JURNAL ILMU LINGKUNGAN
Volume 23 Issue 1 (2025) : 35-42 ISSN 1829-8907

Potential Sources of Raw Water in Coastal Areas, Jawai and South Jawai Districts, Sambas Regency, West Kalimantan

Samiat[1], Nora Idiawati[2], Sepridawati Siregar[3*], and Sukal Minsas[2]

[1]Faculty of Civil Engineering, Tanjungpura University, Pontianak, Indonesia
[2]Faculty of Math and Science, Tanjungpura University, Pontianak, Indonesia
[3]Faculty of Medicine, Abdurrab University, Pekanbaru, Riau, Indonesia; email: sepridawati.siregar@univrab.ac.id

ABSTRAK

Daerah pesisir Kecamatan Jawai dan Jawai Selatan terletak di Kabupaten Sambas, Pontianak, Kalimantan Barat, merupakan daerah yang memiliki keterbatasan akan pemenuhan kebutuhan air bersih terutama untuk kebutuhan air minum. Penelitian ini dilakukan dibeberapa desa di Kecamatan Jawai dan Kecamatan Jawai Selatan. Pengambilan sampel dari desa tersebut berupa air hujan, air sumur bor, air gunung, air sumur dangkal dan air parit yang kemudian dianalisa parameter kimia, fisika dan mikrobiologi. Tujuan penelitian adalah untuk mengetahui potensi sumber air baku di daerah Kecamatan Jawai dan Jawai Selatan untuk pemenuhan akan kebutuhan air bersih dan air minum berdasarkan Peraturan Keputusan Menteri Kesehatan Republik Indonesia Nomor 2 tahun 2023, tentang standar baku mutu kesehatan lingkungan media air minum dan peruntukan penggunaan air berdasarkan Pemerintah Republik Indonesia No. 82 Tahun 2001, tentang Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air. Berdasarkan PP No. 82 Tahun 2001, dari hasil analisa air di Kecamatan Jawai, hanya air hujan memiliki nilai yang masih ≤ baku mutu parameter, sedangkan di Kecamatan Jawai Selatan, air gunung dan air hujan memiliki nilai yang masih ≤ baku mutu parameter. Oleh karena itu sumber air tersebut masuk ke dalam kategori sebagai Air kelas satu, yaitu air yang peruntukannya dapat digunakan untuk air baku air minum, dan atau peruntukan lain yang mempersyaratkan mutu air yang sama dengan kegunaan tersebut. Berdasarkan PERMENKES RI No. 2 Tahun 2023, air hujan, air gunung dan air sumur bor tidak layak digunakan sebagai media air minum. Berdasarkan metode STORET, status mutu air masuk dalam kelas B yaitu kategori 'cemar ringan'.

Kata kunci: Air bersih, Air gunung, Air hujan, Kualitas air, Pencemaran air

ABSTRACT

The coastal areas of Jawai and South Jawai Districts are located in Sambas Regency, Pontianak, West Kalimantan, which have limited access to clean water needs, especially for drinking water needs. This research was conducted in several villages in Jawai District and South Jawai District. Samples taken from the village were rainwater, drilled well water, mountain water, shallow well water, and ditch water, which were then analyzed for chemical, physical, and microbiological parameters. The research aims to determine the potential of raw water sources in the Jawai and South Jawai sub-districts to fulfill the need for clean water and drinking water based on the Decree of the Minister of Health of the Republic of Indonesia Number 2, 2023, concerning environmental health quality standards for drinking water media and water use designations based on the Government of the Republic of Indonesia No. 82, 2001, concerning Water Quality Management and Water Pollution Control. Based on Government Regulation no. 82, 2001, from the results of water analysis in Jawai District, only rainwater has values that are still ≤ parameter quality standards, while in South Jawai District, mountain water and rainwater have values that are still ≤ parameter quality standards. Therefore, this water source is included in the category of first-class water, namely water whose designation can be used for raw drinking water and other purposes that require the same water quality as that use. Based on the Republic of Indonesia Minister of Health Regulation No. 2, 2023, rainwater, mountain water, and drilled well water are unsuitable for drinking water use. Based on the STORET method, the water quality status is included in class B, namely the 'lightly polluted' category.

Keywords: Clean water, Mountain water, Rain Water, Water Quality, Water Pollution

Citation: Idiawati, N., Minsas, S., dan Siregar, S. (2025). Potential Sources of Raw Water in Coastal Areas, Jawai and South Jawai Districts, Sambas Regency, West Kalimantan. Jurnal Ilmu Lingkungan, 23(1), 35-42, doi:10.14710/jil.23.1.35-42

1. INTRODUCTION

The area of Sambas Regency is 6,395.70 km2, or around 4.36% of the area of West Kalimantan Province. Astronomically, Sambas Regency is located between 2°08' north latitude and 0°33' north latitude and 108°39' east longitude and 110°04' east longitude (Habibie et al., 2013).

Jawai and South Jawai are districts in Sambas Regency. Jawai district, centered around Sentebang, covers an area of 193.99 km^2. It is bordered to the north by South Jawai district, to the south by Pemangkat and Semparuk districts, to the east by Tekarang district, and to the west by the Natuna Sea. In contrast, South Jawai, with its administrative center in Matangterap district, spans 93.51 km2. It is situated north of Jawai District, south of the Sambas Besar River, east of Tebas District, and west of the Natuna Sea (BPS Sambas Regency, 2017).

