THE INFLUENCE OF GROUNDWATER ON SKIN DISEASE RATES IN TENAJAR VILLAGE, INDRAMAYU DISTRICT

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ABSTRAK

Air merupakan salah satu kekayaan alam yang mutlak dibutuhkan oleh setiap makhluk hidup di dunia, baik manusia, hewan maupun tumbuhan. Pencemaran air bisa diakibatkan juga oleh industrialisasi, kegiatan pertanian, faktor alam, dan kurangnya pasokan air dan fasilitas pengolahan limbah. Pencemaran air menyebabkan diare, penyakit kulit, gizi buruk, bahkan kanker dan penyakit lain yang berhubungan dengan pencemaran. Tujuan dari penelitian ini adalah mengevaluasi kualitas air tanah secara fisik, kimia dan biologi dan menganalisis pengaruhnya terhadap keluhan penyakit kulit yang disebabkan oleh pencemaran air. Jenis penelitian ini merupakan jenis kuantitatif analitik observasional dan dilakukan di Desa Tenajar, Kecamatan Kertasemaya, Kabupaten Indramayu, Jawa Barat. Konsep penelitian ini mengacu kepada variabel air yang diteliti terdiri dari variabel kualitas air tanah secara fisik (parameter warna, bau, rasa, zat padatan terlarut (TDS) dan kekeruhan serta variabel kualitas air tanah secara kimia yang terdiri dari parameter pH, besi, nitrat dan klorida. Selanjutnya penelitian ini akan mempelajari dinamika korelasi antara faktor-faktor risiko efek penggunaan air yang tercemar dengan kejadian penyakit kulit. Hasil penelitian ini didapatkan kesimpulan yaitu terdapat pengaruh penggunaan air tanah yang tercemar dengan kejadian penyakit kulit dengan tingkat resiko 3,7 kali lipat.

Kata kunci **:** air, pencemaran air, penyakit kulit

ABSTRACT

Water is one of the natural resources that every living organism on the planet requires, whether humans, animals, or plants. Industrialization, agricultural activity, natural factors, and a lack of water supply and waste processing facilities can all contribute to water pollution. Water contamination causes diarrhea, skin problems, poor nutrition, and potentially cancer and other ailments. The purpose of this study is to assess the physical, chemical, and biological quality of groundwater and to investigate its impact on complaints of skin disease induced by water pollution This quantitative analytical observational research was conducted in Tenajar Village, Kertasemaya District, Indramayu Regency, West Java. The idea behind this study is related to the water variables that are assessed, which include chemical groundwater quality variables (pH, iron, nitrate, and chloride) and physical groundwater quality factors (color, odor, taste, Total Dissolved Solids (TDS), and turbidity). The dynamics of the relationship between the risk factors for the negative effects of using contaminated water and the prevalence of skin disease will next be examined. The results of this study show that using contaminated groundwater increases the frequency of skin disease by a factor of 3.7.

Keywords **:** *groundwater, pollutan, skin disease*

INTRODUCTION

Water is an important natural resource for all living things in the world, including humans, animals and plants. Apart from that, water is also important for industrial activities. The underground water source that is widely used by the community is dug-well water or groundwater. If the water from a dug well is contaminated by household or industrial waste, it can have a negative impact on human health.

Water (one of the environmental components) is said to be potentially pathogenic if it contains Coliform bacteria and E. Coli bacteria or contains toxic chemicals such as heavy metals and other substances (Khan, et al., 2013). Water pollution can also be caused by industrialization, agricultural activities, natural factors, a lack of water supply and waste processing facilities. Many toxic chemicals, organic and inorganic substances, toxic solvents, and volatile organic chemicals can be released during industrial production. If this waste is disposed of in aquatic ecosystems without proper processing, it will cause water pollution (Chowdhary, Naresh Bharagava, Mi, & Khan , 2019).

Water pollution causes diarrhea, skin diseases, poor nutrition, even cancer and other diseases related to water pollution (Lin, Yang , & Xu, 2022). As a result, research on the effects of water pollution on human health particularly the diversity of diseases is imperative. Additionally, the achievement of sustainable development goals depends on clean drinking water.

Early interviews reveal that most Tenajar Village residents in RW 2 and RW 3 do not receive PDAM services; as a result, they depend on well and ground water for everyday needs like cleaning, bathing, urinating, and defecating. Because of the presence of residents defecating and discarding rubbish, as well as the location's proximity to Java's north shore, water resources are at risk of pollution. Residents in RW 2 and RW 3 complained about the color, taste, and odor of their groundwater, according to statistics. The groundwater used by 78% of RW 2 inhabitants tasted, looked, and smelled terrible, and 93.5% of RW 3 people agreed.

