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ANALYZING THE IMPACT OF DISSOLVED ORGANIC COMPONENTS ON RIVER WATER QUALITY AND ITS IMPLICATIONS FOR HUMAN HEALTH: A CASE STUDY FROM BANJAR DISTRICT

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Abstract

Introduction: *Environmental contamination, especially water quality, is a global issue. The association between river water quality and human health is explored in Banjar Regency, rich in natural resources and essential rivers, utilizing dissolved organic components concentration as an indicator.* ***Methods:*** *A mixed-methods study in Banjar District, South Kalimantan, Indonesia, examined the impact of river water quality on human health, using dissolved forganic components as a primary indicator. Water quality assessments, nutrient content measurements, consumption surveys, and water-related disease epidemiology provided data. The statistical studies revealed key correlations and patterns.* ***Results and Discussion:*** *Water quality metrics varied among sampling locations. The dissolved fish feed negatively correlated with dissolved oxygen, while nutrient content weakly correlated with gastrointestinal disorders. High water temperatures increased respiratory illnesses. Drinking water from sources with high dissolved fish feed content caused digestive and respiratory problems. The study confirms previous research linking water quality parameters to health effects. The complex relationship between water quality and health is location-dependent, illustrating how environmental factors, especially water quality, shape illness trends.* ***Conclusion:*** *The study illuminates the complex links between river water quality, human health, and water usage in Banjar District. Dissolved fish feed content affects digestive and respiratory disorders, emphasizing the need of water quality management for regional health. These findings guide Banjar District water resource management and public health measures and help solve worldwide environmental pollution issues.*

INTRODUCTION

The significance of environmental contamination on a worldwide scale, particularly in regard to the quality of water, has recently risen to the forefront as a major problem. This shift in focus is due to the fact that the issue has been brought to light. The Banjar Regency presents itself as a representative instance of the greater problem when seen in the light of the current worldwide environmental catastrophe. This is because the Banjar Regency is recognized by its plethora of natural resources, most notably its river systems. As a result, this is why it was named after Banjar. Not only do the rivers that run through this geographic location provide visually spectacular scenery, but they also provide essential transportation routes for the population that is located there (1). In spite of this, they are simultaneously confronted with the difficulties posed by environmental disruptions, in particular with regard to the quality of the river water and the far-reaching effects this has on the wellbeing of human beings.

The decline in water quality has a wide variety of substantial and varied effects that have ramifications for human health. A wide variety of diseases, including those that have an influence on the digestive, respiratory, and immune systems, have the potential to spread through sources of polluted water, which have the capacity to act as vectors in the spread of disease (2). Numerous empirical investigations have shown, again and time

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again, that there is a considerable correlation between the presence of pollutants in specific geographic regions and an increased prevalence of respiratory diseases in such regions. The primary source of pollutants in Banjar Regency varies, although it usually comprises both point and non-point sources of pollution. Point sources are identifiable locations, such as industrial facilities, wastewater treatment plants, and agricultural runoff outlets, from which pollutants are discharged directly into bodies of water. Industrial operations in Banjar Regency, including as mining, manufacturing, and processing, may emit pollutants into the water, including heavy metals, chemicals, and organic contaminants (3). The primary source of pollutants in Banjar Regency varies, although it usually comprises both point and non-point sources of pollution. Point sources are identifiable locations, such as industrial facilities, wastewater treatment plants, and agricultural runoff outlets, from which pollutants are discharged directly into bodies of water. Industrial operations in Banjar Regency, including as mining, manufacturing, and processing, may emit pollutants into the water, including heavy metals, chemicals, and organic contaminants.

Non-point sources of pollution are diffuse and frequently result from runoff from urban, agricultural, and deforested areas. In Banjar Regency, agricultural runoff from pesticide and fertilizer applications, as well as sedimentation from land clearing activities, can pollute rivers and streams with nutrients, pesticides, and sediment (4). Urban runoff, including sewage overflows and inappropriate trash disposal, contributes to the region's water contamination. This association has been proved time and time again (5-6) The most important aspect that can be considered while attempting to explain the occurrence of this event is the presence of pollutants in the water.

