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Bacteriological quality and environment risk of water pollution of dug wells on Semau Island, Indonesia

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Abstract---Dug wells are a source of clean water used by many people in Indonesia. Poor quality water can have negative effect on public health. This study was to obtain an overview of the bacteriological quality of water and the risk of water pollution of dug wells on Semau Island, Indonesia. The research design was a cross-sectional study. The research location was on Semau Island (8 villages), one dug well was taken for each village as a sample. Observations and laboratory examinations were conducted to determine environment risk factors, total coliform, *Escherichia coli* and total bacterial. The results showed that the total coliform in 6 samples exceeded standards, *E. coli* were found in all samples, the total plate number ranged 85-190 CFU/ml. The dug wells environment showed that 50% are at a distance of <10m from the source of pollution, 100% no waste water drainage, 62% there were cracks on the floor, 62% of the well 3 meters deep no plastered, 82% no fence. Some samples had poor bacteriological quality and environment risk factors for contamination, it is necessary to improve the facilities and environmental of the wells and treat water before consumption.

Keywords---Coliform, *Escherichia coli*, total plate count, pollution, dug wells.

Introduction

Environmental pollution can be caused by physical, chemical, biological pollutants. Water contaminated with microorganisms can cause environmental-based diseases, including diarrhea (Haseena et al., 2017) . Water that does not meet the requirements is also one of the factors that influence the occurrence of health problems in Indonesia and East Nusa Tenggara. The results of the Basic Health Research conducted by Ministry of Health (2018) found that the prevalence of diarrhea in East Nusa Tenggara was 6.58 % and Kupang District was 9.25%. Diarrhea cases in Kupang Regency in 2017, 2018, 2019 were 8,229 cases, 6,537 cases, and 14,544 cases. The results of basic research of health also show that sanitation conditions in Kupang Regency have not all were good. One of the clean water facilities that are still mostly used by the people of Indonesia is dug well water. Based on the results of the basic health research conducted by Ministry of Health in 2014, it showed that the largest proportion of households based on the type of drinking water source in Indonesia is dug wells.

Waterborne organisms are classified into three categories; bacteria, viruses, and protozoa; amounted to 58%, 36% and 17% of the total investigations, respectively. The total number of samples in all investigations is 8,118, with the detection of one or more organisms in 30% of samples, Viruses were detected in 52%, bacteria in 35% and protozoa in 12% (Farrell et al., 2021). Fecal coli is one indicator of water quality used to determine water pollution (Tang et al., 2022) . Research in Kermansyah showed that Fecal coliform was found in water sources in urban (22%) and rural (45%) (Davoodi et al., 2018) . Preliminary research on dug well water in Labuan Bajo showed that the E. coli parameters exceeded the requirements (Wolo et al., 2020) . A water inspection study using the MPN (Most Probable Number) method which consists of 3 tests, namely, a presumption test, a confirmatory test, and a reinforcing test showed that from 15 drinking water samples 8 samples of drinking water were tested positive for Coliform bacteria contamination, while 7 other samples were negative. Of the 8 positive Coliform samples, only 1 sample was negative for fecal Coliform bacteria and 7 other samples were positive for fecal Coliform bacteria (Aulya et al., 2020) .

Semau District is located on Semau Island, Kupang Regency, East Nusa Tenggara Province. To meet the daily needs of clean water, some people use sources from dug wells. Because the area is near the coast, the well water on Semau Island is partly salty and partly fresh. Not every family that uses water from a well has its own well. Existing wells are mostly used communally or used by several families. A study was conducted in the village of Bokonusan, Semau Island which showed that the average distance dug wells from the pollutant source was <11 meters, there were dug wells whose construction did not meet the requirements (Telan & Baok, 2017) .

Dug wells that are used communally if they are not in accordance with health standards, will have a negative impact on many people. Communal use of wells also has the potential for contamination of well water. Bad behavior of well users will have an effect on the environmental conditions of the dug well. Therefore, it is important to conduct research on the bacteriological quality and environmental conditions of dug wells on Semau Island which are used communally. This study

aims to determine the bacteriological quality of dug well water on Semau Island which is used communally. In addition, I also want to get an overview of environmental conditions which are risk factors for water pollution.

Method

Research design

It was a cross-sectional study. The study population was dug wells in Semau District which consisted of 8 villages namely Bakunusa, Otan, Uita, Batuinan, Letbaun, Hulolot, Uyata, and Hansisi. The sampled wells are wells that are used communally (one well is used by more than one family). The sample used was 8 dug wells representing each village in Semau District, namely 8 villages. The criteria for dug wells that were sampled were communal or shared by more than 1 family, well water was used as a source of clean water for daily needs and fresh water.