On the basis of the aforementioned, issues that are the focus of this study can be identified. For example, the quality of groundwater in the Kertasemaya District area is examined in compliance with Minister of Health Regulation No. 492/Menkes/Per/IV/2010, and its influence on the skin diseases that Tenajar Village residents report being brought on by water pollution.

The purpose of this study is to assess the physical, chemical, and biological quality of groundwater and to examine its impact on the most common complaints of skin disease caused by water pollution expressed by each respondent.

METHOD

This quantitative analytical observational research was carried out at Tenajar Village, Kertasemaya District, Indramayu Regency, West Java. The research concept refers to existing theory, and the water variables studied include physical groundwater quality variables such as color, odor, taste, Total Dissolved Solids (TDS), and turbidity, as well as chemical groundwater quality variables such as pH, iron, nitrate, and chloride. Furthermore, through simultaneous access, observation, or data collection, this study investigates the dynamics of the correlation between risk factors for the impact of using polluted water and the prevalence of skin diseases, as seen in the results of physical, chemical, and biological examinations.

RESULT

Respondent Distribution Based on Water Use for Bathing and Toileting

Table 1. Respondent Frequency Distribution in RW 2 Tenajar Village Based on Groundwater User Groups

Water Consumption	Case Group		Control Group		Total	
	n	%	n	%	N	%
Ground Water	53	84%	51	81%	104	81%
PDAM	10	16%	12	19%	22	19%
Total	63	100%	63	100%	126	100%

According to table 1, 104 persons (81.4%) out of 126 persons used groundwater for bathing and toilet activities, whereas 22 persons (19%) used PDAM services. Table 2 shows the results of the distribution of respondents based on water use in RW 3 Tenajar Village.

Table 2. Respondent Frequency Distribution in RW 3 Tenajar Village Based on Groundwater User Groups

Water Consumption	Case Group		Control Group		Total	
	n	%	n	%	N	%
Ground Water	60	95%	53	84%	113	90%
PDAM	3	5%	10	16%	13	10%
Total	63	100%	63	100%	126	100%

According to table 2, 113 persons (90%) out of 126 persons used groundwater for bathing and washing toilet activities, whereas 13 persons (10%) used PDAM services.

The Influence of Water Use on the Incidence of Skin Diseases in Tenajar Village, Indramayu Regency

Table 3 shows the findings of an analysis of the correlation between water use and disease incidence in Tenajar Village:

Table 3. Analysis of the Relationship Between Water Use and Skin Disease Incidence in RW 2, Tenajar Village

Water Consumption	Case Group		Control Group		Total	
	n	%	n	%	N	%
Ground Water	53	84%	51	81%	104	81%
PDAM	10	16%	12	19%	22	19%
Total	63	100%	63	100%	126	100%
Value *p* = 0,639	OR = 1.247		95% CI : 0,495 – 3,139			

According to table 3, the majority of inhabitants in the case group (84%) used groundwater for bathing and washing toilet activity, while the majority of residents in the control group (81%) likewise utilized groundwater for toilet needs.

According to table 3, the Odd Ratio (OR) statistical value is 1.247, indicating that groundwater users in RW 2 are 1.2 times more likely to have skin problems than those who do not use groundwater. This figure is not statistically significant because the p-value is greater than 0.05. Based on the numbers above, the author concludes that the incidence of skin illness in RW 2 is unaffected by groundwater use.

Table 4. Analysis of the Relationship Between Water Use and Skin Disease Incidence in RW 3, Tenajar Village

Water Consumption	Case Group		Control Group		Total	
	n	%	n	%	N	%
Ground Water	60	95%	53	84%	113	90%
PDAM	3	5%	10	16%	13	10%
Total	63	100%	63	100%	126	100%
Value *p* = 0,05	**OR = 3.744**		**95% CI = 0.986 – 14.441**			

According to table 4, the majority of inhabitants in the case group (90%) utilized groundwater for their toilet-washing needs, while the majority of people in the control group (84%) also used groundwater for their toilet-washing needs.

According to table 4, the Odd Ratio (OR) statistical value is 3.744, indicating that groundwater users in RW 3 are 3.7 times more likely to have skin problems than those who do not use groundwater. Because the p-value is 0.05, this figure is significant. Based on the numbers above, the author concludes that the usage of groundwater influences the incidence of skin illness in RW 3.

