sample during water quality laboratory testing raw.

Table 7: Water Well Color (Source: Minister of Health Regulation no 32 of 2017)

Point Well	Standard*	Day 1	Day 2	Day 3	Average
A	50 TCU	26	28	26	26,6

B		8	10	10	8,6
C		8	8	6	7,3
D		10	8	8	8,6
E		6	8	8	7,3
F		4	7	8	6,3
G		10	8	10	9,3

Table 7 showed that the tested water sample fulfilled the quality standard requirements. The groundwater sample test is in the range of 4 – 28 in which the value does not exceed the limit maximum allowed in water of 50 TCU according to Minister of Health Regulation No.32 of 2017. Color in groundwater can be caused by dissolved organic material, inorganic materials such as iron or manganese. At sampling point A, the color value is proportional to the value of organic matter and turbidity. Organic matter value reached 12 mg/L and turbidity reached 26 mg/L. The iron content at point A affects the color of the groundwater. The presence of Fe content in water causes the color of the water to change to yellow-brown after (some time) contact with air. Besides being harmful to health, iron in water also causes an unpleasant odor, yellow on the walls of the tub, and yellow spots on the clothes [9].

3.1.4 Turbidy

Turbidity is the measure of cloudiness of a liquid. Turbidity in water is caused by large numbers of suspended organic and inorganic particles, such as sediments or microscopic organisms. These particles are picked up as water moves through rock and soil, and into your groundwater supply.

Table 8: Water Well Turbidity (Source: Minister of Health Regulation no 32 of 2017)

Point Well	Standard*	Day 1	Day 2	Day 3	Average
A	25 NTU	26	25	26	25,67
B		15	16	16	15,67
C		8	9	7	8
D		12	11	11	11,3
E		10	10	9	9,7
F		8	7	8	7,7
G		6	7	7	6,7

Table 8 showed there are 2 water samples a well that has a value of 26 NTU at point A that exceeds the rules so it doesn't fulfill the quality standard requirements, ground water that fulfills the quality standard requirements can be used for daily purposes such as washing, shower, toilet, and others.

3.1.5 Total Dissolved Solid (TDS)

Groundwater comes from the aquifer through the rocks and produces water products containing TDS. Common cations that contribute to TDS are calcium, magnesium, potassium, and sodium. Common anions include bicarbonate, carbonate, chloride, nitrate, sulfates, and silicates. TDS values in groundwater are shown in Table 9.

Table 9: Water Well TDS (Source: Minister of Health Regulation no 32 of 2017)

Point Well	Standard*	Day 1	Day 2	Day 3	Average
A	1000mg/L	3520	3545	3512	3535
B		3180	3182	3117	3010
C		2834	2915	2921	2890
D		3027	3368	3320	3238
E		1503	1624	1520	1549
F		1944	1951	1938	1944
G		1582	1430	1417	1476

The results of the analysis of the TDS parameter in ground water ranged from 1417 mg/l – 3545 mg/l indicating that in general the entire ampel tested passed the quality standard. Water with a TDS value <1,500 mg/L has an unpleasant taste and is not suitable for consumption as drinking water. TDS is related to the value of hardness, turbidity level, and salinity [10]. Dissolved solid contamination comes from organic matter, salts, and dissolved gasses. If the water contains dissolved solids, it will affect the physiological function of the kidneys [11].

3.1.6 pH

pH is used to express the intensity of the acid or base state of a solution. The results of the analysis can be seen in Table 10.

Table 10: Water Well pH (Source: Minister of Health Regulation no 32 of 2017)

Point Well	Standard*	Day 1	Day 2	Day 3	Average
A	6,5-8,5	7,42	7,11	8	7,51
B		8,3	8,1	8,21	8,2
C		6,81	6,76	6,83	6,8
D		6,69	6,49	6,5	6,56
E		6,82	6,55	6,64	6,67
F		6,53	6,33	6,28	6,33
G		6,82	6,78	6,5	6,7

3.1.7 Iron (Fe)

Water flows through the layers of soil so it dissolves the iron causing the iron to seep inside groundwater. According to Minister of Health Regulation no 32 of 2017 the permitted level of iron content (Fe) for clean water quality is 1.0 mg/L. The results of the analysis can be seen in Table 11.