Water quality indicators commonly used to assess the feasibility of cultivation are based on physical, chemical, and microbiological factors. The observed Physical factors in water include temperature, brightness, and suspended particles. In contrast, chemical factors include biological oxygen demand (BOD), chemical oxygen demand (COD), dissolved oxygen (DO), alkalinity, organic matter, and others (Putri et al., 2017). Meanwhile, biological indicators of water quality that are starting to be developed nowadays are observations of organisms that live in water (Siswadi, 2015).

PDAM, the regional drinking water company in Sambas City has relied on surface water sources, specifically rivers in the vicinity, to meet the area's drinking water demands. According to the Water Treatment Plant (WTP) operation report, the quality of these rivers has been deteriorating and showing a trend towards further degradation. The declining quality of raw water will inevitably escalate the workload at the WTP. To cope with the rising demand for water supply, there is a risk that WTP operations may be compelled to exceed their processing capacity, potentially leading to decreased quality of treated water (Ismanto et al., 2021; Sulistyarso, 2015). Given the deteriorating water conditions and the challenge of meeting the demand for clean water, particularly in the Jawai and South Jawai districts, it is crucial to analyze the potential of commonly used water sources, such as mountain water, drilled well water, shallow well water, rainwater, and ditch water. This study will assess water quality parameters and evaluate the suitability of these sources for providing clean water.

This research aims to determine the suitability of water quality parameters in villages around Jawai and Jawai Selatan Districts, Sambas Regency, and provide recommendations to the local community regarding water sources that can be used to meet their raw water needs for drinking water based on the Decree of the Minister of Health, the Republic of Indonesia No. 2, 2023 and water class designation based on Republic of Indonesia Government Regulation No. 82, 2001, concerning Water Quality Management and Water Pollution Control (Lestari et al., 2023).

2. METHODS

This research was carried out for one year. Water sampling was carried out in August-November 2023. The research location was in Jawai and South Jawai Districts, Sambas Regency (Figure 1). In Jawai District, sampling was carried out in Bakau Village, Parit Setia Village, Dungun Laut Village, Mutus Darussalam Village, Sarang Burung Danau Village, Sarang Burung Kolam Village, Sentebang Village, Sungai Nilam Village, Sungai Nyirih Village, Lambau Village and Pelimpaan Village. Meanwhile, for the South Jawai District, sampling was carried out in Jawai Laut Village, Sabaran Village, Semperiuk A Village, Semperiuk B Village, and Suah Api Village. Parameter measurements are based on the Decree of the Minister of Health, the Republic of Indonesia Number 2, 2023, concerning environmental health quality standards for drinking water media and the allocation of water use based on the Government of the Republic of Indonesia Number 82, 2001, concerning Water Quality Management and Water Pollution Control. The analysis was conducted at the Pontianak branch of the Sucofindo Laboratory and the Integrated Laboratory at Tanjungpura University.

Research stations were determined using the sample survey method, a sampling method carried out by dividing the research area into stations expected to represent the research population. Determining water sampling points is based on ease of access, cost, and time so that points considered to represent water quality are determined. Table 1 (Supplementary Materials) describes the number of water sampling locations in villages in Jawai District. Meanwhile, Table 2 contains the number of water sampling locations in villages in the South Jawai District.

From Table 1 in Jawai District, for rainwater, sampling is carried out during the rainy season through rainwater storage tanks with storage capacities ranging from 100 L to 50,000 L. Rainwater sampling is carried out in Bakau Village (10 points), Parit Setia Village (3 points), Dungun Laut Village (22 points), Mutus Darussalam Village (52 points), Sarang Burung Danau Village (63 points), Sarang Burung Pond Village (70 points), Sentebang Village (52 points), Sungai Nilam Village (19 points) , Sungai Nyirih Village (49 points), Lambau Village (19 points) and Pelimpaan Village (38 points).

For drilled well water, samples are taken through pipes connected to the drilled well with varying drilled well depths ranging from 5 to 120 meters. Drilled well water sampling was carried out in Bakau Village (70 points), Parit Setia Village (5 points), Dungun Laut Village (29 points), Mutus Darussalam Village (8 points), Sarang Burung Danau Village (12 points), Village Pond Bird's Nest (11 points), Sentebang Village (37 points), Sungai Nilam Village (16 points), Sungai Nyirih Village (28 points), Lambau Village (3 points) and Pelimpaan Village (7 points).

For shallow well water sampling with a reservoir depth ranging from 1.5 to 4 meters. The sampling was carried out in Bakau Village (1 point), Parit Setia Village (2 points), Dungun Laut Village (1 point), Sarang Burung Danau Village (1 point), Pond Bird's Nest Village (1 point), Sentebang Village (1 point), Sungai Nilam Village (1 point), Sungai Nyirih Village (1 point) and Lambau Village (1 point).

Meanwhile, ditch water sampling was carried out in Parit Setia Village (2 points), which has a ditch specification with a width of 4.5 m and a height of 1.7 m, Mutus Darussalam Village (1 point) which has a ditch specification with a length of 7.6 km, 6 m wide and 2.5 m high, Sarang Burung Danau Village (3 points), which has trench specifications with lengths of around 6.6, 8.7 and 11 km respectively, 5 m wide and 5 m high, Sarang Burung Village Pond (1 point) which has specifications for a ditch with a length of 9.8 km, width of 6 m and height of 2 m, Sungai Nilam Village (1 point) which has specifications for a ditch with a length of 9.2 km, width of 7 m and height of 2.5 m and Pelimpaan Village (1 point) which has specifications for a ditch with a length of 5 km, width of 5 m and height of 2 m.