Data collection technique

Data were collected through interviews, observations, and laboratory examinations. Interviews were conducted to determine the characteristics of the respondents and the use of dug wells. Observations were made to determine the environmental sanitation conditions of dug wells using an observation sheet/checklist. Furthermore, well water samples were taken to determine the bacteriological quality of the water which was carried out through laboratory examinations.

Bacteriological examination procedures

The indicator of biological contamination was determined by calculating the Most Probable Number (MPN) coliform index (Supardan, 2018) ; (Aulya et al., 2020) ; (Some et al., 2021). The analysis of total coliform and *Escherichia coli* concentration was carried out using the MPN method according SNI 01-2332.1-2006. The test stages included presumptive tests, confirmative tests and complete tests. The media used were lactose broth (LB), brilliant green lactose broth (BGLB) and E. coli broth (EC broth). The results obtained were then matched with the MPN table. The total bacteria test used the total plate count method using agar plate count media. Incubation was carried out at 37 C. Observation of the results using a colony counter. Sampling of water and the testing process in the laboratory were carried out with aseptic principles. All equipment and media used were sterilized before use.

Data analysis

The data obtained were presented in the form of graphs and tables to obtain Coliform, *Escherichia coli*, total plate count of bacteria in water and environmental conditions of dug wells which are risk factors for pollution.

Ethical clearance

This study was approved by ethic committee of Health Polytechnic of Kupang (No.LB.02.03/1/0064/2022).

Results

Dug well characteristics

Table 1 Ownership of wells, number of users and distance from the beach

Sample	Ownership	Family Number of users	Distance from the beach (km)
S1	Public	8	7
S2	Public	8	1.5
S3	Personal	3	1.5
S4	Public	8	1
S5	Public	34	2.5
S6	Personal	20	2
S7	Public	20	1.5
S8	Public	7	0.5

Table 1 illustrates that 2 wells are privately owned, while 6 wells are public property. The number of well users ranges from 3 to 34 families. The distance of the well from the beach varies from 0.5 km to 7 km.

Pollution Risk

All wells do not have sewerage or are in poor condition. Wells that are <10m from the latrine are 12% (Figure 1). Distance from other pollutant sources 50% wells <10m (Figure 2). Wells that are <2 meters away are inundated by 50% (Figure 3). The cement floor surrounding the well is at 50% risk (Figure 4). There are 50% of the wells that have puddles of water on the cement floor around the well (Figure 5). There are 62% of wells where the cement floor around the well is cracked (Figure 6). A small number of wells (12%) with buckets and buckets are at risk of causing pollution (Figure 7). The condition of the lip of the well at 25% allows water to seep (Figure 8). Most of the wells (62%) on the walls of the 3 m deep well were not completely plastered (Figure 9). Almost all wells (87%) do not have a fence around the well. Details of the components of the pollution risk assessment of dug wells are shown in table 2. The percentage level of pollution risk for each well is shown in Figure 11.