The local population that lives in close proximity to the banks of the rivers that are located in the Banjar Regency area benefits not only from the scenic aspects that these rivers provide, but also from the essential means of subsistence that they supply. This is because the Banjar Regency area is home to a number of different rivers. The rivers that have been brought up until this point serve as the primary sources of potable water, meeting important day-to-day requirements such as those for drinking, cooking, and sanitation amongst other uses (7). Therefore, it is vital to provide priority to the preservation and maintenance of river water quality in order to ensure the protection of the health and well-being of the population that is located in close vicinity to the river. This can be accomplished by giving the preservation and maintenance of river water quality priority. Communities in Banjar Regency have been involved in fish farming utilizing floating net cages (*keramba*) along the riverbanks in recent years. The growth of this fishing sector generates revenue for the region and its inhabitants. Nevertheless, it can also result in the contamination of rivers. Residual feed, piscine excrement, and cadavers serve as contributors to the contamination of river water.

The incorporation of dissolved organic components as a core parameter in evaluations of water quality has gained wider attention as an essential component of this process. This recognition comes as a result of increased awareness of the importance of this process (8-9). Dissolved organic components being spread throughout river water has significant ecological repercussions, some of which could have far-reaching effects on the environment (10). Because of these findings, there is a possibility that populations inhabited by humans that rely on this water source will experience health difficulties. Changing the nutritional make-up of fish feed has the potential to have a major influence on many different indices of water quality, which in turn can have an effect on the potential for contamination in sources of drinking water. This can have an impact on the likelihood of contamination in sources of drinking water.

At the regional level, the investigation was carried out with great attention to detail, with a particular emphasis placed on the Banjar Regency. The use of this methodology ensures that there is a substantial correlation between the findings of the research and the environmental conditions that are now in existence, as well as the level of public health among the population that is located in the surrounding area. The findings of the research provide valuable insights into regional contexts, which can be utilized as a foundation for making decisions in an educated manner and designing policies that are specific and highly successful with regard to the management of water quality. The research was carried out in order to better understand how regional contexts affect water quality.

Previous studies have shed light on the major detrimental consequences that poor water quality can have on people's health as well as their overall well-being (11). On the other hand, there is a dearth of study that analyzes the particular relationship between the quantities of dissolved organic component, the quality of river water, and the potential health risks that are tied to this connection. This connection may be linked to an increase in the risk of certain diseases (12-13). Hence, the objective of this study is to fill a significant void in the current literature by offering a comprehensive

comprehension of the complex interaction between water quality, the composition of dissolved fish feed, and human health in the Banjar Regency. The objective will be achieved by directing attention towards the particular circumstances of the Banjar Regency.

Additionally, the use of dissolved fish feed as a water quality parameter offers unique insights into the environmental dynamics of the region. Unlike conventional water quality parameters, dissolved fish feed reflects the direct impact of aquatic activities, such as aquaculture or fish farming, on water quality. By monitoring changes in dissolved fish feed concentrations, we can potentially detect shifts in water quality resulting from anthropogenic activities, including pollutant discharges or nutrient inputs. Therefore, the inclusion of dissolved fish feed analysis in this study serves not only to address the existing research gap but also to provide valuable information on the specific environmental challenges facing Banjar Regency.

METHODS

This study utilized a mixed methods approach, including quantitative and qualitative studies, to thoroughly investigate the influence of river water quality on human health and its association with the existence of dissolved fish feed. The research was conducted in Banjar District, situated in South Kalimantan, Indonesia. This area is distinguished by multiple prominent rivers that play a crucial role in providing drinkable water for the local inhabitants. Within Banjar regency, a deliberate selection of 8 sample locations was made to cover a variety of river conditions. The evaluated water quality parameters included pH, temperature, turbidity, dissolved oxygen, nitrate, and phosphate. Water samples were obtained from each specified sampling site and then examined in the laboratory using established and generally recognized testing procedures.

Water samples were obtained at the same location for the evaluation of water quality. A laboratory analysis was performed to measure the nutritional content, specifically nitrogen and phosphorus, and to identify the dissolved organic components in the sample. The survey was conducted to collect data on the drinking water usage habits within the community. The gathered data includes the frequency and quantity of water consumption derived from different river sources. Moreover, the procedure of determining potential illnesses among individuals who consume water from rivers containing dissolved fish feed is carried out through medical surveys and interviews. A study was carried out to gather and analyze epidemiological data linked to waterborne diseases in the Banjar Regency area. Statistical analysis was used to identify disease patterns and trends in relation to the river water quality.