From Tabel 2 (Supplementary Materials), in South Jawai District, rainwater sampling is carried out during the rainy season through rainwater storage tanks with a storage capacity ranging from 1550 to 5000 L. Rainwater sampling is carried out in Suah Api Village (41 points), Semperiuk A Village (4 points), Semperiuk B Village (1 point) and Sabaran Village (38 points).

For drilled well water, samples are taken through pipes connected to the drilled well with varying drilled well depths ranging from 18 to 120 meters. Drilled well water sampling was carried out in Suah Api Village (36 points), Semperiuk A Village (50 points), Semperiuk B Village (43 points), Sabaran Village (61 points) and Jawai Laut Village (3 points).

For shallow well water sampling (5 points) with a reservoir depth ranging from 1 to 3 meters and broncaptering (2 points), each of which has a depth of 1 and 2 meters with a width of 3x3 and 6x6 meters, only in Jawai Laut Village. Meanwhile, ditch water sampling was carried out in Suah Api Village (1 point), which has ditch specifications with a length of 7.3 km, width of 4.5 m and height of 2 m, Semperiuk B Village (1 point) which has ditch specifications with a length of 5.2 km, 13 m wide and 3.5 m high and Sabaran Village (1 point) which has moat specifications with a length of 4.6 km, a width of 6 m and a height of 2.4 m.

All water samples should be placed into a sterilized drum and glass bottle. Seal the containers tightly and temporarily store them in a cooler box before transporting to the laboratory for further analysis.

2.1. STORET Method

The determination of water quality status in this study utilized the STORET Index method, in accordance with the Decree of the Minister of State for the Environment Number 115 of 2003 regarding Guidelines for Determining Water Quality Status. The STORET method serves to identify parameters that either meet or exceed water quality standards. Essentially, this method involves comparing water quality data against standards that are adjusted based on class and intended use, as outlined in Government Regulation Number 82 of 2001 on water quality management and pollution control. In this study, the water quality classification used is class I, which refers to water that can be used as a raw source for drinking water and/or for other purposes that require the same water quality standards as those uses (Fitria et al., 2020).

The determination of water quality status using the STORET method involves the following steps: (a) Periodically collecting water quality and flow data; (b) Comparing the measurement results of each water parameter with the corresponding water quality standard values; (c) Assigning a score of 0 if the measurement results meet the water quality standard (i.e., measurement results < standard); (d) Assigning scores according to Table 3, if the measurement results do not meet the water quality standard (i.e., measurement results > standard); (e) Calculating the total number of negative scores from all parameters, and determining the water quality status based on the total score obtained using the scoring system as follows (HZ et al., 2018):

1) Class A: very good, score = 0; meets quality standards.
2) Class B: good, score = -1 to -10; slightly polluted.
3) Class C: moderate, score = -11 to -30; moderately polluted.
4) Class D: poor, score = -31; heavily polluted.

3. RESULTS AND DISCUSSION

3.1. Water Use in Jawai District

Villagers in Jawai District use 4 types of water to meet their water needs: rainwater, drilled well water, shallow well water, and ditch water. Rainwater fulfills the need for clean, raw water for drinking and cooking activities. Meanwhile, drilled well water, shallow well water, and ditch water are only used for toilet activities (bathing, washing, toilets) and irrigating rice fields/gardens.

3.2. Water Use in South Jawai District

There are 5 types of water used by villagers in South Jawai District to meet their water needs: mountain water, rainwater, drilled well water, shallow well water, and ditch water. Mountain water and rainwater fulfill the need for clean and raw water for drinking and cooking activities. Meanwhile, drilled well water, shallow well water, and ditch water are only used for toilet activities (bathing, washing, toilets) and irrigating rice fields/gardens.

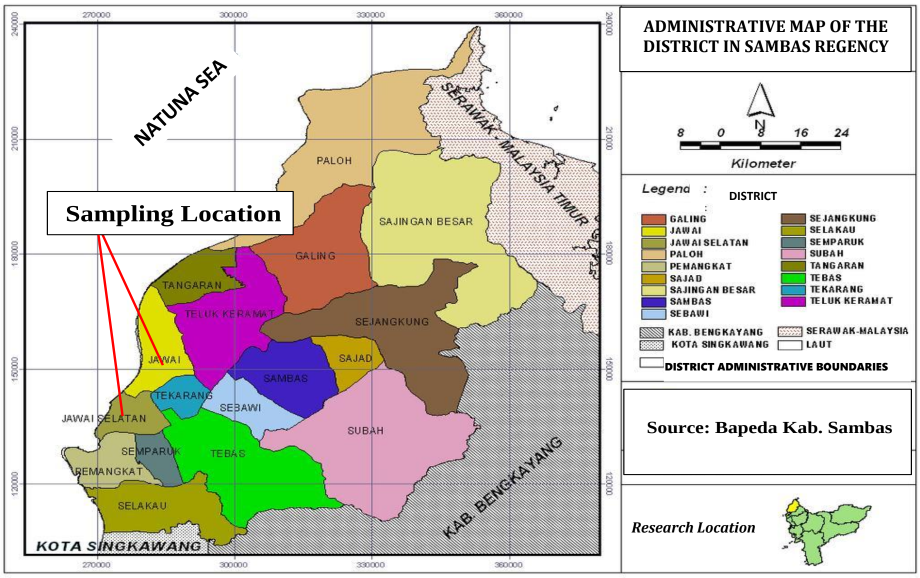

Figure 1. Map of Research Locations in Jawai and South Jawai Districts, Sambas Regency