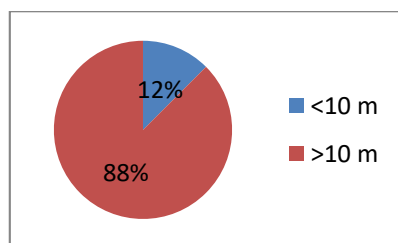


Figure 1. Distance from well to latrine

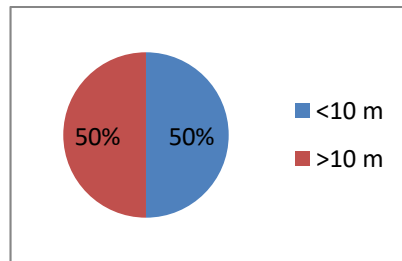


Figure 2. Distance from well to other pollutant sources

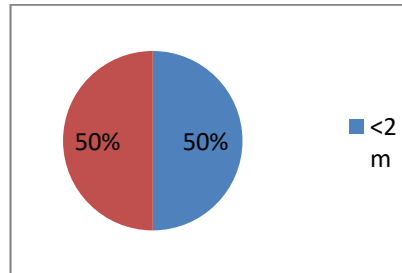


Figure 3. Distance from well to puddle

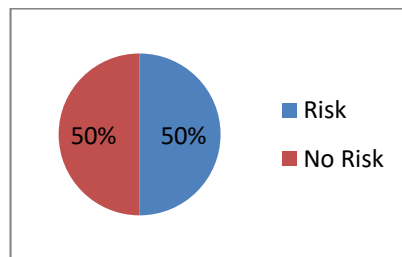


Figure 4. Cement floor surrounding the well

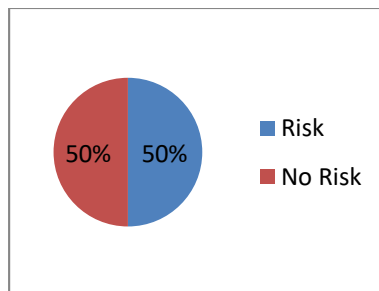


Figure 5. Puddle of water on the cement floor around the well

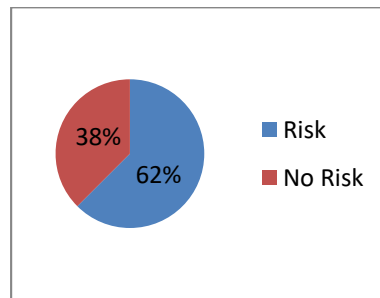


Figure 6. Cracks in the cement floor around the well

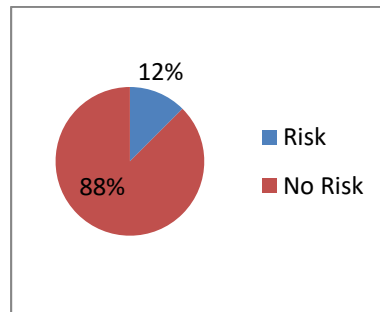


Figure 7 Laying buckets and buckets that cause pollution

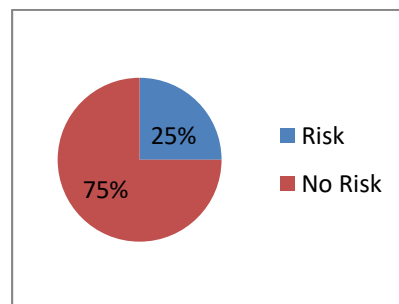


Figure 8. Condition of the well lip that allows water to seep

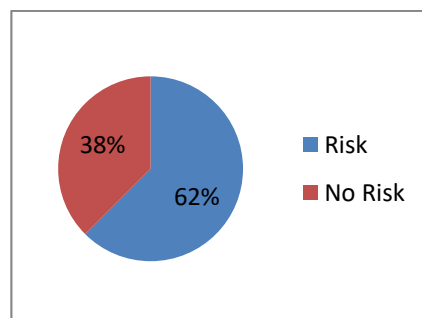


Figure 9. Cement wall with a depth of 3 (three) meters is not plastered tightly/imperfectly

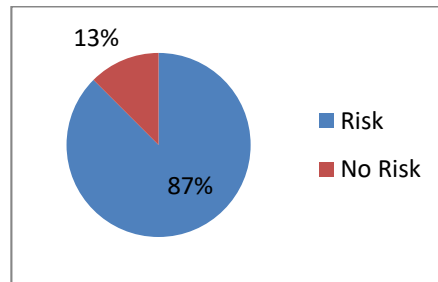


Figure 10. The fence around the well

Table 2 Results of environmental sanitation inspection

No	Variables	Risk	%	No Risk	%
1	There is a latrine at a radius of 10 m around the well	1	12	7	88
2	There are other sources of pollution within a 10 m radius around the well (animal dung, garbage, puddles, etc.)	4	50	4	50
3	There is/at any time there is a puddle of water at a distance of 2 meters around the well	4	50	4	50
4	The sewerage is damaged/no drain	8	100	0	0
5	The cement floor surrounding the well has a radius of less than 1 meter	4	50	4	50
6	There is/at any time there is a puddle of water on the cement floor around the well	4	50	4	50
7	There are cracks in the floor around the cement floor around the well	5	62	3	38
8	The buckets and ropes are placed in such a way as to allow contamination	1	12	7	88
9	The lip of the well (ring) is not perfect so that it allows water to seep into the well	2	25	6	75
10	Cement walls as deep as 3 (three) meters from the ground surface are not plastered tightly enough/imperfectly	5	62	3	38
11	The fence around the well is not perfect/non-existent to allow animals to enter	7	87	1	13