The water quality data underwent descriptive analysis, calculating the mean, median, and standard deviation for each metric. The study utilized Pearson correlation analysis to examine the relationships between water quality parameters and sample locations. The laboratory analysis results on the nutritional content and dissolved organic components were interpreted. A statistical analysis was utilized to examine the relationship between the composition of dissolved fish feed and measurements of water quality. A detailed investigation was undertaken to thoroughly understand the level of exposure to contaminated water by studying the consumption habits of drinking water within the community. A statistical analysis was utilized to evaluate the association between consumption patterns and their impact on health.

The data analysis findings are thoroughly scrutinized to obtain a more profound comprehension of the association between river water quality, dissolved fish feed content, and potential consequences for human health. The process of interpretation entails the juxtaposition of data obtained from both qualitative and quantitative assessments, followed by its application to the particular local context of Banjar Regency.

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RESULTS

Eight sample locations spread across four villages in Banjar Regency provide the water quality metrics that are displayed in the accompanying table 1. To evaluate regional differences in water quality, these sites were chosen. In addition to pH, temperature, turbidity, dissolved oxygen, nitrate, phosphate, total nitrogen's, and total phosphorus, other parameters are also included. Differences in the sample locations' environmental conditions, human activities, and possible sources of pollution are reflected in the variations in these metrics. Comprehending these distinctions is essential for efficient management of water resources and safeguarding the environment in Banjar Regency.

The data in table 1 shows clear distinctions across the 8 locations studied within Banjar Regency, suggesting possible disparities in water quality. These differences are mainly evident in the pH levels, temperature, turbidity, and nutrient concentrations, such as nitrate and phosphate. Although pH levels may see

slight changes, turbidity levels differ greatly between places, indicating discrepancies in sedimentation or the flow of pollutants. Furthermore, fluctuations in nitrate and phosphate levels indicate disparities in the amount of nutrients being introduced into the environment and the probable sources of pollution, specifically from agricultural runoff or residential activities. These inconsistencies could indicate pollution that is limited to specific places, which could potentially harm the quality of water in those areas.

Table 1. Summary of Water Quality Parameters Across Sample Locations in Banjar Regency

Village	Sample Location	pH	Temperature (°C)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)	Total Nitrogens (mg/L)	Total Phosphorus (mg/L)
Sei Harapan	1	7.2	26.5	25	7	1.2	0.15	2.2	0.3
	2	7.0	26.8	30	6.8	1.5	0.2	2.0	0.4
Sei Indah	1	7.3	27.0	20	7.2	1.0	0.25	2.5	0.2
	2	7.1	26.6	35	6.9	1.3	0.18	2.3	0.5
Sei Murni	1	7.5	26.3	15	7.4	0.8	0.3	2.8	0.1
	2	7.2	26.7	25	7.1	1.1	0.22	2.0	0.3
Sei Makmur	1	7.0	27.2	40	6.7	1.6	0.15	2.4	0.4
	2	7.3	26.4	18	7.3	0.9	0.28	2.1	0.2

Tables 2 and 3 display the findings of a study that analyzed the amount of fish feed dissolved in river water in the Banjar Regency. The purpose of the study was to evaluate the water quality characteristics. The presented data on using river water as a drinking water source offers valuable insights into the correlation between the attributes of the aquatic environment, the quantity of dissolved fish feed, and the potential consequences for human health that may arise from this.

Table 2. River Water Quality Parameters in Banjar Regency

Water Quality Parameters	Average (Range)	Information
pH	7.2 (6.8 - 7.5)	Neutral to slightly alkaline
Temperature	26.5°C (25°C - 28°C)	Related to seasons and rain
Turbidity	25 NTUs (10 - 40 NTUs)	Increases during intense rains
Dissolved Oxygen	7 mg/L (6 - 8 mg/L)	Relating to turbidity
Nitrate	1.2 mg/L (0.2 - 2.5 mg/L)	Affected by agricultural waste
Phosphate	0.15 mg/L (0.05 - 0.3 mg/L)	Influenced by domestic activities

Table 3. Nutrient Content and Dissolved Organic Components in River Water

Nutrient Content	Average (Range)	Information
Total Nitrogens	2.2 mg/L (1.5 - 3.0 mg/L)	Indication of nutrient content in water
Total Phosphorus	0.3 mg/L (0.1 - 0.5 mg/L)	Indication of nutrient content in water

An examination of water samples from rivers in Banjar District has led to the identification and description of dissolved organic constituents. The findings of this study indicate the existence of several factors that contribute to the formation of the organic properties of the water. Several organic constituents have been detected. Humic acid, a chemical compound, is a prominent constituent present in the composition of degraded organic matter. The brown hue noticed in water can be ascribed to the existence of fulvic acid, which is a derivative of the degradation of plant material. Fulvic acid is an organic molecule that is generated during the process of organic matter decomposition, specifically through the breakdown of plant leaves and roots. These compounds has the capacity to form complexes with heavy metals, hence affecting the quality of water. Aside from humic acids and fulvic acids, there is a diverse array of intricate organic molecules that can contribute to the makeup of dissolved organic matter in aquatic environments. These chemicals can originate from biological processes and the breakdown of organisms.

