IOP Conference Series: Earth and Environmental Science

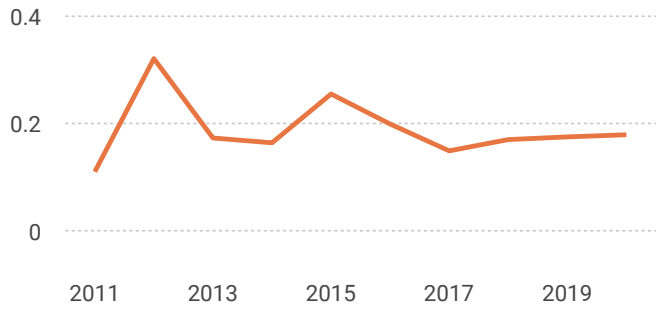
COUNTRY	SUBJECT AREA AND CATEGORY	PUBLISHER	H-INDEX
United Kingdom Universities and research institutions in United Kingdom	Earth and Planetary Sciences Earth and Planetary Sciences (miscellaneous) Environmental Science Environmental Science (miscellaneous)	IOP Publishing Ltd.	26

PUBLICATION TYPE	ISSN	COVERAGE	INFORMATION
Conferences and Proceedings	17551307, 17551315	2010-2020	Homepage How to publish in this journal ees@ioppublishing.org

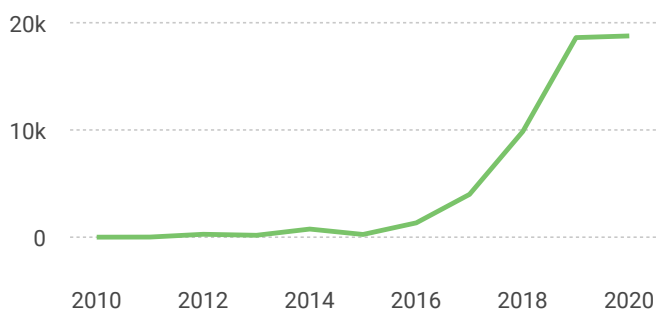
SCOPE

The open access IOP Conference Series: Earth and Environmental Science (EES) provides a fast, versatile and cost-effective proceedings publication service.

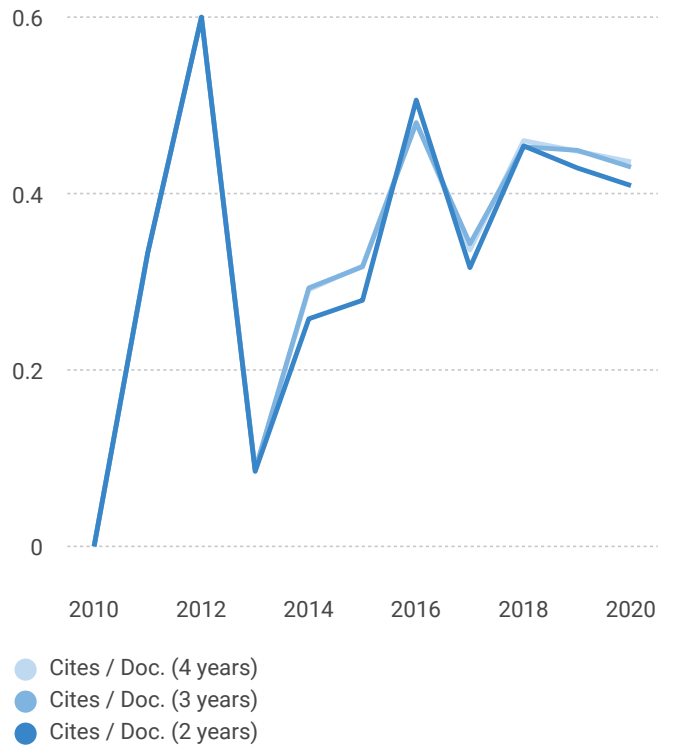
SJR



Total Documents

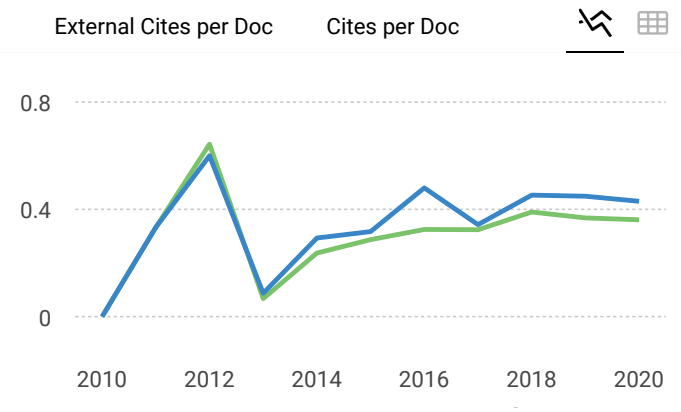


Citations per document



Total Cites Self-Cites

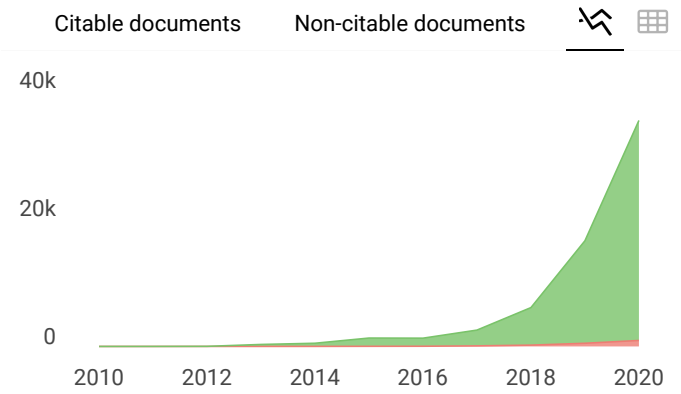
us® data as of April 2021



nental Science - Volume 708 is not available in Scopus.

SCImago Team

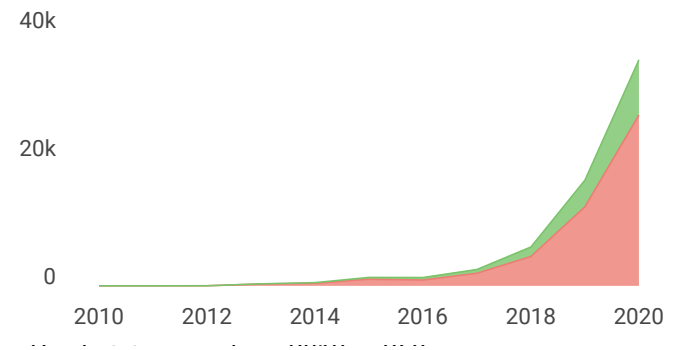
nent, unfortunately we cannot help you with your
copus support: https://service.elsevier.com
.w/scimago/supporthub/scopus/



r Q2 ?

SCImago Team

Melanie Ortiz 8 months ago



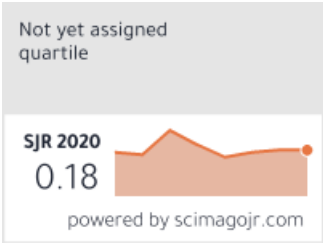
R data for all the publication's types, but the Quartile's
ls and Book Series.

F

IOP Conference Series: Earth and Environmental...

Show this widget in your own website

nental Science - Volume 573 is not available in Scopus.



← ν when will they publish in Scopus?