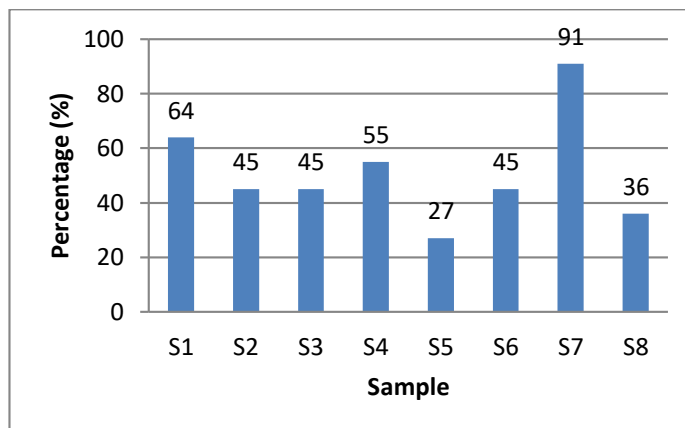


Figure 11. Percentage of Pollution Risk Level

The results of the inspection of the environmental sanitation component which is a pollutant risk factor, from 8 wells, the highest risk of pollution is 91 % and the lowest is 27%.

Total coliforms concentration

The results of the total coliform analysis can be seen in Figure 12. These results indicate that all samples contain coliforms, ranging from 20 to 460 MPN/100ml. Most of them did not meet the requirements, only 2 samples that met the requirements, namely the S2 and S5 samples.

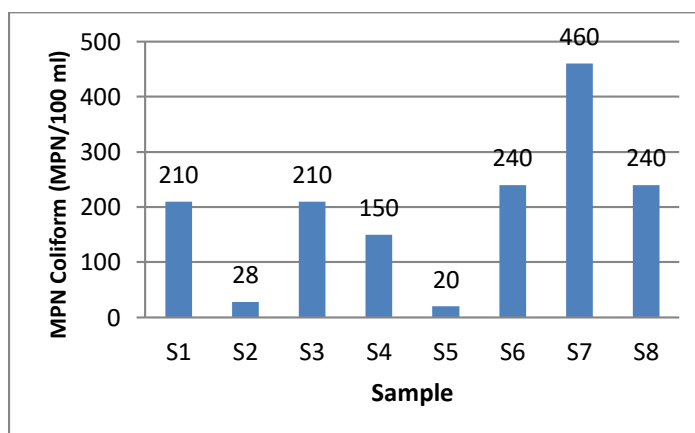


Figure 12. Total coliform concentration

***Escherichia coli* concentration**

The results of the analysis of the *E. coli* content in the dug well water samples can be seen in Figure 13. These results indicate that all water samples contained *E. coli* bacteria with numbers ranging from 9.1 to 460.

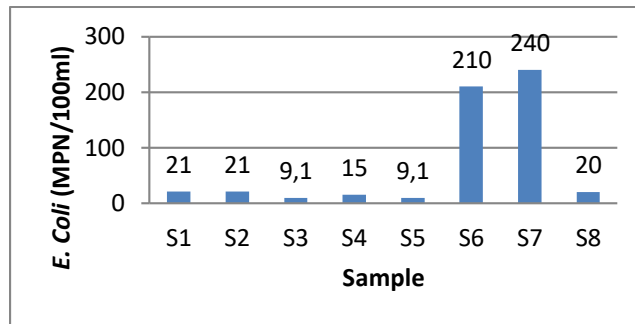


Figure 13. *Escherichia coli* concentration

Total plate count of bacteria

The results of measuring the number of germs (total plate count) in water samples ranged from 85 colonies to 190 (Figure 14).

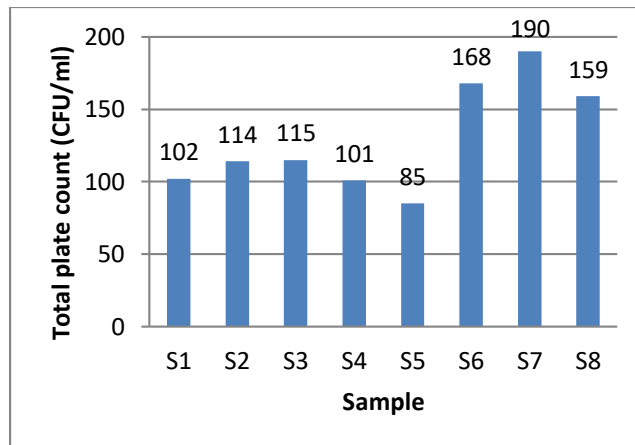


Figure 14 Total plate count of bacteria

Discussion

Water Pollution Risk

Understanding water quality conditions and the factors that influence it needed to improve water quality (Pingping et al., 2019). The results of previous studies show that the sources of water pollution in urban and rural areas are different (Yang et al., 2022) . Poor well location, construction, and hygiene and sanitation practices are some of the influencing factors water quality. There is an urgent need for educating the population on effective water disinfection strategies and for regular well monitoring. (Akoachere et al., 2013).

