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WATER QUALITY ASSESSMENT OF RIVERS IN PADANG USING WATER POLLUTION INDEX AND NSF-WQI METHOD

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ABSTRACT: The study was conducted on 4 major rivers in Padang, namely Kandis River, Air Dingin River, Kuranji River, and Arau River to determine the status of water quality using the Pollution Index (PI) and NSF-WQI method. These rivers are used as drinking water sources and for the purpose of fisheries, agriculture and water recreation so that quality needs to be analyzed. The data used is dry season data at 6 sampling stations for each river since years 2015 - 2018 by analyzing 12 parameters, namely total suspended solids, total dissolved solids, pH, dissolved oxygen, biological oxygen demand, ammonia, nitrates, nitrites, total Phosphates, Fecal coliform, chemical oxygen demand and temperature. The analysis results showed that the status of water quality of 4 major rivers in the city of Padang from 2015 until now has been in a lightly polluted and moderately polluted condition. The pollution index of all rivers is in the range of 2.11-6.06. The calculation of water quality index shows that almost at all stations, river water quality is in a bad category with NSF-WQI values in the range of 29.27- 48.75. It is hoped that the results of this research can be used to improve the quality of the Kandis River, Air Dingin River, Kuranji River, and Arau River so that these rivers can be utilized in accordance with their purposes.

Keywords: Water Quality, River, Padang.

1. INTRODUCTION

The physiography of Padang City, from the east to the west coast consists of a complex ecosystem region with a unique landscape entity as a provider of environmental services for the people of Padang City. Upstream all the rivers flowing is directed east with hilly topography [1] [2].

Padang has many rivers, i.e 5 large rivers and 16 small rivers. The longest river is Kandis River with a length of 20 km. Rivers in Padang are used by the community to bathe, wash and for toilet purpose, drinking water sources, agricultural, fisheries and industrial activities. The high utilization of water and the occurrence of pollution to the river make it important to protect the rivers so that it can be utilized properly. The use of water for various purposes must be done wisely by considering biological needs and to support economic growth and activity [3] [4]. River management is needed to maintain its quality and quantity. The government can take the necessary policies if the status of the river is known. Studies have been done to determine the status of water quality and water quality index, including the

Ciambalung River in Banten Province [5], Metro River in Malang [4] and research on the status of water quality of rivers around Dramaga IPB [6]. The research aims are to determine the status of water quality for Kandis River, Air Dingin River, Kuranji River, and Arau River. This study uses the Pollution Index (PI) method (Decree of the Minister of Environment No. 115 of 2003) and NSF-WQI method. PI and NSF-WQI are methods of assessing river water quality that is simple and easy to implement. Pollution index can be the basis for environmental analysis and river management [7 – 10]. The PI value shows the level of pollution which is relative to the water quality standard required at the water source while water quality index shows the total water quality that exists at a particular location and time from certain parameters.

2. METHODS

The study was conducted on 4 major rivers in Padang, i.e Kandis River, Air Dingin River, Kuranji River, and Arau River. The data used is the measurement of river water quality during the Dry Season conducted by the Environmental Protection Agency of Padang Laboratory from 2015 to 2018. In each river, there are 6 sampling stations in the upstream to the downstream.

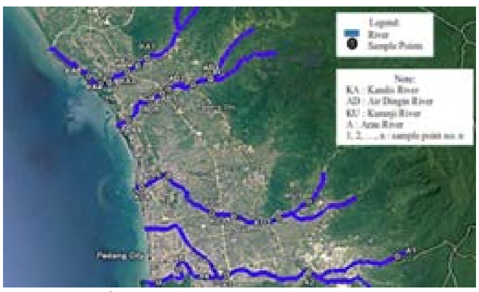

Fig. 1 Map of sampling point distribution.