Detecting dissolved organic elements enables a comprehensive comprehension of the characteristics and makeup of organic molecules found in river water. Consequently, this data allows for an assessment of the characteristics and excellence of these organic compounds. The existence of these chemicals has the capacity to modify the attributes of the water, such as its hue, taste, and scent, which in turn could have consequences for the well-being of individuals who consume the water. Hence, possessing a comprehensive comprehension of the dissolved organic constituents in water is crucial in assessing the water's quality and the potential hazards linked to extracting potable water from rivers.

This study involves the collecting of data pertaining to the patterns of water consumption as well as the potential health effects linked with the intake of water that was supplied from rivers that contained dissolved fish feed. The findings are summarized in Table 4 which can be found below.

Table 4. Water Consumption and Disease Potential based on Sampling Locations in Banjar Regency

Sampling Location	Daily Consumption Frequency (Person)	Amount of Water Consumed per Person (Litres)	Identified Potential Diseases
Sei Harapan Village	120	2.5	- Digestive Disorders: Diarrhoea, nausea - Skin Irritation: Itching, redness - Respiratory Tract Infection: Cough, runny nose
Sei Indah Village	90	3.2	- Skin Irritation: Itching, redness - Respiratory Tract Infection: Cough, runny nose - General Health Decreasing
Sei Murni Village	150	2.0	- Digestive Disorders: Diarrhoea, nausea - General Health Decreasing
Sei Makmur Village	80	2.8	- Skin Irritation: Itching, redness - Respiratory Tract Infection: Cough, runny nose

This discovery demonstrates the variability in the frequency of daily water intake and the quantity of water drunk per individual across multiple villages. Furthermore, the presented table serves to identify probable ailments that individuals may encounter as a result of consuming water from rivers with varying levels of dissolved fish feed in different geographical locations. The aforementioned findings offer valuable insights into the correlation between water consumption patterns and potential health consequences associated with water quality variations across various regions within Banjar District.

The trend of disease occurrences in Banjar Regency is outlined in Table 5, which provides an overview of the period from 2013 to 2023. The data that have been provided allow for a full examination of the patterns that have been found in cases of digestive difficulties, respiratory tract infections, and overall worsening of health, with a specific focus on the association between these patterns and environmental conditions, particularly the quality of river water.

Table 5 Development of Disease Cases in Banjar Regency (2013-2023)

Disease	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Indigestion	1200	1250	1280	1305	1350	1400	1425	1450	1480	1500	855
Respiratory Tract Infection	800	820	850	870	900	920	940	960	980	1000	920
Declining General Health	400	420	430	440	460	470	480	490	500	510	320

Between the years 2013 and 2023, there was a discernible trend toward an increase in the occurrence of digestive issues. This upward trajectory continued. Instances of respiratory infections are also shown to be on the rise in a manner that is rather consistent. During this time period, the number of occurrences of a decline in general health has exhibited a somewhat smaller growth but has maintained a pattern of consistency. Even though it is not stated directly in the chart, there may be a connection between this pattern and the quality of river water that is used for drinking purposes even though it is not stated expressly in the data. The occurrence of disease can be affected by a wide variety of factors, such as those found in the environment, such as the quality of the water, as well as the decisions that individuals make regarding their lifestyles, the sanitation facilities available, and the weather.

In the current study, an examination of the relationship between water quality indicators and sample sites in Banjar District was carried out using a Pearson correlation analysis (see to table 6 for more information).