Just copy the code below and paste within your html code:

<a href="https://www.scim

SCImago Team

Melanie Ortiz 1 year ago

Dear Sir/Madam,
thank you very much for your comment, unfortunately we cannot help you with your request. We suggest you contact Scopus support: https://service.elsevier.com /app/answers/detail/a_id/14883/kw/scimago/supporthub/scopus/
Best Regards, SCImago Team

SCI

Explore, commun sense of **free tool**

Get it

N **Natt** 1 year ago

I would like to know the quartile of this journal. Why isn't it showing on the website?

reply

SCImago Team

Melanie Ortiz 1 year ago

Dear Natt,
Thank you for contacting us. We calculate the SJR data for all the publication's types, but the Quartile's data are only calculated for Journals and Book Series.
Best regards, SCImago Team

N **Nurgustaana** 2 years ago

Dear SCImago Team!
I want to know previous quartiles of journal (for 2018 and 2019 years). I have tried find information about a quartile, but discovered just SJR for 2018. Could you please provide information about it?
Yours sincerely, Nurgustaana

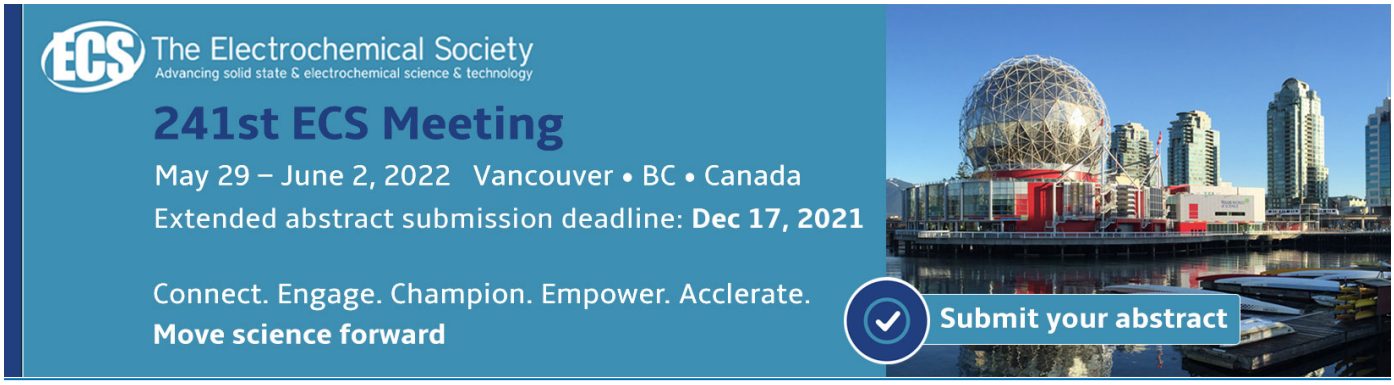
reply

SCImago Team

Melanie Ortiz 2 years ago

Dear Nurgustaana,

International Conference on Environmental Resources Management in Global Region



UNIVERSITAS GADJAH MADA
FACULTY OF GEOGRAPHY
DEPARTMENT OF ENVIRONMENTAL GEOGRAPHY
THE 2ND INTERNATIONAL CONFERENCE ON ENVIRONMENTAL RESOURCES MANAGEMENT IN GLOBAL REGION
Jalan Kaliurang, Skip Utara, Bulaksumur, Yogyakarta 55281
Email : icerm.geo@ugm.ac.id | Website : icerm.geo.ac.id | Contact Person : Mr. Nugroho Christanto (+62 811 2509 441)

LIST OF PARTICIPANT ICERM 2018

No	Nama
1	Sri Rum Giyarsih
2	Seri Aryati
3	Slamet Suprayogi
4	Eko Haryono
5	Andri Kurniawan
6	Sindu Nuranto
7	Suratman
8	Gianto
9	Nicky Setyawan
10	Mega Dharma Putra
11	Hartono
12	Rini Rachmawati
13	Winny Hafilia Permatasari
14	Kurniawan Andre Cahyono
15	Jooudie Luntungan
16	Rika Harini
17	Hapriadi Malik
18	Yudhi Utomo
19	Abdurrahman Azzam A
20	Muhammad Qodri Al Ghozali

UNIVERSITAS GADJAH MADA
FACULTY OF GEOGRAPHY
DEPARTMENT OF ENVIRONMENTAL GEOGRAPHY
THE 2ND INTERNATIONAL CONFERENCE ON ENVIRONMENTAL RESOURCES MANAGEMENT IN GLOBAL REGION
Jalan Kaliurang, Skip Utara, Bulaksumur, Yogyakarta 55281
Email : icerm.geo@ugm.ac.id | Website : icerm.geo.ac.id | Contact Person : Mr. Nugroho Christanto (+62 811 2509 441)

21	Alfi Wira Wijaya
22	Shinta Ira Damayanti
23	Laelina Rahmawati
24	Nur Rizki Fitri Hastari
25	Venny Vivid Fadhilah
26	Fitroh Amaniah
27	Aulia Nur F
28	Alpine Prima Priambada
29	Bagus Aditya
30	Rahma Aulia Zahra
31	Noverita Nur Hanifan
32	Adia Islami Permono
33	Intan Fatin Nurbaiti
34	Ramadhani Nurazizah
35	Azizatul Maghfiroh
36	Oki Silvie Wildayanti
37	Chafda Larasati
38	Francelina Permata Nusa
39	Noor Ulfati Fatimah
40	Ardyani Putri Wijaya
41	Aulia Ika Rahmawati
42	Fahkrunisa

UNIVERSITAS GADJAH MADA
FACULTY OF GEOGRAPHY
DEPARTMENT OF ENVIRONMENTAL GEOGRAPHY
THE 2ND INTERNATIONAL CONFERENCE ON ENVIRONMENTAL RESOURCES MANAGEMENT IN GLOBAL REGION
Jalan Kaliurang, Skip Utara, Bulaksumur, Yogyakarta 55281
Email : icerm.geo@ugm.ac.id | Website : icerm.geo.ac.id | Contact Person : Mr. Nugroho Christanto (+62 811 2509 441)

43	Tegar Dwi Pramanto
44	Sadewa Kusuma Negara
45	Dzakwan Taufiq N M
46	Taufik Budi Waskita
47	M Mawahibul F
48	Anugrah Jorgi F
49	Lis Sulastri
50	Puspasari Setyowati
51	Yuacinofa Mega D K
52	Tita Thalia Nurcahyani
53	Yofi Sabila Rosyida
54	Yossi Veronica D S
55	Mirna Ayi Setyaningrum
56	Natasha Michelle A
57	Wisha Puti M
58	Boma Karunia Dwi Putra
59	M Rifqy
60	Gita Oktaviani Fadila
61	Sofia Lutfiana
62	Elya Pratiwi Isti Faroh
63	Noranna Dwi S A
64	Narastravika Henardi Putri

UNIVERSITAS GADJAH MADA
FACULTY OF GEOGRAPHY
DEPARTMENT OF ENVIRONMENTAL GEOGRAPHY
THE 2ND INTERNATIONAL CONFERENCE ON ENVIRONMENTAL RESOURCES MANAGEMENT IN GLOBAL REGION
Jalan Kaliurang, Skip Utara, Bulaksumur, Yogyakarta 55281
Email : icerm.geo@ugm.ac.id | Website : icerm.geo.ac.id | Contact Person : Mr. Nugroho Christanto (+62 811 2509 441)

65	Bernadetta Indri D A
66	Gema Reinadova J R
67	Muh Galih Prakosa
68	Mulyadi Alwi
69	Muhammad Riza Baihaqi
70	Agung Laksono
71	Alfin F H
72	Lalang Bayu F
73	Kurniasari
74	Esya Rachma N
75	Muhammad Rafif
76	Akbar Abdul Rokhim
77	Rizky Laudiansyah
78	Naufal Fattan
79	Mega Rakhmantika
80	Adita W N
81	Muhammad Rizal Saputra
82	Ariel Seto Adinugraha
83	Hestina Fardani
84	Nadya A H
85	Emy Puspita Y
86	Iqbal Nugraha