All wells do not have sewerage or are in poor condition. Water polluted by sewage is not suitable as drinking water and for recreation (Some et al., 2021) . Good waste management is needed to reduce water pollution (Bisimwa et al., 2022) .

Other studies have shown that dug wells that are close to a septic tank cause high coliform bacteria contamination (Supardan, 2018). A study found the well construction and location did not meet the requirements, the number of indicator bacteria exceeded the standard. Variation of bacteriological parameters between locations does not significant because well characteristics and hygiene and sanitation practices were similar. Difference in bacteriological quality with respect to the state of the well, and the presence of cover was not significant. Well distance from sanitary structures is negatively correlated with bacteriological characteristics indicating it could be a major contributing factor to poor water quality (Akoachere et al., 2013).

The results of another study showed that the quality of two dug well water samples in Kampung Ujung The Labuan Bajo area is no longer suitable for use as raw material for drinking water. Furthermore, the government must provide other water sources such as: addition of raw water storage tanks, so that the community does not depend completely in dug well water (Wolo et al., 2020). Sanitation and hygiene in water sources are significantly related to the presence of *E. coli* in household drinking water (Ondieki et al., 2022). Poor sanitation, lack of understanding about basic hygiene and cleanliness, poor economic conditions, hygiene and other activities contribute to water pollution. Bacteria in water increase the risk of waterborne diseases and other health problems. Season affects the level of water contamination (Choudhury et al., 2022).

Many human activities cause a decrease in water quality (Kadwe et al., 2022). A study showed that almost all groundwater samples were contaminated with pathogenic microorganisms. In addition, the values of several parameters that determine the physicochemical quality of water are also not in accordance with the standards. The chloride ion concentration was slightly below the specified limit in most of the water samples. Consuming unsafe drinking water is one of the main causes of the prevalence of water-borne diseases such as diarrhea, gastroenteritis, typhoid fever and others (Alsalmeh et al., 2021)

Total coliform concentration

This study found water samples that exceeded the requirements for coliform levels. Other study aimed to determine the biological contamination of dug well water in Central Lombok, the results obtained are dug well water with a distance of 3.45 m and 4.70 m to a septic tank contaminated with coliform bacteria with the highest coliform MPN index of 1898 per 100 mL. (Supardan, 2018) . The degree of acidity (pH) is one of the important factor in bacterial growth. This study aims to determine the characteristics of pH and its effect on The occurrence of coliform bacteria in the Madura Strait indicates that the survival of bacteria in an alkaline environment is higher than in an acidic environment (Wahyuni, 2015).

Giving chlorine in water aims to reduce microorganisms in the water to be consumed. However, the water to be consumed should be cooked first at the right temperature and time because it does not rule out the possibility that microorganisms are resistant to antimicrobials. Studies have shown that many Coliforms in wastewater are also resistant to antibiotics (Marano et al., 2020). Research on efforts to eliminate coliform and *e coli* in wastewater installations has

been carried out (Balogun & Ogwueleka, 2021) . Research on various methods to remove coliforms from water has been carried out, including slow sand filters (matuzahroh et al., 2020).

***Escherichia coli* concentration**

This study found *E. coli* contamination in water. Other research show that there is a relationship between the number of *E. coli* in drinking water samples and the lack of protection of water sources, including improper defecation behavior, livestock manure, and proximity to water sources (Gwimbi et al., 2019) . Several factors that are predicted to cause faecal coliform contamination in water sources include education, sanitation, and experience of lack of water (Getachew et al., 2018).

Clean water at home using tanks in Guadalajara, half of the samples examined for coliform content exceeded the limit, while *E. coli* was not detected (Rubino et al., 2019). Research in Central Lombok found that dug well water sources contaminated by *Escherichia coli* bacteria contained 2 well water samples, namely 14 per 100 mL and 16 per 100 mL (Supardan, 2018) . Risk factors that increase *E. Coli* include temperature and fecal contamination. Fecal contamination may be a risk factor for increasing *E. coli* (Soare et al., 2022). Research has been carried out to determine the microbiological quality of seawater on the most attractive beaches in Albania. Seawater samples were tested mainly for *Escherichia coli* and fecal enterococci (Bakalli et al., 2021).