Table 11: Water Well Iron (Source: Minister of Health Regulation no 32 of 2017)

Point Well	Standard*	Day 1	Day 2	Day 3	Average
A	1 mg/L	0,1	0,14	0,12	0,12
B		0,2	0,02	0,2	0,14
C		0,02	0,02	0,02	0,02
D		0,1	0,2	0,12	0,14
E		0,1	0,12	0,12	0,12
F		0,2	0,2	0,2	0,2
G		0,02	0,02	0,02	0,02

Based on the table above the range of iron (fe) parameter value is 0,02-0,14 which is the highest value in location F that is 0,2 whereas the lowest pH value is location G that is 0,2. Iron compounds are soluble and quite abundant in soil. Groundwater usually has an amount of carbon dioxide, with possibly low dissolved oxygen or even an anaerobic atmosphere. Iron in water is usually dissolved in the form of bicarbonate compounds or salts, sulfate salts, hydroxides, colloids or combined with organic compounds [9]. The distance between the final disposal site and the water source can affect the value of iron in groundwater [12][13]. The value of iron will decrease with the passage of time and places where water flows through the soil layer and iron can be retained in soil grains [14].

3.1.8 Organic Matter

Organic matter in groundwater will contaminate ground water. This is caused through waste, spills, and surface water runoff. Organic chemicals consumed in high levels can cause damage to the circulatory system, kidneys, liver, reproductive system and nervous system. Table 12 explains the amount of organic matter in groundwater..

Table 12: Water Well Organic Matter (Source: Minister of Health Regulation no 32 of 2017)

Point Well	Standard*	Day 1	Day 2	Day 3	Average
A	10 mg/L	12,2	12,1	11,8	12,03
B		10,2	9,8	9,9	9,97
C		9,6	9,8	9,3	9,57
D		1,8	11,6	11,2	8,20
E		8,6	8,8	8,6	8,67
F		7,9	7,9	8	7,93
G		10,5	10,8	10,8	10,70

Organic content that enters groundwater can be caused by pollution around the water source. the highest value is obtained at point A where point A is close to the pollutant source from the final disposal site and residential areas. at point BCDEF the value of organic content is still below the quality standard while the value at point G exceeds the quality standard.

3.2 Ground water Quality Status Based on Storet Method

To determine the contaminant level overall can be analyze using STORET method. STORET method describes the parameters that fulfill the water quality standard. STORET method principally is given comparison between water quality with the standard suitable with the function to determine the status.

Table 13: Calculation of the Storet Method for each Sample Point

Sampling Point A								
Parameters	**Min**	**Max**	**Average**	**Standard**	**Min Score**	**Max Score**	**Average Score**	**Total**
Temperatur	29	29,5	29,2	Air temperature	0	0	0	0
Color	26	28	26,6	50 TCU	0	0	0	0
Turbidity	25	26	25,67	25 NTU	0	-1	-3	-4
TDS	3512	3545	3526	1000mg/L	-1	-1	-3	-5
pH	7,11	8	7,51	6,5-8,5	0	0	0	0
Fe	0,1	0,14	0,12	1 mg/L	0	0	0	0
KMNO4	11,8	12,2	12,03	10 mg/L	-2	-2	-6	-10
B								
Parameters	**Min**	**Max**	**Average**	**Standard**	**Min Score**	**Max Score**	**Average Score**	**Total**
Temperatur	27,8	28,1	27,6	Air temperature	0	0	0	0
Color	8	10	8,6	50 TCU	0	0	0	0
Turbidity	15	16	15,67	25 NTU	0	0	0	0
TDS	3117	3182	3160	1000mg/L	-1	-1	-3	-5
pH	8,1	8,3	8,20	6,5-8,5	0	0	0	0
Fe	0,02	0,2	0,14	1 mg/L	0	0	0	0
KMNO4	9,8	10,2	9,97	10 mg/L	0	-2	0	-2
C								
Parameters	**Min**	**Max**	**Average**	**Standard**	**Min Score**	**Max Score**	**Average Score**	**Total**
Temperatur	28	28,6	28,4	Air temperature	0	0	0	0