UNIVERSITAS GADJAH MADA
FACULTY OF GEOGRAPHY
DEPARTMENT OF ENVIRONMENTAL GEOGRAPHY
THE 2ND INTERNATIONAL CONFERENCE ON ENVIRONMENTAL RESOURCES MANAGEMENT IN GLOBAL REGION
Jalan Kaliurang, Skip Utara, Bulaksumur, Yogyakarta 55281
Email : icerm.geo@ugm.ac.id | Website : icerm.geo.ac.id | Contact Person : Mr. Nugroho Christanto (+62 811 2509 441)

87	Novia Ismayuni
88	Yohanes Melky Masjoyo
89	M Rizal Saputra
90	Afifah Winda K
91	Eni Paryani
92	Edwin Suryo Prayogo
93	Yolla Yulianda
94	Tiara Bintanika
95	Farah Pasha Salsabila
96	Tiara Putri Amalia
97	Kartika Ayu W
98	Wahyu Karisma Sari
99	Rahma Hardinasari
100	Angga Prasetya N
101	Ulil Isnaini
102	Novanda Nurul
103	M Ridho
104	Yolanda F A
105	Rifa'i
106	Rizka Widyantari
107	Rifqiya Nur Aisyah
108	Rivo Maulana

UNIVERSITAS GADJAH MADA
FACULTY OF GEOGRAPHY
DEPARTMENT OF ENVIRONMENTAL GEOGRAPHY
THE 2ND INTERNATIONAL CONFERENCE ON ENVIRONMENTAL RESOURCES MANAGEMENT IN GLOBAL REGION
Jalan Kaliurang, Skip Utara, Bulaksumur, Yogyakarta 55281
Email : icerm.geo@ugm.ac.id | Website : icerm.geo.ac.id | Contact Person : Mr. Nugroho Christanto (+62 811 2509 441)

109	Sufia Nur Ahadiah
110	Risma Sari S
111	Salma Hayyu
112	Luthfiya Hanim
113	Ikhwan Amri
114	Retno Murti
115	M Azhar
116	Kholifah F
117	Monita Deka
118	Lutfi Ardianti
119	Isna Aulia
120	Kurniawati
121	M Awanda Pratama
122	Lisa Anissa
123	Danung Shodikh
124	Arina K
125	Annisa Dzikra
126	Evi Setianingsih
127	Irma Yuliana
128	Heni Dwi L
129	Dwike Ariestantya
130	M. Yusup

131	I Gusti Putu Dwi Awatara
132	Tri Suyud M
133	Ambar Teguh S
134	A R Ade Yudono
135	Prabang Setyono
136	Eni Muryani
137	Dina Asrifah
138	Sapto Hariyanto

Peer review statement

To cite this article: 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **256** 011003

Peer review statement

All papers published in this volume of *IOP Conference Series: Earth and Environmental Science* have been peer reviewed through processes administered by the proceedings Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

OPEN ACCESS 012050

The Impact of Population Pressure on Agricultural Land towards Food Sufficiency (Case in West Kalimantan Province, Indonesia)

R F Putri, M Naufal, M Nandini, D S Dwiputra, S Wibirama and J T S Sumantyo

+ Open abstract View article PDF

OPEN ACCESS 012051

Detection of Cropland Salinization with Vegetation Index In Various Coastal Condition

T A Tivianton and R Kurnia

+ Open abstract View article PDF

OPEN ACCESS 012052

Environmental and Social Sustainability: The role of Forest as the most influential ecosystem

Rina Laksmi Hendrati

+ Open abstract View article PDF

JOURNAL LINKS

Journal home

Journal scope

Information for organizers

Information for authors

Contact us

Reprint services from Curran Associates

PAPER • OPEN ACCESS

Characteristic of water quality in upstream of Bolango River basin in Gorontalo Province

M Mahmud[1], F Lihawa[2] and B Labdul[1]

IOP Conference Series: Earth and Environmental Science, Volume 256, The 2nd International Conference on Environmental Resources Management in Global Region (ICERM 2018) 22–23 October 2018, Yogyakarta, Indonesia

Citation M Mahmud *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **256** 012045

marikemahmud@yahoo.com

[1] Faculty of Engineering, Gorontalo State University, Gorontalo City, Indonesia

[2] Center for Environmental and Population Studies, Gorontalo State University, Gorontalo City, Indonesia

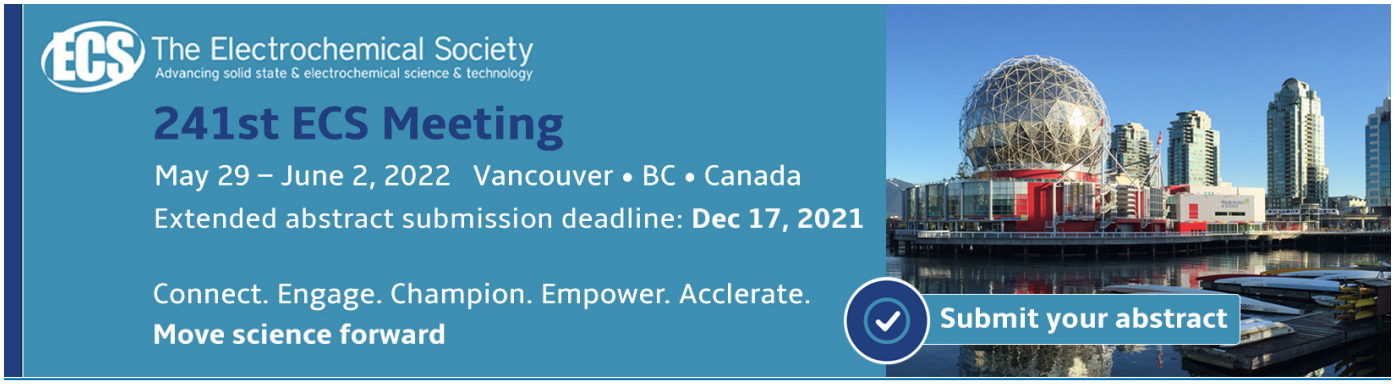
https://doi.org/10.1088/1755-1315/256/1/012045

Abstract

This study aims to find out the characteristics of water quality in the upstream of Bolango River Basin so that it can be utilized by Gorontalo people. The study took place in the upstream of Bolango River Basin of Gorontalo Province. River water samples were taken at five points, namely upstream of Bolango River, Bolango at Bunuo Village, upstream of Mongiilo River, middle part of Mongiilo River and estuary of Mongiilo River. Groundwater samples were taken from one location as a control, namely Kopi Village, in Bone Bolango Regency, Gorontalo Province. Water quality was analyzed at the Research Center and Industry Standardization Laboratory of Manado. The examined parameters consisted of physical, chemical and biological aspects. Criteria for the characteristics of river water quality referred to the Government Regulation Number 82 of 2001 Class II and Water Pollution Index referred to the Decision of Minister of Environment Number 115 of 2003. Groundwater quality referred to the Regulation of Minister of Health Number 32 of 2017. Data were analyzed using tables and graphs and then interpreted. The study results showed that the analysis of surface water quality for the upstream Bolango River and Bolango River (Bunuo Village) met the requirements of Government Regulation Number 82 of 2001 Class II, except the BOD parameters. Based on Government Regulation 82 of 2001, BOD parameter should not exceed 3 mg/l. The results of the analysis indicated that the BOD concentration in the 5 rivers ranged between 3.5 - 8 mg/L. COD parameter ranged between 17-32 mg/l. It tended to be above the established quality standard. Based on the results, all river water in the Upstream of Bolango Watershed was contaminated by organic materials. Water was evaluated using Water pollution index method in accordance with the Decision of Minister of Environment Number 115 of 2003 so that the water quality of the upstream of Bolango River was in good condition. The water of Bolango River (Bunuo Village), upstream of Mongiilo River, middle part of Mongiilo River, and estuary of Mongiilo River was lightly polluted. The characteristics of shallow groundwater met the requirements of the quality standard stipulated by the

Regulation of Minister of Health Number 32 of 2017.