Table 1. Drilling Well Water Analysis Results

Characteristics	Unit	Results	Maximum Permissible Limit	Methods
a. Microbiological parameters				
1. Escherichia Coli	CFU/100mL	0	0	SM ed.23.Th.2017, 9221 G
2. Total Coliform	CFU/100mL	0	0	SNI 06.6858-2002
b. Physical parameters				
1. Temperature	^oC	24.30	Air Temperature ±3	SNI 06-6989.23: 2005
2. Total Dissolve Solid (TDS)	mg/L	938	< 300	SNI 6989.27: 2019
3. Turbidity	NTU	< 0.06	< 3	SNI 06-6989.25: 2005
4. Color	TCU	< 1.5	10	SNI 6989.80: 2011
5. Odor	-	Odorless	Odorless	SM ed.23.Th.2017, 2150
c. Chemical parameters				
1. pH	-	6.95	6.5 – 8.5	SNI 6989.11: 2019
2. Nitrate (as NO_3^-) (dissolved)	mg/L	3.06	20	SNI 6989.79: 2011
3. Nitrite (as NO_2^-) (dissolved)	mg/L	< 0.003	3	SNI 06.6989.9: 2004
4. Chromium Hexavalent (Cr^{6+}) (dissolved)	mg/L	< 0.01	0.01	SNI 06.6989.71: 2009
5. Iron (Fe) (dissolved)	mg/L	< 0.02	0.2	SNI 6989.84: 2019
6. Manganese (Mn) (dissolved)	mg/L	0.02	0.1	SNI 6989.82: 2018
7. Free Chlorine (dissolved)	mg/L	0.11	0.2 – 0.5	SM.ed.23.Th.2017,4500 CI-G
8. Arsenic (As) (dissolved)	mg/L	< 0.001	0.01	SNI 6989.81: 2018
9. Cadmium (Cd) (dissolved)	mg/L	0.02	0.003	SNI 6989.84: 2019
10. Lead (Pb) (dissolved)	mg/L	0.02	0.01	SNI 6989.84: 2019
11. Fluoride (F) (dissolved)	mg/L	< 0.05	1.5	SNI 06.6989.29: 2005
12. Aluminum (dissolved)	mg/L	< 0.04	0.2	SNI 6989.82: 2018

Table 2. Mountain Water Analysis Results

Characteristics	Unit	Results	Maximum Permissible Limit	Methods
a. Microbiological parameters				
1. Escherichia Coli	CFU/100mL	0	0	SM ed.23.Th.2017, 9221 G
2. Total Coliform	CFU/100mL	0	0	SNI 06.6858-2002
b. Physical parameters				
1. Temperature	^oC	24.40	Air Temperature ±3	SNI 06-6989.23: 2005
2. Total Dissolve Solid (TDS)	mg/L	42	< 300	SNI 6989.27: 2019
3. Turbidity	NTU	< 0.06	< 3	SNI 06-6989.25: 2005
4. Color	TCU	< 1.5	10	SNI 6989.80: 2011
5. Odor	-	Odorless	Odorless	SM ed.23.Th.2017, 2150
c. Chemical parameters				
1. pH	-	7.61	6.5 – 8.5	SNI 6989.11: 2019
2. Nitrate (as NO_3^-) (dissolved)	mg/L	3.17	20	SNI 6989.79: 2011
3. Nitrite (as NO_2^-) (dissolved)	mg/L	< 0.003	3	SNI 06.6989.9: 2004
4. Chromium Hexavalent (Cr^{6+}) (dissolved)	mg/L	< 0.01	0.01	SNI 06.6989.71: 2009
5. Iron (Fe) (dissolved)	mg/L	0.16	0.2	SNI 6989.84: 2019
6. Manganese (Mn) (dissolved)	mg/L	0.01	0.1	SNI 6989.82: 2018
7. Free Chlorine (dissolved)	mg/L	< 0.02	0.2 – 0.5	SM.ed.23.Th.2017,4500 CI-G
8. Arsenic (As) (dissolved)	mg/L	< 0.001	0.01	SNI 6989.81: 2018
9. Cadmium (Cd) (dissolved)	mg/L	0.01	0.003	SNI 6989.84: 2019
10. Lead (Pb) (dissolved)	mg/L	< 0.003	0.01	SNI 6989.84: 2019
11. Fluoride (F) (dissolved)	mg/L	< 0.05	1.5	SNI 06.6989.29: 2005
12. Aluminum (dissolved)	mg/L	< 0.04	0.2	SNI 6989.82: 2018

Table 3. Rainwater Analysis Results

Characteristics	Unit	Results	Maximum Permissible Limit	Methods
a. Microbiological parameters				
1. Escherichia Coli	CFU/100mL	0	0	SM ed.23.Th.2017, 9221 G
2. Total Coliform	CFU/100mL	0	0	SNI 06.6858-2002
b. Physical parameters				
1. Temperature	^oC	24.60	Air Temperature ±3	SNI 06-6989.23: 2005
2. Total Dissolve Solid (TDS)	mg/L	24	< 300	SNI 6989.27: 2019
3. Turbidity	NTU	< 0.06	< 3	SNI 06-6989.25: 2005
4. Color	TCU	< 1.5	10	SNI 6989.80: 2011
5. Odor	-	Odorless	Odorless	SM ed.23.Th.2017, 2150
c. Chemical parameters				
1. pH	-	7.35	6.5 – 8.5	SNI 6989.11: 2019
2. Nitrate (as NO_3^-) (dissolved)	mg/L	3.19	20	SNI 6989.79: 2011
3. Nitrite (as NO_2^-) (dissolved)	mg/L	< 0.003	3	SNI 06.6989.9: 2004
4. Chromium Hexavalent (Cr^{6+}) (dissolved)	mg/L	< 0.01	0.01	SNI 06.6989.71: 2009
5. Iron (Fe) (dissolved)	mg/L	< 0.02	0.2	SNI 6989.84: 2019
6. Manganese (Mn) (dissolved)	mg/L	0.02	0.1	SNI 6989.82: 2018
7. Free Chlorine (dissolved)	mg/L	< 0.02	0.2 – 0.5	SM.ed.23.Th.2017,4500 CI-G
8. Arsenic (As) (dissolved)	mg/L	< 0.001	0.01	SNI 6989.81: 2018
9. Cadmium (Cd) (dissolved)	mg/L	0.01	0.003	SNI 6989.84: 2019
10. Lead (Pb) (dissolved)	mg/L	0.02	0.01	SNI 6989.84: 2019
11. Fluoride (F) (dissolved)	mg/L	< 0.05	1.5	SNI 06.6989.29: 2005
12. Aluminum (dissolved)	mg/L	< 0.04	0.2	SNI 6989.82: 2018