Color	6	8	7,3	50 TCU	0	0	0	0
Turbidity	7	9	8,00	25 NTU	0	0	0	0
TDS	2834	2921	2890	1000mg/L	-1	-1	-3	-5
pH	6,76	6,83	6,80	6,5-8,5	0	0	0	0
Fe	0,02	0,02	0,02	1 mg/L	0	0	0	0
KMNO4	9,3	9,8	9,57	10 mg/L	0	0	0	0

D

Parameters	**Min**	**Max**	**Average**	**Standard**	**Min Score**	**Max Score**	**Average Score**	**Total**
Temperatur	27,4	28	27,6	Air temperature	0	0	0	0
Color	8	10	8,6	50 TCU	0	0	0	0
Turbidity	11	12	11,33	25 NTU	0	0	0	0
TDS	3027	3368	3238	1000mg/L	-1	-1	-3	-5
pH	6,49	6,69	6,56	6,5-8,5	0	0	0	0
Fe	0,1	0,2	0,14	1 mg/L	0	0	0	0
KMNO4	1,8	11,6	8,20	10 mg/L	0	-2	0	-2

E

Parameters	**Min**	**Max**	**Average**	**Standard**	**Min Score**	**Max Score**	**Average Score**	**Total**
Temperatur	28,5	28,7	28,5	Air temperature	0	0	0	0
Color	6	8	7,3	50 TCU	0	0	0	0
Turbidity	9	10	9,67	25 NTU	0	0	0	0
TDS	1503	1624	1549	1000mg/L	-1	-1	-3	-5
pH	6,55	6,82	6,67	6,5-8,5	0	0	0	0
Fe	0,1	0,12	0,11	1 mg/L	0	0	0	0
KMNO4	8,6	8,8	8,67	10 mg/L	0	0	0	0

F

Parameters	**Min**	**Max**	**Average**	**Standard**	**Min Score**	**Max Score**	**Average Score**	**Total**
Temperatur	28	29,1	28,8	Air temperature	0	0	0	0
Color	4	8	6,3	50 TCU	0	0	0	0
Turbidity	7	8	7,67	25 NTU	0	0	0	0
TDS	1938	1951	1944	1000mg/L	-1	-1	-1	-3
pH	6,28	6,53	6,38	6,5-8,5	-2	0	-6	-8
Fe	0,2	0,2	0,20	1 mg/L	0	0	0	0
KMNO4	7,9	8	7,93	10 mg/L	0	0	0	0

G

Parameters	**Min**	**Max**	**Average**	**Standard**	**Min Score**	**Max Score**	**Average Score**	**Total**
Temperatur	28	28,3	28,1	Air temperature	0	0	0	0
Color	8	10	9,3	50 TCU	0	0	0	0

Turbidity	6	7	6,67	25 NTU	0	0	0	0
TDS	1417	1582	1476	1000mg/L	-1	-1	-3	-5
pH	6,5	6,82	6,70	6,5-8,5	0	0	0	0
Fe	0,02	0,02	0,02	1 mg/L	0	0	0	0
KMNO4	10,5	10,8	10,70	10 mg/L	-2	-2	-6	-10

Table 14: Ground water Quality Status for each Sample Point

Sampling Point	Total Score	Quality Status
A	-19	moderately polluted
B	-7	slightly polluted
C	-5	slightly polluted
D	-7	slightly polluted
E	-5	slightly polluted
F	-11	moderately polluted
G	-15	moderately polluted