Characteristic of water quality in upstream of Bolango River basin in Gorontalo Province



IOP Conf. Series: Earth and Environmental Science **256** (2019) 012045 doi:10.1088/1755-1315/256/1/012045

Characteristic of water quality in upstream of Bolango River basin in Gorontalo Province

M Mahmud[1], F Lihawa[2], and B Labdul[1]

[1]Faculty of Engineering, Gorontalo State University, Gorontalo City, Indonesia
[2]Center for Environmental and Population Studies, Gorontalo State University, Gorontalo City, Indonesia

marikemahmud@yahoo.com

Abstract. This study aims to find out the characteristics of water quality in the upstream of Bolango River Basin so that it can be utilized by Gorontalo people. The study took place in the upstream of Bolango River Basin of Gorontalo Province. River water samples were taken at five points, namely upstream of Bolango River, Bolango at Bunuo Village, upstream of Mongiilo River, middle part of Mongiilo River and estuary of Mongiilo River. Groundwater samples were taken from one location as a control, namely Kopi Village, in Bone Bolango Regency, Gorontalo Province. Water quality was analyzed at the Research Center and Industry Standardization Laboratory of Manado. The examined parameters of consisted of physical, chemical and biological aspects. Criteria for the characteristics of river water quality referred to the Government Regulation Number 82 of 2001 Class II and Water Pollution Index referred to the Decision of Minister of Environment Number 115 of 2003. Groundwater quality referred to the Regulation of Minister of Health Number 32 of 2017. Data were analyzed using tables and graphs and then interpreted. The study results showed that the analysis of surface water quality for the upstream Bolango River and Bolango River (Bunuo Village) met the requirements of Government Regulation Number 82 of 2001 Class II, except the BOD parameters. Based on Government Regulation 82 of 2001, BOD parameter should not exceed 3 mg/l. The results of the analysis indicated that the BOD concentration in the 5 rivers ranged between 3.5 - 8 mg/L. COD parameter ranged between 17-32 mg/l. It tended to be above the established quality standard. Based on the results, all river water in the Upstream of Bolango Watershed was contaminated by organic materials. Water was evaluated using Water pollution index method in accordance with the Decision of Minister of Environment Number 115 of 2003, so that the water quality of the upstream of Bolango River was in good condition. The water of Bolango River (Bunuo Village), upstream of Mongiilo River, middle part of Mongiilo River, and estuary of Mongiilo River was lightly polluted. The characteristics of shallow groundwater met the requirements of the quality standard stipulated by the Regulation of Minister of Health Number 32 of 2017.

1. Introduction

Bolango River ecosystem is located in Bone Bolango Regency, Gorontalo Province. Bone Bolango Regency is crossed by several river basins, one of which is Bolango River basin. Bolango River is one of the rivers that cross Bone Bolango Regency and Gorontalo City. This study was conducted on rivers in the upstream of Bolang River Basin. The rivers as samples were rivers that cross two sub

districts, namely BulangoUluSub district and Bulango Utara Sub district. Bolango River plays a strategic role as a source of irrigation water in Gorontalo City and most of the people live there depending on Bolango River. Many community activities use this river water for drinking water, fish farming and water resource for the domestic needs of the community.

Water is very important for life. No living creatures can live without water. Therefore, it is necessary to preserve water from pollutants that can endanger living creatures. Water quality needs to be evaluated because Bolango River is widely used by the community as a source of drinking, and irrigation water to irrigate crops and plantations and for fisheries. Water quality monitoring aims to identify pollutant, causes of changes between ecological variable, and condition of certainplace in general [1].

Water is a good solvent for various types of chemicals. Containing chemical compounds, rainwater can dissolve nutrients. It also washes pollutants well. If the conditions of the area on which water passes are very dirty, this dirt will be carried by rainwater into the river. This will certainly increase the level of water pollution. A research shows that the quality of water existing around Limboto Lake and the surrounding rivers has been polluted [2]. Problems in water resources management are very complex, including discharge fluctuations in the dry and rainy seasons, damage to land in the catchment area, erosion and sedimentation, increase in waste entering the river and restorability of rivers [3]. If these problems are not solved, the adequate availability and quality of water in all places will be increasingly difficult and expensive. The main problem in this area is, among others, high level of erosion [4]. Land degradation and frequent flooding in BulangoUluSub district can change the quality of river water, both Bolango River and Mongiilo River. This will disturb the Gorontalo people as consumers of water. A high level of erosion will affect the height of solids suspended in the river. In addition, many people live along the Bolango River which will also increase the level of water pollution.

According to Government Regulation Number 38 of 2011, there are several things that must be taken into consideration in managing rivers, one of which is river border. River border is a space on the left and right of the riverbed between the border line and the edge of bed and river embankment with a distance of 3m from the outer edge of the embankment foot. In order to protect the river and prevent river pollution, the use of river bounder need to be restricted. The government has regulated that it is not allowed to be planted with plants other than grass and not allowed to be planted [5]. In reality, many people live along the river and do their daily activities. The water quality needs to be evaluated. This study aims to identify the characteristics of water quality in the upstream of Bolango River Basin so that it can be utilized by Gorontalocitizen.

2. Research methods

The study was conducted in the upstream of Bolango River basin of Gorontalo Province. River water samples were taken at five locationswhich areupstream of Bulango River, Bolango River in Bunuo Village, middle part of Mongiilo River, Mongiilo River and estuaryofMongiilo River. Groundwater samples were taken in onelocation as a control, namely Kopi Village, Bone Bolango Regency, Gorontalo Province as shown in Figure 1.

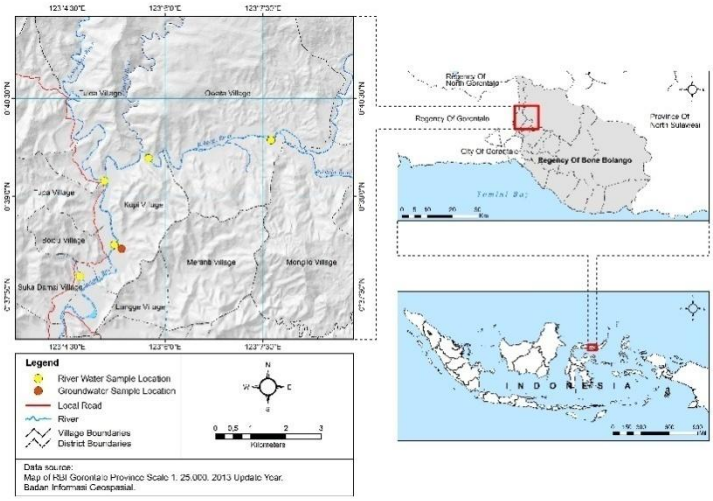


Figure 1. Map of sampling location.