3.3. Water Analysis in Jawai District

Analysis of drilled well water and rainwater from Jawai District was carried out at the PT Laboratory. Sucofindo, Pontianak (Table 1 and 3). The water analysis was carried out based on the Regulation of the Minister of Health of the Republic of Indonesia Number 2, 2023, concerning environmental health quality standards for drinking water media, with microbiological, physical, and chemical parameters.

From the drilled well water analysis results, the microbiological parameters are by the required quality standards. In contrast, for the physical parameters, only the Total Dissolved Solid (TDS) parameter value (938 mg/L) far exceeds the quality standards necessary (<300 mg/L). For chemical parameters, only the results of the Cadmium (Cd) parameter analysis (0.02 mg/L) have a value above the required quality standard (0.003 mg/L).

From the results of rainwater analysis, for microbiological and physical parameters, the results are by the required quality standards, while for chemical parameters, the Cadmium (Cd) and Lead (Pb) parameters with analysis results are 0.01 mg/L and 0. .02 mg/L has a respective value above the required quality standards, namely 0.003 mg/L and 0.01 mg/L. Thus, based on PERMENKES No. 2, 2023, rainwater and drilled well water are unsuitable for drinking water use.

From the analysis of the 4 water sources in Jawai District, based on PP RI No. 82, 2001, drilled well water has a cadmium value of 0.2 mg/L, which exceeds the specified quality standard limit of 0.01 mg/L. Meanwhile, rainwater has a value that is still ≤ standard quality parameters based on PP No. 82, 2001. Therefore, this water is categorized as first-class water, namely water whose designation can be used for raw drinking water and other purposes that require the same water quality as that use. If the water is used as drinking water, it must go through a process first, namely at least being cooked to be suitable for consumption.

3.4. Water Analysis in South Jawai District

Analysis of mountain water and rainwater from the South Javai District was carried out at the PT Laboratory. Sucofindo (Table 2 and 3), Pontianak. The water analysis was carried out based on the Regulation of the Minister of Health of the Republic of Indonesia Number 2, 2023, concerning environmental health quality standards for drinking water media, with microbiological, physical, and chemical parameters.

From the results of the mountain water analysis, the microbiological and physical parameters are by the required quality standards. In contrast, the chemical parameters are only the results of the analysis of the Cadmium (Cd) parameter (0.01 mg/L), which has a value above the required quality standard (0.003 mg /L).

From the results of rainwater analysis, for microbiological and physical parameters, the results are by the required quality standards, while for chemical parameters, the Cadmium (Cd) and Lead (Pb) parameters with analysis results are 0.01 mg/L and 0. .02 mg/L has a respective value above the required quality standard, namely 0.003 mg/L and 0.01 mg/L. Thus, based on the Republic of Indonesia Minister of Health Regulation No. 2, 2023, mountain water and rainwater are unsuitable for drinking water use.

From the analysis of the 6 water sources in South Jawai District, mountain water and rainwater have values that are still ≤ standard quality parameters based on PP RI No. 82, 2001. Therefore, these two water sources fall into the category of first-class water, namely water whose designation can be used for raw drinking water and other purposes that require the same water quality as that use. If the water is used as drinking water, it must go through a process first; at least, it must be cooked to be suitable for consumption.

3.5. Determination of Water Quality Status using the STORET Method

Determination of water quality status is carried out using the STORET method by giving scores to parameters that meet or exceed water quality standards.

Based on the Republic of Indonesia Minister of Health Regulation No. 2, 2023, for drilled well water, the physical parameters TDS and chemical parameters Cd have values that exceed the required quality standards, so they have a score of -3. Based on the results of these scores, the quality status of drilled well water is in the class B category, which is lightly polluted. For rainwater, the chemical parameters Cd and Pb have values that exceed the required quality standards, so they have a score of -4. Based on the results of these scores, the quality status of rainwater is also included in the class B category, namely lightly polluted. Meanwhile, for mountain water, only the chemical parameter Cd has a value that exceeds the required quality standards, so it has a score of -2. Based on the results of these scores, the mountain water quality status is included in the class B category, which is lightly polluted (Table 4).

Table 4. Determination of Water Quality using the STORET Method

Sample Name	Parameter			Total
	Physics	Chemistry	Biology	
Drilling Well Water	-1	-2	0	-3
Rainwater	0	-4	0	-4
Mountain Water	0	-2	0	-2

3.6. The Impact of TDS and How to Process It

TDS concentration in water is one of the most significant factors in providing taste to water. Also, it offers important ions such as calcium, magnesium, potassium, and sodium (Islam et al., 2016). Water flowing through springs and natural water channels with high concentrations of organic salts in minerals and rocks or groundwater originating from wells with high salt concentrations will also produce higher particle measurements (B. B. Wang, 2021).