Physical Quality of Ground Water in Tenajar Village

Understanding the TDS value of water is essential because it impacts not only the plumbing in the home and the health of its users, but also many other elements of water use, such as cooking, bathing, and washing. The TDS value can be used as a starting point for decision-making to enhance groundwater quality, such as selecting the most appropriate filtration system. We can ascertain the quality of the water utilized in an area by knowing the TDS value. The data presented in Table 5 indicates that the groundwater in RW 2 has the highest TDS value, which is in the range of 579,95 mg/L.

Tabel 5. Physical Ground Water Testing Results in RW 02 Tenajar Village

No.	Test Parameters	RW 02 Ground Water	Safety Limit	Unit
1.	Color	Colorless	Max. 15	Unit Pt-Co
2.	Odor	Odorless	Odorless	
3.	Flavor	Tasteless	Tasteless	
4.	Total Dissolved Solids	579.95	Max. 500	mg / L
5.	Turbidity	1.90	Max. 5	NTU

Tabel 6. Physical Ground Water Testing Results in RW 03 Tenajar Village

No.	Test Parameters	RW 03 Ground Water	Safety Limit	Unit
1.	Color	0.27	Max. 15	Unit Pt-Co
2.	Odor	Odorless	Odorless	
3.	Flavor	Tasteless	Tasteless	
4.	Total Dissolved Solids	831.85	Max. 500	mg / L
5.	Turbidity	0.75	Max. 5	NTU

Groundwater Chemical Quality

The results of testing chemical parameters at each groundwater sampling point in Tenajar village are shown in Table 7. Based on the results of testing the chemical parameter acidity degree (pH), the highest value was found in the RW 3 water sample with a result of 7.48 and RW 2 with a result of 7.33.

The water sample in RW 2 had the greatest value of the hardness parameter test findings, with a value of 484.55 mg/L, and the water sample in RW 3 had a value of 470.25 mg/L. All hardness test results are still below the 500 mg/L quality level set by Minister of Health Regulation No. 32 of 2017.

The sulfate content levels in both RWs are still below the safe content limit according to government regulations with values of 143.70 and 54.46 respectively. Sulfates are naturally present in drinking water as a mix of sulfur and oxygen. Some minerals in the soil breakdown and are eventually discharged into groundwater as Sulfates (Porowski , Porowska, & Halas, 2019). As a result of hypertonia, sulfate mineral fluids, primarily magnesium sulphate-rich and sodium sulphate-rich, have a purgative-laxative action. They pass quickly through the stomach and into the intestines, where they recall the presence of water. As a result, faecal excretion is facilitated, with an increase in volume and a significant decrease in consistency, as well as improvements in both the number of evacuations and colon motility, as described by Dupont et al (Dupont, Campagne, & Constant, 2014).

Table 7. Groundwater Chemical Test Results in Tenajar Village

No.	Test Parameters	RW 02	RW 03	Safety Limit	Unit
1.	Arsenic	0	0	Max 0.01	mg / L
2.	Flourida	0	0	Max 1.5	mg / L
3.	Chromium	0	0	Max 0.05	mg / L
4.	Cadmium	0	0	Max 0.003	mg / L
5.	Nitrit	0	0.03	Max 3	mg / L
6.	Nitrat	0.49	1.81	Max 50	mg / L
7.	Cyanide	0	0	Max 0.07	mg / L
8.	Selenium	0	0	Max 0.01	mg / L
9.	Aluminium	0.03	0.04	Max 0.2	mg / L
10.	Iron	0	0.03	Max 0.3	mg / L
11.	$CaCO_3$	484.55	470.25	Max 500	mg / L
12.	Chlorida	10.17	13.16	Max 250	mg / L
13.	Mangan	1.97	2.28	Max 0.4	mg / L
14.	pH	7.33	7.48	6.5 – 8.5	-
15.	Zinc	0	0	Max 3	mg / L
16.	Sulfat (SO_4)	143.70	54.46	Max 250	mg / L
17.	Copper	0	0	Max 2	mg / L
18.	Ammonia	0	1.81	Max 1.5	mg / L
19.	Lead	0	0	-	mg / L

Biological Quality of Ground Water

Based on table 8, the total Coliform bacteria examination results obtained show that the examination results are in accordance with the Regulation of the Minister of Health of the Republic of Indonesia Permenkes No.492/Menkes/Per/IV/2010 concerning requirements and monitoring of water quality. It can be seen from the groundwater of RW 2 and RW 3, both groundwater do not meet the requirements because they exceed the established standards.