Water samples were taken using water sampler. Physical measurements were done in situ. The tools used to measure included: DO Meter, Thermometer andTDS Meter. Chemical measurements were conducted in the laboratory.Water quality was analyzed at the Research Center and Industry Standardization Laboratory of Manado. Chemical parameters were analyzed using Atomic Absorption Spectrophotometer (AAS) and microbiological parameters were measured using the MPN method. The examined parameters consisted physical, chemical and biological aspects. Physical parameters included: temperature, TDS, TSS and Turbidity. Chemical parameters included: pH, COD, BOD, DO, Total Phosphate as P, nitrite, nitrate, ammoniac, arsenic, barium, boron, selenium, cadmium, chromium (VI), copper, iron, lead, manganese, zinc, chloride, cyanide, fluoride, sulphate, free chlorine, sulphur as H_2S, oil and fat, detergents and phenol compounds as phenols. The measured microbiological parameter was total Coliforms.

Criteria for the characteristics of river water quality referred to the Government Regulation Number 82 of 2001 Class II and Water Pollution Index Method referred to the Decision of Minister of Environment Number 115 of 2003. Groundwater quality referred to the Regulation of Minister of Health Number 32 of 2017. The water quality data obtained from the laboratory wereanalyzed descriptively by using tables and graphs, compared by water quality standard criteria , and interpreted. The status of water quality pollution level was calculated using the water pollutions index method, analyzed by comparing it with the water pollution index criteria and shown in the table and interpreted.

The Surface Water Quality Scale was calculated on five rivers and one shallow groundwater. The calculation of pollutant index in the upstream of Bolango River, Bolango River (Bunuo Village), the upstream of Mongiilo River, the middle part of Mongiilo River and estuary of Mongiilo River used the Water Pollution Index Method based on the Decision of Minister of Environment Number 115 of 2003. The initial step of the calculation commenced with calculating the Ci / lij value per parameter for parameters that did not have a range and the lower the parameter value, the better the quality of water. Lij indicates the parameter concentration included in the quality standard according to the designation (j). The Ci value indicates the parameter concentration of water quality (i) which was obtained from the results of the analysis of water samples at a sampling location. Water pollution index for designation (j) is a function of Ci / Lij. The values of water pollution index were calculated using the formula:

$$PI = \sqrt{\frac{(\frac{Ci}{Lix})_M^2 + (\frac{Ci}{Lix})_R^2}{2}} \quad (1)$$

For decreasing parameters which indicates that the level of pollution is increasing, such as DO, the Ci / Lij value of the measurement results is replaced by the value of Ci / Lij from the calculation result:

$$DO = \frac{C_{im} - C_i\ (hasil\ ukur\ )}{C_{im} - L_{ij}} \quad (2)$$

whereC_{im} is saturated DO value.

If the quality standard has a range such as pH: If Ci ≤ Lij then:

$$pH = \frac{C_i - L_{ij}\ (rata - rata\ )}{L_{ij}\ (min\ ) - L_{ij}\ (rata - rata\ )} \quad (3)$$

If Ci≥ Lijthen :

$$pH = \frac{C_i - L_{ij}\ (rata - rata\ )}{L_{ij}\ (max\ ) - L_{ij}\ (rata - rata} \quad (4)$$

If the value of Ci / Lij is greater 1, the new Ci / Lij value is measured using the formula:

$$New\ Ci/Lij\ baru\ =\ 1.0\ +\ P\ log\ (Ci/Lij)\ of\ measurement\ result \quad (5)$$

The final step is to determine the average value and maximum value of the overall Ci / Lij values as in Table 3 and enter them in the formula:

$$PI = \sqrt{\frac{(\frac{Ci}{Lix})_M^2\ +\ (\frac{Ci}{Lix})_R^2}{2}} \quad (6)$$

PI values are as follows:

0≤ PI ≤ 1.0 >	meets quality standards (good condition)
1 ≤ PI ≤ 5.0	lightly polluted
5.0 <PI <10	medium polluted
PI> 10	heavily polluted

3. Result andDiscussion

3.1. Condition of surface water quality

The surface water quality was taken at fivelocations (Figure 1): upstream of Bolango River, Bolango River (Bunuo Village), middle part of Mongiilo River, upstream of Mongiilo River and estuary of Mongiilo River. The results of surface water quality analysis are shown in Table 1.

Table 1. Results of surface water quality analysis

No	Parameter	Unit	Quality standards	Analysis Results					Note
				River I	River II	River III	River IV	River V	
				PHYSICAL					
1	Temperature	°C	Deviation 3	27.1	26.8	27.2	27.2	27.42	MS
2	TDS	mg/l	1000	85	120	200	180	165	MS
3	TSS	mg/l	50	7	5	10	6	3	MS
4	Turbidity	NTU	-	0.9	0.8	2.09	1.6	1.9	MS
				CHEMICAL					
5	pH	-	6 - 9	7.2	7.3	7	6.9	7.3	MS
6	BOD	mg/l	3	3.5	4	8	5	8	TMS
7	COD	mg/l	25	17	18	24	32	17	TMS
8	DO	mg/l	4	7.3	7.3	7.1	7.1	6.9	MS
9	Total Phosphate as P	mg/l	0.2	0.02	0.03	0.05	0.04	0.04	MS
10	NO_3 as N	mg/l	10	2.26	2.15	2.13	2.15	2.45	MS
11	NH_3.N	mg/l	(-)	0.24	0.23	0.3	0.2	0.3	MS
12	Arsenic (As)	mg/l	1	0.0001	0.0001	0.0005	0.0004	0.0002	MS
13	Barium (Ba)	mg/l	(-)	<0.0002	<0.0002	<0.0003	<0.0002	<0.0001	MS
14	Boron (B)	mg/l	1	0.1	0.1	0.2	0.2	0.2	MS
15	Selenium (Se)	mg/l	0.05	0.001	0.001	0.001	0.001	0.001	MS
16	Cadmium (Cd)	mg/l	0.01	0.004	0.003	0.005	0.004	0.0035	MS
17	Chromium (VI)	mg/l	0.05	0.00	0.00	0.00	0.00	0.00	MS
18	Copper (Cu)	mg/l	0.02	0.0032	0.002	0.003	0.004	0.003	MS
19	Iron (Fe)	mg/l	(-)	0.018	0.02	0.1	0.1	0.1	MS
20	Lead (Pb)	mg/l	0.03	0.01	0.01	0.01	0.01	0.01	MS
21	Manganese (Mn)	mg/l	(-)	0.021	0.01	0.01	0.02	0.01	MS
22	Mercury (Hg)	mg/l	0.002	<0.00012	<0.000113	<0.0004312	<0.000383	<0.0004324	MS
23	Zinc (Zn)	mg/l	0.05	<0.0017	<0.0016	<0.0018	<0.0016	<0.0012	MS
24	Chloride (Cl)	mg/l	(-)	41	43	67	61	62	MS
25	Cyanide (Cn)	mg/l	0.02	0.00	0.00	0.00	0.00	0.00	MS
26	Fluoride (F)	mg/l	1.5	0.02	0.02	0.02	0.02	0.03	MS
27	Nitrite as N	mg/l	0.06	0.02	0.02	0.03	0.035	0.02	MS
28	Sulphate (SO_4)	mg/l	(-)	16.51	17.48	18.35	16.41	17.23	MS
29	Free Chlorine (Cl_2)	mg/l	0.03	0.00	0.00	0.00	0.00	0.00	MS
30	Sulphur as H_2S	mg/l	0.002	0.00	0.00	0.00	0.00	0.00	MS
				MICROBIOLOGICAL					
31	Total Coliforms	Total/100 ml	5000	360	340	290	300	380	MS
				ORGANIC CHEMICAL					
32	Oil and fat	ug/l	1000	17	15	60	40	32	MS
33	Detergent	ug/l	200	35.6	32.4	58.7	34.7	43.4	MS
34	Phenol compounds as phenols	ug/l	1	0.00	0.00	0.00	0.00	0.00	MS