Total value of each sampling point is added up and the ground water quality statistics are determined. In Table 13, the results of point A are worth -19 so based on table 3 the groundwater is moderately polluted, as well as at other points. Point A is the closest location to the source of pollutant, landfills and residential areas, so the pollutant value is the highest compared to other sample points. Points F (-11) and G (-15) are included in the heavily polluted category due to the location of points F and G close to densely populated settlements. Points B (-7), C (-5), D(-), and E (-5) are included in the mildly polluted category. Based on Table 13, from all sampling points the highest pollution is in the TDS parameter. The leaching of salts from the soil and the possibility of household sewage seeping into the groundwater are the two main causes of the groundwater sample's high TDS concentration [15]. The ground water was contaminated heavily by TDS, Nitrate posed the biggest threat to the groundwater's quality, followed by nitrite and heavy elements like arsenic and hexavalent chromium [16]. The groundwater near the studied landfill sites had varying levels of total hardness, total dissolved solids, nitrate, and lead during the monsoon and winter seasons. Environmental factors, such as high evaporation, low rainfall, and the existence of permafrost, significantly restricted both the rainfall infiltration and the leachate infiltration.

If we look at the total score for each parameter, the TDS value has the lowest number for each sample drop, followed by the organic substance value (KMnO4). High TDS values in well water can be caused by the solubility of organic and inorganic substances [18]. To reduce organic substances dissolved in water, ground water must be kept away from sources of pollution such as septic tanks or domestic waste processing or leachate infiltration, because domestic wastewater causes high levels of organic substances. High TDS levels in water can be used by human activities such as agriculture, water use, industry processes and mining [19]. Organic matter and high TDS in groundwater can be removed using physical adsorption, reverse osmosis (RO), nanofiltration, ultrafiltration, distillation, precipitation, membrane filtration, ion exchange, electrolysis, and bacteria-based bioremediation [18][20].

4. Conclusions

The quality of ground water in Tambakboyo Hamlet, Tikuung District, Lamongan Regency is in the status of lightly polluted and heavily polluted. Light pollution occurs in wells at points B, C, D, and E, while heavy pollution occurs at points A, F, G. Pollution can occur due to the influence of landfills and domestic wastewater.

References

[1] Popkin B, Anci DK, Rosenberg I (2010) Water, hydration, and health.Nutr Rev 68(8): 439-458

[2] Jidauna, G. D., Dabi, D.D., Saidu, J.B., Abaje. B., Ndabula. C. (2013). Assessment of Ground water Quality in Selected Location in Jos, Plateau State, Nigeria. International Journal of Marine, Atmospheric & Earth Sciences, 2013, 1(1): 38-46.

[3] Maru, R., Baharuddin, I. I.,Badwi, N., Nyompa, S., and Sudarso. (2018). Analysis of Water Well Quality Drilling Around Waste Disposal Site in Makassar City Indonesia. IOP Conf. Series: Journal of Physics: Conf. Series 954.

[4] Adelekan, B. A., "Water Quality of Domestic Wells in Typical African Communities: Case Studies from Nigeria," International Journal of Water Resources and Environmental Engineering, Vol. 2, No. 6, 2010, pp. 137-147.

[5] Sugiarto, Hariono, B., Destarianto, P., Nurudin,M. (2018). Determination of Water Quality Status at Sampean Watershed Bondowoso Residence Using Storet Method. IOP Conf. Series: Journal of Physics: Conf. Series 953.

[6] Minister of Health Regulation Republic of Indonesia no 32 of 2017. Standar Baku Mutu Kesehatan Lingkungan Dan Persyaratan Kesehatan Air Untuk Keperluan Hygienesanitasi. Kolam Renang, Solusi Per Aqua, Dan Pemandian Umum.