Total Plate Count of bacteria

The results of measuring the number of bacteria in water samples varies. The result was similar to a study in Nigeria was carried out to determine the physicochemical and microbiological parameters in water samples collected from five hand dug wells at selected locations . Total bacteria count ranges from 2.79×10^8 up to 9.66×10^8 CFU/ml (Adegalu et al., 2016) . Studies on lake water in India reveal that microbiological qualities water samples exceeded the allowable limit. This study aims to study the physicochemical and microbiological contamination of water samples in lakes in India. The antibiotic sensitivity profiles of the main isolates from the water samples were assessed by disc diffusion test, and the two isolates that showed the highest resistance percentage of antibiotics (Skariyachan et al., 2021).

Microbiological research water on the coast of Colombia it is known that *E.coli* and *Salmonella* spp. detected in 70% and 20% of samples. The highest *E. coli* counts were observed on urban and rural beaches with the presence of many restaurants on the beach. The presence of *Salmonella* sp. is associated with rivers that do not have a wastewater treatment system (Soto-Varela et al., 2021) . Microbial assessment of water samples in Nigeria confirmed the presence of vibrio species due to fecal pollution. Bacterial isolates were identified in some of the water samples were *Enterobacter cloaca*, *Escherichia coli*, *Klebsiella oxytoca*, *Pseudomonas fluorescens* and *Salmonella* spp. The study revealed that sanitation facilities including better toilets and latrines are lacking in many areas. Hand dug wells have the highest frequency of pollutant and bacteria occurrence

due to their proximity to the septic tank . The study concludes that residents in the study area are exposed to polluted water sources , which pose a threat to their health (Adedeji et al., 2017)

Conclusion

The results of laboratory tests on water samples showed that the total coliform in 6 samples were no good, *Escherichia coli* were found in all samples, the total plate number bacteria 85-190 colonies/ml. The results of observations in the dug wells environment show that the wells still have conditions that are risk factors for contamination of well water so it is necessary to improve the facilities and environmental conditions of the wells and treat water before consumption. In future, we may conduct research to improve the bacteriological quality of water using local materials.

Acknowledgments

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References

- Adedeji, O. H., Olayinka, O. O., & Oladimeji, O. (2017). Physicochemical and microbiological examination of hand-dug wells, boreholes and public water sources in selected areas of Ibadan, Nigeria. *Journal of Applied Sciences and Environmental Management*, 21(3), 576. <https://doi.org/10.4314/jasem.v21i3.19>
- Adegalu, A., Emmanuel, A., Awokunmi, E., Odunayo, R., & Edward, A. (2016). *Physicochemical and Bacteriological Assessment of Hand-Dug Wells Water From Ile-Oluji, Nigeria*. 433–440.
- Akoachere, J. F. T. K., Omam, L. A., & Massalla, T. N. (2013). Assessment of the relationship between bacteriological quality of dug-wells, hygiene behaviour and well characteristics in two cholera endemic localities in Douala, Cameroon. *BMC Public Health*, 13(1), 1. <https://doi.org/10.1186/1471-2458-13-692>
- Alsalmeh, A., Al-Zaqri, N., Ullah, R., & Yaqub, S. (2021). Approximation of ground water quality for microbial and chemical contamination. *Saudi Journal of Biological Sciences*, 28(3), 1757–1762. <https://doi.org/10.1016/j.sjbs.2020.12.017>
- Aulya, W., Fadhliani, F., & Mardina, V. (2020). Analysis of Coliform and Colifecal Total Pollution Test on Various Types of Drinking Water Using the MPN (Most Probable Number) Method. *Serambi Journal of Agricultural Technology*, 2(2), 64–72. <https://doi.org/10.32672/sjat.v2i2.2416>
- Bakalli, M., Malollari, I., & Selamaj, J. (2021). Microbial indicators of coastal water in Albania. *WSEAS Transactions on Environment and Development*, 17, 232–236. <https://doi.org/10.37394/232015.2021.17.23>
- Balogun, S., & Ogwueleka, T. C. (2021). Coliforms removal efficiency of Wupa wastewater treatment plant, Abuja, Nigeria. *Energy Nexus*, 4(August), 100024.