Increasing TDS concentrations in water bodies limit the function of water for drinking, power generation, industrial cooling, supporting biodiversity, ecosystem services, recreation, transportation routes, waste disposal, agricultural production, irrigation, energy production, regional planning, and fish farming (Lemessa et al., 2023). Substances and ions such as nitrates, lead, arsenic, and copper can contaminate water sources, which can cause various diseases related to heavy metal consumption and poisoning (Dippong et al., 2017).

High concentrations of TDS in water also form calcium or magnesium scale in water boilers, heaters, and pipes, causing excess buildup and drainage problems, and nitrate ions can pose a risk to human health due to the risk of formation of N-nitroso compounds (NOC) and lack of public knowledge about these substances (Dewangan et al., 2023; Ward et al., 2018).

Nitrates in water that still do not meet water treatment standards can pose a non-carcinogenic threat to various communities (Dippong et al., 2019). Even the United States Environmental Protection Agency (US EPA) secondary regulations recommend that TDS should be below 500 mg/L (EPA, 2012), which is also supported by the World Health Organization (WHO) recommendation of below 600 mg/L (Organization, 2004).

Several methods that reduce TDS have been reviewed: boiling and heating water with and without $NaHCO_3$, absorption with food-grade activated carbon (Jacobsen, 2004; Pradeep et al., 2016), and battery-powered electrolysis (Agostinho et al., 2012). To determine the effectiveness of reducing TDS, we can do it by obtaining water samples and selecting the difference in TDS before and after the experiment (B. B. Wang, 2021).

3.7. Cd and Pb Impact on Health and How to Process It

One of the main symptoms of chemical poisoning seems to be a damaged immune system, which opens the door to all kinds of diseases in the body (Hernández-Cortez et al., 2017). However, chemical levels in drinking water are hardly enough to cause acute health impacts (Levin et al., 2023). Exposure to small amounts of the chemical over a long period can cause chronic health effects (Singh et al., 2022). Health impacts include damage to the immune system, cancer, nervous system disorders, congenital disabilities, and organ damage. Pb, Cd, Cr, Cu, Zn, Mn, Ni, Co, and Mo are toxigenic and carcinogenic agents commonly found as contaminants in human drinking water supplies in many regions of the world (Mitra et al., 2022; Singh et al., 2022).

Consuming contaminated drinking water, which mainly contains Pb and Cd, can cause a person to suffer kidney failure (Singh et al., 2022). Most of the Pb we consume is excreted from the body through urine, but there is still a risk of its accumulation, especially in children, and is cumulative over time (S. Wang et al., 2021). Lead poisoning stunts children's growth, damages the nervous system, and causes learning disabilities, and now it is related to crime and anti-social behavior in children (Kuang et al., 2020).

Exposure to Cd in low doses can cause vomiting, coughing, and headaches. In contrast, in larger doses, it can replace calcium in bones, causing painful bone disorders and kidney failure, and can accumulate in the kidneys and liver (Fatima et al., 2019).

To remove heavy metals from polluted water sources involves a series of techniques, including adsorption, coagulation, ion exchange, chemical precipitation, membrane filtration, and electrochemical technology (Lupa & Cocheci, 2023; Zamora-Ledezma et al., 2021). These technologies were selected based on efficiency, practicality, cost, environmental impact and operational challenges (Zamora-Ledezma et al., 2021).

Materials and processing technologies that are widely available locally provide opportunities for households to access safe and clean drinking water (Senanu et al., 2023). Cassava peels, rice husks, coconut shells and husks, various types of clay, zeolites, and ceramic water filters provide opportunities to address heavy metal contamination (lead, arsenic, zinc, copper, chromium, and cadmium) in drinking water (Uchechi et al., 2021; Yang et al., 2021). The advantages of using local materials and processing technology include ease of access to materials, low costs, and ease of technology transfer (Senanu et al., 2023). Some mitigation techniques available to remove by-products from processing processes include the use of plants (phytoremediation) and the use of microorganisms (bioremediation) (Akpor, 2010).

4. CONCLUSION

This research was conducted to determine the condition of the water intended to meet the clean water needs in several villages in Jawai and South Jawai Districts. From the results of the analysis of several physical, chemical and microbiological parameters, it shows that there are several physical and chemical parameters that exceed the quality standards set in accordance with the Republic of Indonesia Minister of Health Regulation Number 2, 2023. These parameters are TDS and heavy metals (Pb and Cd). Therefore, action is needed to reduce TDS concentration and eliminate heavy metals.

Based on PERMENKES No. 2, 2023, rainwater, mountain water and drilled well water are not suitable for use as drinking water. Based on PP no. 82, 2001, rainwater and mountain water are categorized as first-class water, where water is intended to be used as raw drinking water. For the meantime, it is recommended to use water sourced from mountain water and rainwater.

The study may have limited geographical coverage, focusing only on specific coastal areas within Jawai and South Jawai Districts, which may not represent the entire region's water resources. Data collection may have been conducted over a limited time frame, which could affect the seasonal variability of water sources and quality. The study has relied on certain methodologies or sampling techniques that could introduce bias or limit the comprehensiveness of the data. The availability and accessibility of existing data on water quality and quantity in the region could restrict the depth of analysis and conclusions drawn. Potential contamination of identified raw water sources has not been thoroughly investigated, which could impact their viability for use. The study may have faced budgetary limitations, restricting the scope of research and the number of samples or sites analyzed. These limitations highlight the need for further research and a comprehensive approach to understand the potential sources of rainwater, mountain water, and groundwater, as well as the methods that will be established to obtain clean water that meets the quality standards.