Source: Primary Data of 2017
Note:
River I = Upstream of Bolango River; II = Bolango River of Bunuo Village; River III = Upstream of Mongiilo River; River River IV = Middle part of MongiiloRiver ;River V = Estuary of Mongiilo River

The results of surface water quality analysis for river water show that the water quality meets the requirements of Government Regulation Number 82 of 2001 Class II, except BOD parameter. Based on Government Regulation Number 82 of 2001, BOD parameter should not exceed 3 mg/l. The results of the analysis show that the BOD concentration in the 5 rivers ranged between 3.5 - 8 mg/l. Based on these results, the ecosystem water of Bolango River upstream contains organic materials. The presence of organic materials can be resulted from domestic waste of the community along the river. In natural waters, decay of plants acts as a source of organic materials. Natural waters have the BOD value between 0.5 - 7.0 mg/l [1, 6]. Natural waters having BOD values of more than 10 mg/l are considered to have been polluted [1]. The results of chemical analysis for the upstream of Bolango River basin are still low compared to the study that the water quality of the Winongo River has been highly polluted [5]. Some parameters in Winongo River such as BOD, COD, Nitrate, Detergent, Phenol and coliforms are above the quality standard. There are characteristic differences between Winongo River and rivers in the upstream of Bolango River ecosystem. The level of pollution of Bolango River is low because

the number of people living in the upstream of river basin is still lower than those in Winongo River border. Although people living in the upstream of Bolango River Basin defecate along Bolango River and Mongiilo River, the coliform parameter is still below the established quality standard.

The results of the analysis on the Upstream of Mongiilo River, middle part of Mongiilo River and Estuary of Mongiilo River showed that the physical, chemical and organic and microbiological parameters were below the water quality standards based on the Government Regulation Number 82 of 2001 Class II. Organic parameters such as BOD and for the 3 rivers ranged between 5-8 mg/l, which was above the required quality standards, i.e. not exceeding 3 mg/l. The COD parameter in the middle part ofMongiilo River was above the quality standard, i.e. 32 mg/l. The quality standard requirement for COD is 25 mg/l. This shows that the water quality of the middle part of Mongiilo River has been contaminated with organic materials. The presence of organic material can be due to the domestic waste of the community or due to the decay of plants which were dead and entering into the river. A study showed that Krueng Cut waters had COD values ranging between 10.25 - 18.82 which is lower than the COD concentration in the ecosystem of Bolango River (between 17 - 32 mg/l)[7]. Similarly, the BOD parameter in Krueng Cut River ranged between 2 - 5.6 mg/l, lower than the water quality in the Bolango River in which the BOD ranged between 3.5 to 8 mg/l. The government should pay a great deal of attention to such water quality, so that pollution will not increase along the river and shallow groundwater. Research showed that if not observed, the quality of groundwater will deteriorate [8]. Poor water quality may cause waterborne diseases such as diarrhea, cholera and typhoid, etc.

Organic materials can take the form of carbohydrates, oils, fats and waxes, proteins, amino acids, detergents, soaps and pesticides. BOD only describes organic material that can be decomposed biologically (biodegradable). Organic materials are the result of decay of relatively dead plants and animals or the result of waste from domestic and industrial waste. The BOD value of waters is affected by temperature, plankton density, presence of microbes, and types and concentration of organic materials [1]. The contamination of organic materials can be indicated by the high parameters of BOD and COD as shown in Figure 2.

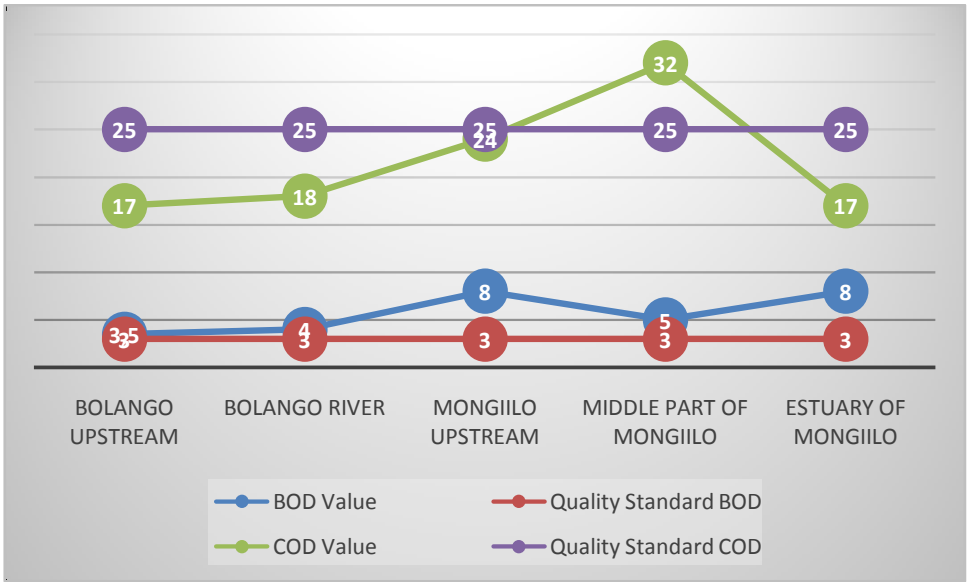


Figure 2. Results of BOD and COD Parameter Analysis.

The results of the COD analysis show the total amount of oxygen required to chemically oxidize organic materials, both which can be degraded biologically and which are difficult to be degraded

biologically. The existence of organic material can come from nature or from household and industrial activities. The COD values in unpolluted waters are usually less than 20 mg/l [1].

The results of the analysis of physical parameters indicated that temperature, turbidity, TDS and TSS still met the specified quality standard requirements. TSS parameter ranged between 3-10 mg/l, which was below the quality standard set at 50 mg/l. This shows that the upstream of Bolango River ecosystem is still in natural conditions; there is no erosion that can increase TSS. This is strengthened by the values of low turbidity ranging between 0.8 - 2.09 mg/l. Suspended solids are positively correlated with turbidity. The higher the value of suspended solids resulted in higher value of turbidity [1]. Other chemical parameters such as phosphate as P, nitrite, nitrate, ammonia, arsenic, barium, boron, selenium, cadmium, chromium (VI), copper, iron, lead, manganese, zinc, chloride, cyanide, fluoride, sulphate, free chlorine, Sulphur as H_2S, Oil and fat, detergent and phenol compounds as phenols still met the specified quality standards. Chemical and organic parameters such as cadmium, arsenic, selenium, boron, copper, lead, mercury, zinc and fluoride, although they could be detected, were still in natural conditions because river water flowed through such minerals. There was no factory activity that could increase these chemicals in water. The low inorganic parameters were also characterized by low values of TDS ranging between 85-200 mg/l, which was below the standard set at 1000 mg/l. Other organic chemical parameters such as detergents, oils and fats were detected in water because people threw domestic waste at Bolango River. They were detected but still below the standard set. Nitrate parameters ranged from 2.13 to 2.45 mg/l and phosphate was detected ranging between 0.02 - 0.05 mg/l. The results of nitrate analysis tended to be the consistent where nitrates in Karangsong waters ranged between 0.4148- 2.4541 mg/l , and phosphate parameters ranged between 0.2253-0.6261 mg/l higher than those in the upperstream of Bulango River [9]. The presence of nitrates and phosphates in both waters is due to human activity. Coastal Karangsong Waters are influenced by household activities, industry, fishponds, ship traffic, and mangrove vegetation. The upstream of Bolango River is affected by household activities and people plantations. This happen because they grow crops using NPK fertilizer to fertilize plants. Fertilizers can seep into the soil and when the rain comes, the remains of the use of fertilizer can be carried away by runoff and goes into the BolangoRiver. People also use Bolango River as public toilets. This can be detected from total coli bacteria in the river. Although it is still below the quality standard, the increase in pollution along with the increase in population should put on the alert. Socialization should be given to the community so that they change their behaviour regarding the importance of environmental sanitation. A research conducted shows that the factor of lack of extension and socialization from the local government related to river water management causes low awareness and understanding of the people living in the area of KarangAnyar River banks related to river water management [10]. Low levels of education contribute to a lack of awareness of the importance of river water.