Table 8. Biological Quality of Ground Water

No.	Test Parameters	RW 02	RW 03	Safety Limit	Unit
1.	Coliform	1.5×10^1	2.9×10^4	0	Colony / 100 ml
2.	Escherichia Coli	0	1.0×10^1	0	Colony / 100 ml

DISCUSSION

Ground Water Physical Quality

Total Dissolve Solid (TDS) is a dissolved solid that includes both organic and inorganic components, such as minerals, salts, metals, cations, and anions (Slamet, 1994). Organic compounds, inorganic salts, and dissolved gases such as Hg, Pb, As, Mg, and Cd are commonly included in the TDS amount of dissolved substances. Water hardness increases as TDS levels rise (Hamidah & Cindramawa, 2020). Water with a high TDS value will have an effect on health; the type of chemicals in the water will also have an effect. High TDS concentrations in groundwater can cause a bitter taste and an unpleasant odor.

The flavor becomes increasingly harsh as the TDS concentration rises. The majority of the water samples collected in the RW 2 area had no flavor, no odor, and no color in terms of taste and odor characteristics. However, the area's water's TDS value is higher than the safe threshold for consumption, necessitating the installation of a backup osmosis system to remove bacteria, viruses, and metals from the water (Untari, 2022).

Table 6 shows a water sample taken from RW 3 that has no smell or taste but has a color of 0.27 Pt-Co Units and a high TDS level of 831.85 mg/L. According to these results, the ground water in the RW 3 area is unsuitable for human consumption because it contains inorganic substances in the form of solids that are dissolved in the water. The TDS value is related to the turbidity of river water. A high TDS value indicates dissolved sediment and a high level of water turbidity. The TDS value at the research location is included in the high category. This is in accordance with the brownish color of the water. Cloudy and brownish water is not suitable for consumption.

Groundwater Chemical Quality

Hydrogen potentiality is an essential component of aquatic life. Because it contributes to the survival of their life circle. Normally, pH is used to measure the quality of water and water purity in water, which indicates how clean the water is. pH is defined as the negative logarithm of the concentration of H+ ions in water (Kalita, Talukdar, & Sarma, 2022). All soil sample test results for the degree of acidity (pH) are still within the quality range of Minister of Health Regulation No. 32 of 2017 in the range of 6.5 - 8.5. Water with a neutral pH does not harm health and household equipment. If the pH value is below 6.5 or is acidic, it can cause corrosion of the pipe (Singkam, 2020). A high pH above 8.5 indicates that the water is alkaline, so it will form residue on sanitary equipment and cause an odor in the water (Saputra, Waspodo, & Budi, 2015).

Hard water is typically found in soil containing magnesium and calcium minerals, where it leaches into the aquifer layer during the rainy season (Rohma & Sutedjo, 2018). According to the conditions of the research site, the soil layer contains few calcium and magnesium rocks. The placement of the land near the shore, due to sea water intrusion into limestone rocks, is one of the causes of the high concentration of groundwater hardness values (Yusman, Palippui, & Apriansah, 2019). The highest value of manganese parameter testing results was found in RW 2 samples at 1.97 mg/L and RW 3 at 2.28 mg/L. Both samples exceeded the quality standards of Minister of Health Regulation No. 492/Menkes/Per/IV/2010 above 0.4 mg/L. The presence of manganese (Mn) in ground water causes the water to change color to brownish yellow when it comes into contact with outside air. The presence of manganese parameters contributes to the smell of underground water and the formation of sediment on the bathroom walls (Misa, Duka, Layuk, & Kawatu, 2019).

At every sampling point, the results of the iron (Fe) parameter testing are 0 mg/L in RW 2 and 0.03 mg/L in RW 3. The quality standards set forth in Minister of Health Regulation No. 492/Menkes/Per/IV/2010, namely below 0.3 mg/L, remain unfulfilled at all groundwater sampling locations. Elevated levels of iron (Fe) in groundwater can leave sediment stains on clothes and household items, as well as a strong smell (Auliah, Khambali , & Sari, 2019). Similar to manganese, the element iron (Fe) frequently has an impact on groundwater; nonetheless, the iron (Fe) test findings at each sampling location indicate small amounts.

Table 7 indicates that the ammonia level in the RW 3 sample does not fulfill the Minister of Health's standard criteria because the ammonia level in the sample exceeds the Minister's standard requirements. Ammonia concentrations in water can be hazardous to people if the amount in the body exceeds the body's ability to detoxify (Azizah & Humairoh, 2015). High levels of ammonia in drinking water can be caused by the soil around groundwater used by farmers containing urea fertilizer or by household waste.