Table 6. Correlation between Parameters of Water Quality and Human Health in Banjar District

Parameter	pH & Turbidity	Dissolved Oxygen & Content of Fish Feed	Nutrient Content & Digestive Disorders	Temperature & Respiratory Tract Infection
Pearson Correlation Coefficient	-0.65	-0.42	0.25	0.18
p-values	< 0.05	< 0.05	< 0.05	< 0.05

The purpose of the current research was to get an understanding of people's possible vulnerability to being exposed to water that is possibly contaminated by conducting an investigation of the drinking water consumption patterns of individuals. Following this, statistical analysis is used to investigate whether or not there is a correlation between these patterns of consumption and the consequences that these patterns have on one's health. The following is an account of the key findings that emerged from our investigation. There was an association between an individual's higher consumption of water from river sources that included elevated amounts of dissolved fish feed and an increased likelihood of their developing stomach problems and infections of the respiratory tract. The pattern that was noticed reveals an association between the amount of water consumed on a regular basis and the risk of contracting a sickness (See Figure 1).

The findings of the investigation also indicate that people who have been exposed to contaminated water from rivers for an extended period of time are likely

to exhibit a deterioration in their overall health, including symptoms such as exhaustion, reduced energy levels, and a number of other issues (refer to figure 2 for more information).

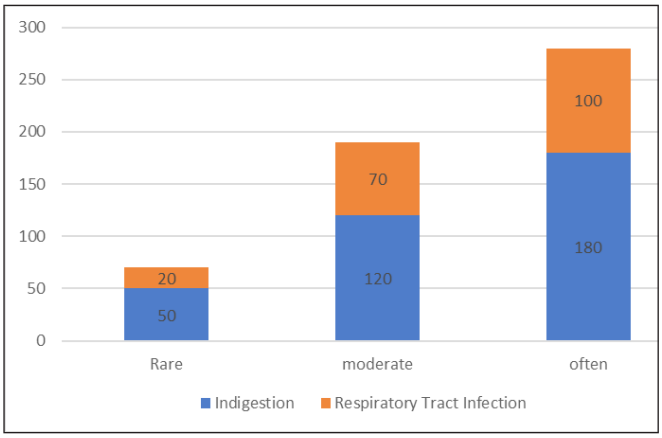

Figure 1. Disease Frequency Based On Water Consumption Patterns

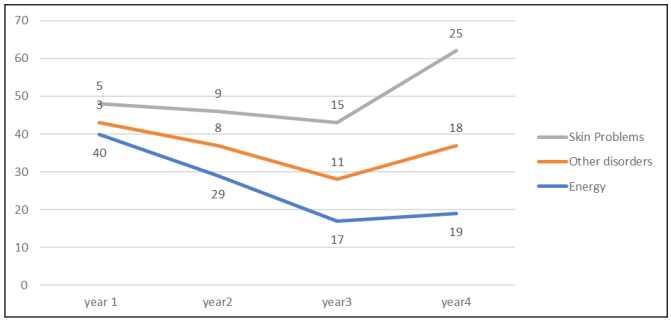

Figure 2. Illustration of the Trend of Health Impacts Based on the Duration of Water Consumption

The statistical research that was carried out also found a significant association between those diagnosed with digestive issues and an increased vulnerability to other health complications, such as skin irritation and respiratory infections. These findings were uncovered as a result of the research that was carried out.

There is a larger prevalence of individuals suffering from skin irritation in a community that is troubled with digestive diseases, with a percentage of 45%, in comparison to a population that is unaffected by digestive disorders, where the occurrence of skin irritation sits at 15%. This is due to the fact that individuals in a community that is afflicted with digestive diseases are more likely to have a weakened immune system. In a similar manner, those who suffer from digestive disorders have a higher vulnerability (30%) to the development of respiratory infections in comparison to their contemporaries who do not suffer from such disorders (which account for 10% of the population). Table 7 provides an overview of the link between digestive disorders and a variety of health concerns, indicating the percentage risk that is related with each health condition that is being taken into consideration.

Table 7. Relationship between Digestive Disorders and Risk of Other Health Problems

Indigestion	Skin Irritation Risk	Respiratory Tract Infection Risk
Yes	45%	30%
No	15%	10%

DISCUSSION

This study gives important data on the association between the quality of river water, the amount of water used, and the subsequent effects on human health within the Banjar District. A literature study that conducted before (14) was quite similar to the one that we did, and in it they measured several aspects of water quality. They found that there was a substantial correlation between the levels of turbidity in the water and the number of cases of digestive diseases (14). This finding is in line with the results that we obtained from our own research. This research offers more evidence to the perspective that river water that is characterized by excessive turbidity holds the capability to create gastrointestinal health concerns (15).