ACKNOWLEDGMENT
The authors would like to thank the Faculty of Math and Science, Tanjungpura University, Pontianak, and Sambas district government, West Kalimantan, for their financial support.

REFERENCES

Agostinho, L. C. L., Nascimento, L., & Cavalcanti, B. F. (2012). Water Hardness Removal for Industrial Use: Application of the Electrolysis Process. 1: 460. doi: 10.4172/scientificreports. 460 Volume 1• Issue 9• 2012

Akpor, O. (2010). Remediation of heavy metals in drinking water and wastewater treatment systems: Processes and applications. *International Journal of Physical Sciences*, *5*, 1807–1817.

Dewangan, S. K., Shrivastava, S., Kadri, M., Saruta, S., Yadav, S., & Minj, N. (2023). *"Temperature Effect on Electrical Conductivity (EC) & Total Dissolved Solids (TDS) of Water: A Review." 10*, 514–520.

Dippong, T., Cristina, M., Goga, F., & Cical, E. (2017). Seasonal Evolution and Depth Variability of Heavy Metal Concentrations in the Water of Firiza-Strîmtori Lake, NW of Romania. *Studia Universitatis Babeş-Bolyai Chemia*, *62*, 213–228. https://doi.org/10.24193/subbchem.2017.1.19

Dippong, T., Mihali, C., Hoaghia, M.-A., Cical, E., & Cosma, A. (2019). Chemical modeling of groundwater quality in the aquifer of Seini town – Someş Plain, Northwestern Romania. *Ecotoxicology and Environmental Safety*, *168*, 88–101. https://doi.org/https://doi.org/10.1016/j.ecoenv.2018.10.030

EPA, U. S. (2012). 2012 edition of the drinking water standards and health advisories. *EPA 822-S-12-001*.

Fatima, G., Raza, A. M., Hadi, N., Nigam, N., & Mahdi, A. A. (2019). Cadmium in Human Diseases: It's More than Just a Mere Metal. *Indian Journal of Clinical Biochemistry : IJCB*, *34*(4), 371–378. https://doi.org/10.1007/s12291-019-00839-8

Fitria, L., Desmaiani, H., Marcelina, M., Syafrianto, M. K., & Khairi, S. (2020). Status Mutu Air pada Lahan Gambut di Sungai Putat Kota Pontianak Kalimantan Barat. *Rekayasa*, *13*(1). https://doi.org/10.21107/rekayasa.v13i1.5920

Habibie, H., Nasrullah, N., & Barlian, S. (2013). Studi Penanggulangan Banjir Kabupaten Sambas Kal-bar (Studi Kasus Kecamatan Selakau). *Jurnal Mahasiswa Teknik Sipil Universitas Tanjungpura*, *2*(2).

Hernández-Cortez, C., Palma-Martínez, I., Gonzalez-Avila, L. U., Guerrero-Mandujano, A., & Castro-Escarpulli, R. C. S. and G. (2017). *Food Poisoning Caused by Bacteria (Food Toxins)* (N. Malangu (ed.); p. Ch. 3). IntechOpen. https://doi.org/10.5772/intechopen.69953

HZ, M., Amin, B., Jasril, J., & Siregar, S. H. (2018). Analisis Status Mutu Air Sungai Berdasarkan Metode STORET Sebagai Pengendalian Kualitas Lingkungan (Studi Kasus: Dua Aliran Sungai di Kecamatan Tembilahan Hulu, Kabupaten Indragiri Hilir, Riau).

Dinamika Lingkungan Indonesia, *5*(2). https://doi.org/10.31258/dli.5.2.p.84-96

Islam, M., Sarkar, M. K., Afrin, T., Rahman, S. S., Talukder, R., Howlader, B., & Khaleque, A. (2016). A Study on the Total Dissolved Solids and Hardness Level of Drinking Mineral Water in Bangladesh. *American Journal of Applied Chemistry*, *4*, 164–169. https://doi.org/10.11648/j.ajac.20160405.11

Ismanto, H., Herawati, H., & Nurhayati, N. (2021). Penyediaan Air Bersih untuk Masyarakat Tepian Sungai (Studi Kasus Desa Tanjung Bugis Kecamatan Sambas Kabupaten Sambas). *Jurnal TEKNIK-SIPIL*, *21*. https://doi.org/10.26418/jtsft.v21i2.59213

Jacobsen, E. K. (2004). Water filtration. *Journal of Chemical Education*, *81*(2), 224A.

Kuang, W., Chen, Z., Shi, K., Sun, H., Li, H., Huang, L., & Bi, J. (2020). Adverse health effects of lead exposure on physical growth, erythrocyte parameters and school performances for school-aged children in eastern China. *Environment International*, *145*, 106130.