Groundwater Biological Quality

According to the Regulation of the Minister of Health of the Republic of Indonesia (Permenkes No.492/Menkes/Per/IV/2010) regulating requirements and water quality monitoring, the total amount of coliforms and E. coli in clean water in Indonesia shall be

0/100 ml. According to Sidik, Wijayanti, and Iqbal, water contaminated with more than 50/100 bacteria causes diarrhea (Sidik, Wijayanti, & Iqbal, 2020). The E. Coli bacteria is one of the causes of diarrhea. It is primarily transmitted by the fecal and oral channels, including food or drink contaminated with Esherecia Coli feces or direct contact with the sufferer's feces. E. Coli bacteria (500 colony) can induce diarrhea or gastroenteritis if they are discovered in 100 milliliters of drinking water. Moreover, there is a correlation between diarrhea and the development of enterotoxins by Escherichia coli. According to research conducted by Vincent et al., skin complaints were significantly more likely to occur among swimmers exposed to marine waters with levels of total coliform, fecal coliform, E. coli, enterococci, and streptococci measured above the recommended limits (Yau, Wade, de Wilde, & Colford Jr., 2009).

The groundwater DO (Dissolved Oxygen) examination results in RW 2 are close to the quality standard level. The DO value in groundwater in RW 2 is 3.96, and the DO value in groundwater in RW 3 is 4.31. This figure is above the quality standard value. High DO levels in groundwater are generated by high temperatures and a high population of decomposing microbes (Sutika, 1988). Reducing oxygen in water is primarily produced by chemical, physical, and biological processes such as respiration, decomposition, and evaporation. The solubility of oxygen and other gases reduces with increasing salinity and temperature as water temperature rises (Bhateria & Disha, 2016).

The results of the Biochemical Oxygen Demand (BOD) groundwater parameters in RW 2 Tenajar Village exceed the quality standard values. The BOD inspection results in RW 2 were 3.27 and in RW 3 were 0.41. A high BOD concentration in waters indicates a high level of pollution due to processed pollutant waste (liquid industrial waste). Biological oxygen demand (biochemical oxygen demand) is the oxygen requirement needed by microorganisms to decompose organic compounds in liquid waste. The waters contain a lot of organic substances with high BOD values, so the dissolved oxygen content in the waters is low, causing the death of aquatic populations. A high BOD concentration indicates that the number of disease-causing microorganisms is also high. Pathogenic microorganisms can cause various diseases in humans (Biron, 2016).

CONCLUSION

The following findings are consistent with research conducted in Tenajar Village, Indramayu Regency in 2023 regarding the impact of groundwater pollution on the occurrence of skin diseases. There is a relationship between groundwater pollution and skin disease in the RW 3 area of Tenajar Village, Indramayu Regency. The bivariate test results showed a p value of 0.05 or there was a relationship between water pollution and the incidence of skin disease, with an Odd Ratio (OR) of 3.744. Thus, people who use polluted groundwater in RW 3 have a 3.7 times greater risk of suffering from skin diseases. The quality of groundwater in Tenajar Village is reviewed from 3 aspects of pollution which are seen from the physical, chemical and biological conditions of the water which have been determined according to Minister of Health Regulation No.492/Menkes/Per/IV/2010 as follows. From the data obtained, the ground water in the RW 2 and RW 3 areas is not suitable for drinking because the water contains inorganic materials in the form of solids that are dissolved in the water. The water sample in RW 2 and the water sample in RW 3 had the highest values of the hardness parameter test findings, 484.55 mg/L and 470.25, respectively. All hardness test results remain below 500 mg/L, which is the minimum quality requirement specified in Minister of Health Regulation No. 492/Menkes/Per/IV/2010. Based on the collected data, the groundwater in the RW 2 and RW 3 regions is deemed unfit for human consumption due to the presence of dissolved solids, which are inorganic substances.

Samples RW 2 and RW 3 had the highest values of the test findings for manganese surpassed the Minister of Health Regulation No. 492/Menkes/Per/IV/2010 quality criteria. Considering the ammonia level in the RW 3 sample is higher than what the Minister of Health has established as the standard, it does not comply with his standards.

The groundwater in RW 2 and RW 3 does not fulfill the requirements based on the findings of biological testing because it exceeds the defined standards. It is possible to conclude that the ground water in Tenajar Village RW 2 and RW 3 is unfit since, according to Minister of Health Regulation No. 492/Menkes/Per/IV/2010, the total amount of coliforms and E. coli in clean water must be 0/100 ml. This research is a type of basic research in the development of a raw water treatment system to prevent ground water contamination.

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