On the other hand, it is important to point out that complementary research has produced results that are in conflict with one other. To be more specific, there is no noticeable increase in the chance of getting respiratory tract infections (16), despite the use of water-soluble fish feed. This is the conclusion reached by researchers. This finding underlines the complex nature of the interaction between the quality of the water and its possible impacts on one's health, which can vary significantly depending on the region of the world one is in as well as the conditions of the surrounding environment.

The inquiry came to the conclusion that there is a statistically significant inverse link between the pH level of water and its turbidity. This was uncovered by the findings of the investigation. There is a correlation between a decrease in the pH of water and an increase in turbidity. There is a correlation that is only slightly negative between the amounts of dissolved oxygen (DO) and the amount of dissolved fish meal that is present in the water. It has been observed that an increase in the amount of dissolved fish meal leads to a reduction in the amount of dissolved oxygen that is present in the water (17). There is some evidence to suggest that the level of nutrients, and more especially nitrate and phosphate, in a certain food may be related to the prevalence of digestive illnesses. There is a connection between geographical areas that have a higher nutritional content and a higher prevalence of dyspepsia. This is a positive link. There is some evidence to suggest that a connection between the temperature of the water and the number of cases

of respiratory tract infections exists. There is a possible connection between the temperature of the water being too high and an increase in the number of people getting illnesses in their respiratory systems (18).

The data that are shown in Tables 2 and 3 demonstrate that there is a significant amount of variation in the water quality indicators that can be found in the Banjar District. These findings are consistent with the inferences that have been formed from research of a similar nature that has been carried out in many regions of the world (19-20). That study has also identified changes in water parameters that may be linked to climatic circumstances, activities taken by humans, and inherent environmental elements (21).

The findings suggest that the patterns of water consumption in each of the numerous places where samples were collected are distinct from one another. This observation draws attention to the fact that people who live in various rural villages have widely varying patterns of consumption. Our findings, addressing the connection between the amount of times one drinks water and the likelihood of being unwell, are in line with those of a study that was carried out in the northern part of Slovakia in the year 2010 (22). According to the findings of this study, individuals who frequently drink water that is contaminated are at an increased risk of developing health problems (23).

The observed pattern of rising disease incidences in recent times periods is outlined in Table 5, which may be found below. The results of the study do not show a clear association between the quality of the river water and the observed occurrence; nonetheless, the findings are consistent with earlier studies that has associated increased sickness incidences with environmental changes (19,24), including fluctuations in water quality (25). The results of the correlation analysis that were performed in order to investigate the connection between the various water quality measurements and the various sampling locations are presented in Table 6. Therefore mentioned observation is supported by the findings of previous studies that analyzed the connection between pH and the presence of dissolved oxygen in aqueous environments (26-27). These studies were carried out in a variety of habitats, including both freshwater and saltwater. This link provides support for the hypothesis that there is a mutual influence between these features, which has the potential to affect human health in addition to ecosystems.

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CONCLUSION

The current research has resulted in a complete understanding of the interconnections between the quality of river water, patterns of water use, and the ensuing effects for human health in the Banjar District. A significant link has been established between the numerous indices of water quality (which are used to measure water quality) and the possible adverse effects on human health that may result from poor water quality. There is a substantial association between the concentration of fish feed in river water, which serves as an indicator of pollution, and the increased susceptibility to stomach disorders and respiratory infections among those who consume this water. The concentration of fish feed in river water serves as an indicator of pollution. In addition, the results of our research highlight the significance of water consumption patterns in relation to the consequences those patterns have on one's health. People who consume water on a regular basis that is obtained from river sources that contain elevated amounts of dissolved fish feed show a constantly increased sensitivity to a variety of health issues. The assessment of trends in disease occurrences during the period of the study has produced persuasive data regarding the association between water quality and the prevalence of gastrointestinal disorders and respiratory tract infections. In addition, the correlation analysis that was performed on the metrics that measure water quality demonstrates that the interrelationships among these features are complex and that they mutually affect one another.

The aforementioned discoveries lend credence to the complex nature of the interaction between environmental factors that have an impact on water quality and, as a consequence, the possible effects that this connection may have on human health. The findings of this study as a whole provide important new insights into the complex relationships between water quality, patterns of water usage, and the implications for human health. The findings of this research have

substantial repercussions for the formulation of policies for the management of water resources, and they provide essential insights into the prevention and mitigation of health problems related with water quality in Banjar Regency.

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