- <https://doi.org/10.1016/j.nexus.2021.100024>
- Bisimwa, A. M., Amisi, F. M., Bamawa, C. M., Muhaya, B. B., & Kankonda, A. B. (2022). Water quality assessment and pollution source analysis in Bukavu urban rivers of the Lake Kivu basin (Eastern Democratic Republic of Congo). *Environmental and Sustainability Indicators*, 14(January). <https://doi.org/10.1016/j.indic.2022.100183>
- Choudhury, M., Malakar, M., & Khan, R. H. (2022). Goalpara and bacterial water contamination. *International Journal of Health Sciences*, 6(March), 8611–8623. <https://doi.org/10.53730/ijhs.v6ns2.7221>
- Davoodi, R., Pirsahab, M., Karimyan, K., Gupta, V. K., Takhtshahi, A. R., Sharafi, H., & Moradi, M. (2018). Data for distribution of various species of fecal coliforms in urban, rural and private drinking water sources in ten years period – A case study: Kermanshah, Iran. *Data in Brief*, 18, 1544–1550. <https://doi.org/10.1016/j.dib.2018.04.053>
- Farrell, M. L., Joyce, A., Duane, S., Fitzhenry, K., Hooban, B., Burke, L. P., & Morris, D. (2021). Evaluating the potential for exposure to organisms of public health concern in naturally occurring bathing waters in Europe: A scoping review. *Water Research*, 206(September). <https://doi.org/10.1016/j.watres.2021.117711>
- Getachew, A., Tadie, A., Chercos, D. H., & Guadu, T. (2018). Level of Faecal Coliform Contamination of Drinking Water Sources and Its Associated Risk Factors in Rural Settings of North Gondar Zone, Ethiopia: A Cross-Sectional Community Based Study. *Ethiopian Journal of Health Sciences*, 28(2), 227–234. <https://doi.org/10.4314/ejhs.v28i2.14>
- Gwimbi, P., George, M., & Ramphalile, M. (2019). Bacterial contamination of drinking water sources in rural villages of Mohale Basin, Lesotho: Exposures through neighbourhood sanitation and hygiene practices. *Environmental Health and Preventive Medicine*, 24(1), 1–7. <https://doi.org/10.1186/s12199-019-0790-z>
- Haseena, M., Malik, M. F., Javed, A., Arshad, S., Asif, N., Sharon, Hanif, Zulfiqar, & Jaweria. (2017). Water pollution and human health. *Environ Risk Assess Remediat*, 1(3), 16–19. <https://doi.org/10.4066/2529-8046.100020>
- Kadwe, S. K., Kharake, A. C., & Raut, V. S. (2022). Assessment of phytoplankton and water quality in the Pravara River: An impact of human indiscriminate behaviour. *International Journal of Health Sciences*, 6(March), 5837–5844. <https://doi.org/10.53730/ijhs.v6ns1.6188>
- Marano, R. B. M., Fernandes, T., Manaia, C. M., Nunes, O., Morrison, D., Berendonk, T. U., Kreuzinger, N., Telson, T., Corno, G., Fatta-Kassinos, D., Merlin, C., Topp, E., Jurkevitch, E., Henn, L., Scott, A., Heß, S., Slipko, K., Laht, M., Kisand, V., ... Cytryn, E. (2020). A global multinational survey of cefotaxime-resistant coliforms in urban wastewater treatment plants. *Environment International*, 144(August), 106035. <https://doi.org/10.1016/j.envint.2020.106035>
- matuzahroh, N., Fitriani, N., Ardiyanti, P. E., Kuncoro, E. P., Budiyo, W. D., Isnadina, D. R. M., Wahyudianto, F. E., & Radin Mohamed, R. M. S. (2020). Behavior of schmutzdecke with varied filtration rates of slow sand filter to remove total coliforms. *Heliyon*, 6(4), e03736. <https://doi.org/10.1016/j.heliyon.2020.e03736>
- Ondieki, J. K., Akunga, D. N., Warutere, P. N., & Kenyanya, O. (2022). Socio-demographic and water handling practices affecting quality of household