Lemessa, F., Simane, B., Seyoum, A., & Gebresenbet, G. (2023). Assessment of the Impact of Industrial Wastewater on the Water Quality of Rivers around the Bole Lemi Industrial Park (BLIP), Ethiopia. In *Sustainability* (Vol. 15, Issue 5). https://doi.org/10.3390/su15054290

Lestari, D., Sari, Y., & Suharyanto, S. (2023). Status Kualitas Air DAS Sanggai di Kabupaten Penajam Paser Utara dan Perumusan Strategi Pencegahan serta Pengendalian Pencemaran Air. *Jurnal Ilmu Lingkungan*, *21*, 914–932. https://doi.org/10.14710/jil.21.4.914-932

Levin, R., Villanueva, C. M., Beene, D., Cradock, A. L., Donat-Vargas, C., Lewis, J., Martinez-Morata, I., Minovi, D., Nigra, A. E., Olson, E. D., Schaider, L. A., Ward, M. H., & Deziel, N. C. (2023). US drinking water quality: exposure risk profiles for seven legacy and emerging contaminants. *Journal of Exposure Science & Environmental Epidemiology*. https://doi.org/10.1038/s41370-023-00597-z

Lupa, L., & Cocheci, L. (2023). *Heavy Metals Removal from Water and Wastewater* (B. A. Almayyahi (ed.); p. Ch. 21). IntechOpen. https://doi.org/10.5772/intechopen.110228

Mitra, S., Chakraborty, A. J., Tareq, A. M., Emran, T. Bin, Nainu, F., Khusro, A., Idris, A. M., Khandaker, M. U., Osman, H., Alhumaydhi, F. A., & Simal-Gandara, J. (2022). Impact of heavy metals on the environment and human health: Novel therapeutic insights to counter the toxicity. *Journal of King Saud University - Science*, *34*(3), 101865. https://doi.org/https://doi.org/10.1016/j.jksus.2022.101865

Organization, W. H. (2004). *Guidelines for drinking-water quality* (Vol. 1). World Health Organization.

Pradeep, G. G., Sukumaran, K. P., George, G., Muhammad, F., & Mathew, N. (2016). Removal of dissolved solids in waste water using activated carbon from coconut shell. *Journal for Research*, *2*(07).

Putri, M., Hartati, S., & Satria, F. (2017). Kematian Massal Ikan dan Sebaran Parameter Kualitas Air di Teluk Jakarta. *BAWAL Widya Riset Perikanan Tangkap*, *8*, 77. https://doi.org/10.15578/bawal.8.2.2016.77-90

Senanu, L. D., Kranjac-Berisavljevic, G., & Cobbina, S. J. (2023). The use of local materials to remove heavy metals for household-scale drinking water treatment: A review. *Environmental Technology & Innovation*, *29*, 103005. https://doi.org/https://doi.org/10.1016/j.eti.2023.103005

Singh, A., Sharma, A., Verma, R. K., Chopade, R. L., Pandit, P. P., Nagar, V., Aseri, V., Choudhary, S. K., Awasthi, G., Awasthi, K. K., & Sankhla, M. S. (2022). *Heavy Metal Contamination of Water and Their Toxic Effect on Living Organisms* (D. J. Dorta & D. P. de Oliveira (eds.); p. Ch. 2). IntechOpen. https://doi.org/10.5772/intechopen.105075

Siswadi, hastiadi hasan; F. A. I. (2015). Analisis Kesesuaian Kualitas Airsungai Kecamatan Sambas Kabupaten Sambas untuk Budidaya Karamba Jaring Apung (Kja). *Jurnal Ruaya : Jurnal Penelitian Dan Kajian Ilmu Perikanan Dan Kelautan*, *Vol 6*, *No 2 (2015): Jurnal Ruaya : Jurnal Penelitian dan Kajian Ilmu Perikanan dan Kelautan*. https://openjurnal.unmuhpnk.ac.id/JR/article/view/2236/pdf

Sulistyarso, G. A. (2015). Optimasi Ketersediaan Air Baku Untuk Air Bersih Di Kabupaten Sambas. *Jurnal Teknik Sipil*.

Uchechi, A., Ify. L, N., & Onyewuchi, A. (2021). A Review on Current Trends in Heavy Metal Removal from Water between 2000-2021. *International Journal of Environment and Climate Change*, *11*(12 SE-Review Article), 67–90. https://doi.org/10.9734/ijecc/2021/v11i1230557

Wang, B. B. (2021). Research on drinking water purification technologies for household use by reducing total dissolved solids (TDS). *PloS One*, *16*(9), e0257865. https://doi.org/10.1371/journal.pone.0257865

Wang, S., Li, Q., Gao, Y., Zhou, Z., & Li, Z. (2021). Influences of lead exposure on its accumulation in organs, meat, eggs and bone during laying period of hens. *Poultry Science*, *100*(8), 101249. https://doi.org/10.1016/j.psj.2021.101249

Ward, M. H., Jones, R. R., Brender, J. D., de Kok, T. M., Weyer, P. J., Nolan, B. T., Villanueva, C. M., & van Breda, S. G. (2018). Drinking Water Nitrate and Human Health: An Updated Review. *International Journal of Environmental Research and Public Health*, *15*(7). https://doi.org/10.3390/ijerph15071557

Yang, X., Huang, G., An, C., Chen, X., Shen, J., Yin, J., Song, P., Xu, Z., & Li, Y. (2021). Removal of arsenic from water through ceramic filter modified by nano-CeO2: A cost-effective approach for remote areas. *Science of The Total Environment*, *750*, 141510. https://doi.org/https://doi.org/10.1016/j.scitotenv.2020.141510

Zamora-Ledezma, C., Negrete-Bolagay, D., Figueroa, F., Zamora-Ledezma, E., Ni, M., Alexis, F., & Guerrero, V. H. (2021). Heavy metal water pollution: A fresh look about hazards, novel and conventional remediation methods. *Environmental Technology & Innovation*, *22*, 101504. https://doi.org/https://doi.org/10.1016/j.eti.2021.101504