3.2. Quality of shallow groundwater

The analysis results of the quality of shallow groundwater taken from the well water of residents living in Kopi Village are shown in Table 2.

Table 2. Results of shallow groundwater analysis in residential areaof Kopi Village.

No	Parameter	Unit	Quality standards	Analysis Results	Note
a	**CHEMICAL**				
1	Arsenic	mg/l	0.05	0.001	MS
2	Fluoride	mg/l	1.5	0.00	MS
3	Chromium, Valence 6	mg/l	0.05	0.00	MS
4	Cadmium	mg/l	0.005	0.001	MS
5	Nitrite (as N)	mg/l	1	0.01	MS
6	Nitrate (N)	mg/l	10	2.02	MS
7	Cyanide	mg/l	0.1	0.00	MS
8	Mercury	mg/l	0.001	<0.000431	MS
9	Iron	mg/l	1	0.12	MS
10	Hardness (CaCO3)	mg/l	500	234.34	MS
11	Chloride	mg/l	(-)	113.44	MS
12	Manganese	mg/l	0.5	0.01	MS
13	pH	-	6.5 – 8.5	6.8	MS
14	Zinc	mg/l	15	0.04	MS
15	Sulphate	mg/l	400	24.79	MS
16	Lead	mg/l	0.05	0.01	MS
17	Selenium	mg/l	0.01	0.0003	MS
b	**PHYSICAL**				
1	Smell	-		Odourless	MS
2	Colour	TCU Scale	50	9.8	MS
3	Taste	-	-	Tasteless	MS
4	TDS	mg/l	1000	350	MS
5	Turbidity	NTU Scale	25	0.05	MS
6	Temperature	^{o}C	^{o}C	28.0	MS
c	**ORGANIC CHEMICAL**				
	Organic substances ($KMnO_4$)	mg/l	10	0.92	MS
	Detergent (Surfactant)	mg/l	0.05	0.01	MS
d	**MICROBIOLOGICAL**				
	Total Coliforms (MPN)	Total/100 ml	50	49	MS

Quality standard: Regulation of Minister of Health Number 32 of 2017
Note: Well 1 = Well water of Kopi Village
Source: Primary Data: 2017

Based on the analysis results as shown in Table 2, shallow groundwater met the requirements of the quality standards set by the Regulation of Minister of Health Number 32 of 2017. The Regulation of Minister of Health Number 32 of 2017 concerns environmental health quality standards for water media for sanitation and hygiene purposes. According to this Regulation, water for sanitation purpose is water that can be used for maintaining personal hygiene such as bathing and toothbrushes and for washing food, utensils and clothing. In addition, it can be used as raw water for drinking water. Based on the laboratory analysis, the quality of shallow groundwater in the study site was suitable for use as community sanitation water. The analysis results of groundwater in Kopi Village showed that the hardness value was 234.34 mg/l. This result was quite high although it was still below the established quality standard. The microbiological parameter was 49 MPN, which was close to the quality standard set at 50 MPN. Although it was still below the quality standard, it had to be controlled. One of the factors that affect the presence of total coliforms bacteria is due to contamination from the surrounding conditions and the presence of water seepage from bathrooms and toilets. A research conducted by Mahmud et al on shallow groundwater in Gorontalo City showed that the coliforms parameter ranged between 150 - 1100 MPN [11]. The high level of coliforms in this area was because the distance

between toilets and wells was very close due to the high population in urban areas. Differences could occur because the location of groundwater extraction was not the same. In this study, samples were taken from the Upstream of Bolango Rivers basin, while the research conducted by Mahmud et al was conducted in the Estuary of Bolango River basin, which is categorized as an urban area [11]. Supervision of shallow ground water is very important. The higher the level of coliform bacteria contamination resulted inhigher risk of the presence of other pathogenic bacteria that normally live in animal faeces. Pollution of coliforms bacteria not only occurs in shallow ground water, but also in refill water depot if using unclean water sources. Research indicated that refill water at depots in Manado City was contaminated with coliforms [12]. This shows a lack of supervision of drinking water in society.

3.3. *Surface water pollution index*

The results of the calculation of the Ci/Lijvalue for the upstream of Bolango River are shown in Table 3.

Table 3. Water Pollution Index Scale of upstream Bolango River.

No	**Physical**	**Li**	**Ci**	**Ci/Lij**
1	TDS	1000	85	0.085
2	TSS	50	7	0.14
	Chemical			
3	pH	6 – 9	7.2	0.133
4	BOD	3	3.5	1.34
5	COD	25	17	0.68
6	DO	4	7.3	0.169
7	Total Phosphate	0.2	0.02	0.1
8	NO3 as N	10	2.26	0.226
9	Arsenic (As)	1	0.0001	0.0001
10	Boron (B)	1	0.1	0.1
11	Selenium (Se)	0.05	0.001	0.02
12	Cadmium (Cd)	0.01	0.004	0.4
13	Chromium (VI)	0.05	0.00	0
14	Copper (Cu)	0.02	0.0032	0.16
15	Lead (Pb)	0.03	0.01	0.333
16	Mercury (Hg)	0.002	<0.00012	0.06
17	Zinc (Zn)	0.05	<0.0017	0.034
18	Cyanide (Cn)	0.02	0.00	0
19	Fluoride (F)	1.5	0.02	0.013
20	Nitrite as N	0.06	0.02	0.333
21	Free Chlorine (Cl_2)	0.03	0.00	0
22	Sulphur as H_2S	0.002	0.00	0
	Microbiological			
23	Total Coliforms	5000	360	0.072
	Organic chemical			
24	Oil and fat	1000	17	0.017
25	Detergent	200	35.6	0.178
26	Phenol compounds as phenols	1	0.00	0
			Average	4.593/26=0.177

For the pH value, then: the Ci<Lij (average) was calculated as follows:

$$pH = \frac{C_i - L_{ij}\,(rata - rata)}{L_{ij}\,(min) - L_{ij}\,(rata - rata)} \quad (7)$$

$$pH = \frac{7.2 - 7.5}{6.0 - 7.5} = \frac{-0.3}{-1.5} = 0.2 \quad (8)$$

The result of calculating DO value was:

$$DO = \frac{C_{im} - C_i(hasil\ ukur)}{C_{im} - L_{ij}} \quad (9)$$

$$DO = \frac{7.97 - 7.3)}{7.97 - 4} = \frac{0.67}{3.97} = 0.169 \quad (10)$$

BOD parameter value = 1.17. In accordance with the provisions if the parameter value exceeds 1, the BOD value of 1.17 was calculated using the formula:

$$1.0 + P\ Log\ (1.17) = 1.0 + 5\ log\ (1.17) = 1.34. \quad (12)$$

The new BOD value was 1.34.

The DO values saturated at a temperature of 27^{o}C is 7.97 [13]

The results of the pollution index calculation are as follows:

Value (Ci/L_{ix}) R = 0.177

Value (Ci/L_{ix}) M = 1.34

Pollution Index Value:

$$PI = \sqrt{\frac{1.34^2 + 0.177^2}{2}} = 0.955 \quad (11)$$

Based on the evaluation, the PI value of Bolango River upstream was 0.955. Based on these results, the water quality of Bolango River upstream met the quality standards (good condition). The recapitulation of the results of the five rivers and shallow groundwater is shown in Table 4

Table 4. Water Quality Index Scale of BolangoRiver.