- drinking water in Kisii Town, Kisii County, Kenya. *Heliyon*, 8(5), e09419. <https://doi.org/10.1016/j.heliyon.2022.e09419>
- Pingping, L., Kang, S., Zhou, M., Lyu, J., Aisyah, S., Binaya, M., Regmi, R. K., & Nover, D. (2019). Water quality trend assessment in Jakarta : A rapidly growing Asian megacity. *Plos One*, 1–17.
- Padmiswari, A. A. I. M., Wulansari, N. T., Antari, N. W. S., Damayanti, I. A. M., Indrayoni, P., & Indrawan, G. S. (2021). The effectiveness of soaking duration on blood cockles (*Anadara granosa*) with activated charcoal towards reducing metals lead (Pb). *International Journal of Health & Medical Sciences*, 4(3), 304–308. <https://doi.org/10.21744/ijhms.v4n3.1756>
- Pérez, A. V., Gámez, M. R., Viteri, C. G. V., & Fernández, M. C. (2019). Renewable sources and natural disasters: A look from legal order in professional training. *International Journal of Social Sciences and Humanities*, 3(2), 1–9. <https://doi.org/10.29332/ijssh.v3n2.283>
- Rubino, F., Corona, Y., Pérez, J. G. J., & Smith, C. (2019). Bacterial contamination of drinking water in guadalajara, Mexico. *International Journal of Environmental Research and Public Health*, 16(1). <https://doi.org/10.3390/ijerph16010067>
- Skariyachan, S., Deshpande, D., Joshi, A., Subramanya, N., Kale, S., & Narayanappa, R. (2021). Physicochemical and microbial pollution of a reservoir in South India and role of bacteriophage treatment to curtail drug-resistant bacterial pollution in water. *Environmental Technology and Innovation*, 24, 102012. <https://doi.org/10.1016/j.eti.2021.102012>
- Soare, C., Mazeri, S., McAteer, S., McNeilly, T. N., Seguino, A., & Chase-Topping, M. (2022). The Microbial Condition of Scottish Wild Deer Carcasses Collected for Human Consumption and the Risk Factors Associated with Pan-E Coli and Coliform Contamination. *SSRN Electronic Journal*, 108(May), 104102. <https://doi.org/10.2139/ssrn.4124014>
- Some, S., Mondal, R., Mitra, D., Jain, D., Verma, D., & Das, S. (2021). Microbial pollution of water with special reference to coliform bacteria and their nexus with environment. *Energy Nexus*, 1(August), 100008. <https://doi.org/10.1016/j.nexus.2021.100008>
- Soto-Varela, Z. E., Rosado-Porto, D., Bolívar-Anillo, H. J., González, C. P., Pantoja, B. G., Alvarado, D. E., & Anfuso, G. (2021). Preliminary microbiological coastal water quality determination along the department of atlántico (Colombia): Relationships with beach characteristics. *Journal of Marine Science and Engineering*, 9(2), 1–17. <https://doi.org/10.3390/jmse9020122>
- Supardan, D. (2018). Coliform Contaminant Analysis at Dug Well in Ungga Village, Central Lombok District, West Nusa Tenggara. *Bioscience*, 2(1), 41. <https://doi.org/10.24036/02018219981-0-00>
- Suryasa, I. W., Rodriguez-Gámez, M., & Koldoris, T. (2022). Post-pandemic health and its sustainability: Educational situation. *International Journal of Health Sciences*, 6(1), i-v. <https://doi.org/10.53730/ijhs.v6n1.5949>
- Tang, M., Xu, W., Zhang, C., Shao, D., Zhou, H., & Li, Y. (2022). Risk assessment of sectional water quality based on deterioration rate of water quality indicators: A case study of the main canal of the Middle Route of South-to-North Water Diversion Project. *Ecological Indicators*, 135, 108592. <https://doi.org/10.1016/j.ecolind.2022.108592>
- Telan, A. B., & Baok, D. (2017). Condition Of Wellness And Essential Bacteria

- Concept Of Escherichia Coli In Water Wall In Villages Of Boconusan , Semaun , Kupang Regency In 2017. *Jurnal Info Kesehatan*, 15(1), 111–118.
- Wahyuni, E. A. (2015). The Influence of pH Characteristics on the Occurance of Coliform Bacteria in Madura Strait. *Procedia Environmental Sciences*, 23(Ictcred 2014), 130–135. <https://doi.org/10.1016/j.proenv.2015.01.020>
- Wolo, D., Rahmawati, A. S., Priska, M., & Damopolii, I. (2020). Study of dug well water quality in Labuan Bajo, Indonesia. *Jurnal Biologi Tropis*, 20(3), 432–437. <https://doi.org/10.29303/jbt.v20i3.2135>
- Yang, Z., Zou, L., Xia, J., Qiao, Y., Bai, F., Wang, Q., & Cai, D. (2022). Spatiotemporal variation characteristics and source identification of water pollution: Insights from urban water system. *Ecological Indicators*, 139(January), 108892. <https://doi.org/10.1016/j.ecolind.2022.108892>