[7] Watson S. B. (2010). Algal Taste and Odour. Chapter 15 in Algae: Source to Treatment. Manual of Water supply Practices – M57. American Water Works Association, Denver, CO, ISBN 978-1-58321-787-0.

[8] Saito, T., Hamamoto, S., Ueki, T., Ohkubo, S., Moldrup., Kawamoto, K., Komatsu, T. (2016). Temperature change affected groundwater quality in a confined marine aquifer during long-term heating and cooling. Water Research Vol. 94 PP 120-127.

[9] Iyabu, H., Muhammad, A., Kilo, J. L., Kilo, A.L. Besi dalam Air Sumur: Studi Kasus di Kelurahan Dulalowo dan Heledulaa. Jamb.J.Chem, Volume 02 (2), 46-52.

[10] Fajarini, S. 2014. Analisi Kualitas Air Tanah Masyarakat di sekitar Tempat Pembuangan Akhir (TPA) Sampah Kelurahan Sumur Batu Bantar Gebang, Bekasi tahun 2013. UIN Syarif hidayatullah

[11] Afrianita, R., T. Edwin dan A. Alawiyah. 2017. Analisis Intrusi Air Laut dengan Pengukuran Total Dissolved Solids (TDS) Air Sumur Gali di Kecamatan Padang Utara. Jurnal Dampak ,14(1),62.

[12] Putri, A. D. N., Utomo, Y., & Kusumaningrum, I. K. (2013). Analisis Kandungan Besi Di Badan Air Dan Sedimen Sungai Surabaya. Jurusan Kimia. FMIPA. Universitas Negeri Malang. Malang.

[13] Sundra, I. K. (2006). Kualitas Air Bawah Tanah Di Wilayah Pesisir Kabupaten Badung. Universitas Udayana.

[14] Cuningham, W. P., Cuningham, A. M., & Saigo, W. B. (2005). Environment Science: A Global Concern. Boston, McGsraw Hill Company.

[15] Sarath Prasanth, S.V., Magesh, N.S., Jitheshlal, K.V. et al. (2012). Evaluation of groundwater quality and its suitability for drinking and agricultural use in the coastal stretch of Alappuzha District, Kerala, India. Appl Water Sci 2, 165–175.

[16] Zeng, D., Chen G,. Zhou, P., Xu, H., Qiong, A., Duo, B., Lu, X., Wang, Z., Ham, Z. (2021). Factors influencing groundwater contamination near municipal solid waste landfill sites in the Qinghai-Tibetan plateau. Elsevier: Ecotoxicology and Environmental Safety, Volume 211, 111913

[17] Minister of Environment Decree Republic of Indonesia no 115 of 2003. Pedoman Penentuan Status Mutu Air.

[18] Si Chen., Xie J., Wen Zhiyou. (2021). Microalgae-Based Wastewater Treatment And Utilization Of Microalgae Biomass: Elsevier: Advances in Bioenergy, Volume 6 Issue 1 pages 165-198.

[19] Miguel Cañedo-Argüelles, Kefford Ben. J., Piscart, C., Prat N., Ralf B. Schäfer d, Claus-Jürgen Schulz. (2013). Salinisation of rivers: An urgent ecological issue. Elsevier: Environmental Pollution, Volume 173 Pages 157-167

[20] Pushpalatha, N. & Sreeja, V. & Karthik, R. & Saravanan, G.. (2022). Total Dissolved Solids and Their Removal Techniques. International Journal of Environmental Sustainability and Protection. 2. 13-20. 10.35745/ijesp2022v02.02.0002.

How to cite this article:

Afrianisa R D, Alala P S, Alfiah T, Niswa N, Ningsi E. Analysis of Ground Water Quality Status in Tambakboyo Hamlet, Tikung District, Lamongan Regency Using Storet Method. *Jurnal Teknologi dan Manajemen.* 2024 Januari; 5(1):31-40. https://doi.org/10.31284/j.jtm.2024.v5i1.5314