No	Name of River	IP Scale	Status of Quality Standard
Spot 1	Upstream of BolangoRiver	0.995	Meet quality standards/good conditions
Spot 2	BolangoRiver (Bunuo Village)	1.203	Lightly Polluted
Spot 3	Upstream of Mongiilo River	2.22	Lightly Polluted
Spot 4	Middle part of Mongiilo River in the	1.504	Lightly Polluted
Spot 5	Estuary of Mongiilo River	2.223	Lightly Polluted
Spot 6	Shallow Groundwater of Kopi Village	0.706	Meet quality standards/good conditions

The results of calculations for the fiverivers show that the upstream of Bolango River is in good condition. The other four rivers are lightly polluted. This happens because the upstream of the river has smaller population than the middle part or estuary of the river. This is understandable because the further downstream, the denser the population live along the river and the heavier the pollution will be. A research showed that Gelis River belonged to moderately polluted [14]. This condition is similar the status of water pollution in the Bolango River ecosystem. The results of a study showed that the index of sea water pollution in the North Coast of Tuban Regency was lightly and moderately polluted [15]. It is still lower than the upstream of Bolango River Basin because activities in the upstream of river basin are affected by the conditions of the local community and the absence of industrial activities, so

that the chemical parameter in the Bolango River Basin is better than the North Coast of Tuban Regency in which the polluted conditions are due to community and industrial waste disposal.

The water quality pollutant index for shallow groundwater in Kopi villages still met the requirements. This is because the distance of the community pollutant sources such as toilets, bathrooms and landfills are far from the location of sampled groundwater. A research conducted by Jaya showed that the farther the distance from the landfill location, the better the quality of shallow groundwater [16]. This is evidenced by the conditions in 1997 that polluted water at a distance of 80 m from the landfill, in 2008 at a distance of 375 m, and in 2014 at a distance of 1-400 m. The water quality of dug wells and drilled wells could meet quality standards at a distance of 750 - 5000 m from the landfill. A research conducted at Kayu Murni Village of Bualemo Regency showed that all shallow well water sampled was contaminated by *E. coli* [17]. This occurred due to water seepage from toilets and bathrooms. It is necessarily important to inform environmental sanitation, so that people understand about the process of contamination in shallow groundwater and its danger to public health.

4. Conclusions

The results showed that the analysis of surface water quality in the upstream of Bolango River ecosystem met the requirements of Government Regulation Number 82 of 2001 Class II, except for the BOD and COD parameters. Based on Government Regulation Number 82 of 2001, BOD parameter should not exceed 3 mg/l. The results of the analysis showed that the BOD concentration in the 5 rivers ranged between 3.5 - 8 mg/l. COD parameter ranged between 17-32 mg /l. They tended to be above the established quality standard. Based on these results, the river water in the upstream of Bolango River Basin is contaminated by organic materials. Based on The Decree of Minister of Environment Number 115 of 2003 about Water Pollution Index, the quality of upstream of BolangoRiver is in good condition. The status of water in Bolango River (Bunuo Village), upstream of Mongiilo River, middle part of Mongiilo River, estuary of Mongiilo River is lightly polluted. The characteristics of shallow groundwater meet the requirements of the quality standard set by the Regulation of Minister of Health Number 32 of 2017.

Reference

[1] Effendi H 2003 *Telaah Kualitas Air. Bagi Pengelolaan Sumber Daya dan Lingkungan Perairan* (Yogyakarta : Kanisius)
[2] Lihawa F dan Mahmud M 2017 Evaluasi Karakteristik Kualitas Air Danau Limboto. J *Pengelolaan Sumber Daya Alam dan Lingkungan* **7** (3): 260-66.
[3] Irianto G and Rejekiningrum P 2008 Efisiensi Pemanfaatan Sumber Daya Air. Suatu Tinjauan Dari Sisi Agroklimat dan Hidrologi. in Purnomo, D.W, Sandrawati. A Witono J R Fijridiyanto I A Setiyanti D Safarinanugraha D J *Manusia dan Lingk.*. **23** (1):111-21.
[4] Purnomo D W Sandrawati A Witono J R Fijridiyanto I A Setiyanti D and Safarinanugraha 2016 Desain Vegetasi Bernilai Konservasi Ekonomi Sistem Tata Air DAS Bolango *J. Manusia dan Lingkungan* **23** (1):111-21.
[5] Yogafanny E 2015 Pengaruh Aktifitas Warga di Sempadan Sungai Terhadap Kualitas Air Sungai Winongo. *J Sains dan Teknologi Lingk.***7** (1): 41-50
[6] Jeffries M and Mills D 1996 *Freshwater Ecology Principles, and Aplication* (UK: John Wiley and Son)
[7] Irham M Abrar F and Kurnianda V 2017 Analisis BOD dan COD di Perairan Estuaria Krueng Cut Banda Aceh. *J Ilmu-Ilmu Perairan*, Pesisir dan Perikanan. **6** (3): 199-204.
[8] Mohsin M Safdar S Asghar F and Jamal F 2013 Assessment of Drinking Water Quality and its Impact on resident Health in Bahawalpur City *J Humanities and Social Sci.* **3** (15): 114-28
[9] Utami T M R Maslukah L and Yusuf M 2016. Sebaran Nitrat dan Fosfat (PO4) di Perairan Karongsong Kabupaten Indramayu *Buletin Oseanografi Marina* **5 (1)**: 31-7

[10] Puspita I Ibrahim L and Hartono D 2016 Pengaruh Perilaku Masyarakat yang Bermukim di Kawasan Bantaran Sungai Terhadap Penurunan Kualitas Air Sungai Karang Anyar Kota Tarakan. *J Manusia dan Lingk*. **23** (2) : 249-58
[11] Mahmud M Lihawa F and Desei F 2015 Kajian Kualitas Air Tanah Dangkal Sebagai Sumber Air Minum Masyarakat Kota Gorontalo. *J Lingk dan Pemb* **1** (3): 249-63
[12] Bambang AG Fatimawali and Kujong N S 2014Analisis Cemaran Bakteri Coliform dan Identifikasi Esherichia Coli Pada Air Isi Ulang Dari Depot di Kota Manado *J Farmasi Unstrat*. **3** (3): 325-34
[13] Marganingrum D 2013 Penilaian Mutu Air Sungai dengan Pendekatan Perbedaan Hasildengan Dua Metode Indeks (Asseement of Citarum River Water Quality using Difference Approximation Result from Two Indeks Method. (*Bulletin of Environmental Geology*). **23** (3): 105-14
[14] Shelfiana U S Sarminingsih A and Nugraha W D 2017 Penentuan Status Mutu Air Sungai Berdasarkan Metode Indeks Pencemaran Sebagai Pengendalian Kualitas. *J Tek. Lingk.* **6**(1) : 1-10
[15] Damaianto B and Masduqi A 2014. Indeks Pencemaran Air Laut Pantai Utara Kabupaten Tuban Dengan Parameter Logam *J Teknik POMITS* **3** :1- 4.
[16] Jaya IWAE 2015 Studi Kualitas Air Tanah Dangkal dan Pendapat Masyarakat Sekitar Tempat Pemrosesan Akhir Sampah Suwung Kecamatan Denpasar Selatan Kota Denpasar. *Thesis*. (Program Magister Program Studi Ilmu Lingkungan Program Pascasarjana Universitas Udayana. Denpasar).
[17] Mahmud M 2016 Evaluasi Kualitas Air dan Sanitasi Lingkungan Masyarakat Kayu Murni Kabupaten Bualemo *Nasional Art, Sains dan Teknologi*.