Table 1. Sampling Locations in Padang Rivers

Stations	Kandis	Air Dingin	Kuranji	Arau
1	Balai Gadang S:00°54’47.80” E:100°27’09.70”	Lubuk Minturun S:00°50’06.60” E:100°23’29.20”	Batu Busuak S:00°54’47.80” E:100°27’09.70”	Lubuk Paraku S:00°56’51.30” E:100°30’24.0”
2	Batipuh Panjang S:00°57’24.60” E:100°22’17.10”	Simpang Lori S:00°50’19.30” E:100°22’49.80”	Gunung Nago S:00°57’24.60” E:100°22’17.10”	Beringin S:00°57’30.20” E:100°27’09.30”
3	Balai Gadang S:00°55’23” E:100°24’21.10”	Aia Dingin S:00°50’30.20” E:100°21’54.30”	Korong Gadang S:00°55’23” E:100°24’21.10”	Lubuk Begalung S:00°57’37,42” E:100°24’05.50”
4	Kampung Jambak S:00°55’15.20” E:100°23’31.70”	Lubuk Minturun S:00°50’39.90” E:100°21’40.50”	Kalumbuk S:00°55’15.20” E:100°23’31.70”	Aur Duri S:00°57’24.60” E:100°22’17.10”
5	Lubuk Buaya S:00°53’48.00” E:100°21’54.70”	Pulai S:00°50’54.20” E:100°21’15.10”	Siteba S:00°53’48.0” E:100°21’54.70”	Subarang Padang S:00°57’24.60” E:100°22’17.10”
6	Padang Sarai S:00°54’15.80” E:100°20’55.20”	Muaro Panjalinan S:00°51’40.40” E:100°20’24.10”	Air Tawar S:00°54’15.80” E:100°20’55.20”	Muaro S:00°57’54.20” E:100°21’31.80”

Source: Data Analysis, (2019).

2.1 Pollution Index

The water quality standard refers to the Government Regulation of Indonesia (GR) No 82 /2001 for Class II. It is due to the fact that Padang Government has not established the class for its rivers [11]. Ateach station, the calculation of Water Quality Status uses pollution index according to Minister of Environment Decree No. 115/2003 [12]. The formula used in the calculation of the Pollution Index is as follows:

$$PI_j = \frac{\sqrt{(Ci/Lij)_M^2 + (Ci/Lij)_R^2}}{2}$$

PI_j : pollution index for a specified water quality purpose (j)
Ci : measured water quality parameters
Li_j : standard water quality parameter (j)
$(Ci/Lij)_M$: Cij/Lij maximum
$(Ci/Lij)_R$: Cij/Lij average

The value of the PIj (Pollution Index) obtained was then evaluated and compared with the following table:

Table 2. Classification of water quality status based on Pollution Index (NSF-WQI)

Pollution Index	Criteria
$0 \leq PIj \leq 1{,}0$	Meet quality standards
$1{,}0 < PIj \leq 5{,}0$	Lightly polluted
$5{,}0 < PIj \leq 10$	Moderately polluted
$PIj > 10$	Heavily polluted

Source: GR No 82 /2001.

2.2 Water Quality Index

The formulation of the water quality index can be used to provide quick information on water quality conditions on water pollution management and control policies. The water quality index is calculated using NSF-WQI method. The NSF-WQI index is the most widely used index and is used as a reference in the procedure for preparing water quality indexes in various countries. Water quality index calculation using NSF-WQI method for rivers in Padang is carried out with the following formula:

$$\sum_{i=0}^{n} Wi \times Li$$

NSF-WQI : water quality index score
Wi : the weight score
Li : the sub-index score

This study aims to formulate a Water Quality Index with reference to NSF-WQI. There are 9 parameters used in determining the water quality index using NSF-WQI method, i.e DO, pH, BOD, temperature, total phosphate, nitrate, turbidity, total solids and fecal coliform. In this study, index modification was used based on Ai Silmi's research, so only 7 parameters were carried out on the analysis, i.e DO, pH, temperature, phosphate, nitrate, TSS and fecal coliform [13] [14].

Table 3 Parameters and weight scire of water quality index for 7 parameters on NSF-WQI

Parameter	Weight Score
DO	0.23
pH	0.14
Temperature	0.12
Total phosphate	0.12
Nitrate	0.10
Total solids	0.09
Fecal coliform	0.20
Total	1

Source: GR No 82 /2001.

The calculation results from NSF-WQI are then adjusted to the water quality index criteria table (NSF-WQI) [15] which can be seen in table 4.

Table 4 Water quality index criteria (NSF-WQI)

Pollution Index	Criteria
0 - 25	Very bad
26 - 50	Bad
51 -70	Medium
71 - 90	Good
91 - 100	Excellent

Source: GR No 82 /2001.

3. RESULTS

3.1 Calculation of Pollution Index

The processed data are data on the quality of the Kandis River, Air Dingin River, Kuranji River, and Arau River since 2015-2018 during the Dry season. The calculation was done by analyzing 12 parameters, i.e TSS, TDS, pH, DO, BOD, NH_3 -N, NO_2-N, NO3-N, Total Phosphate, Fecal coliform, COD and temperature which can be seen in Table 5-8. Regulation Government of Indonesia No. 82 of 2001 regulates that there are 4 classifications of rivers, i.e: class 1 as drinking water sources, class 2 for water recreation, class 3 for fisheries and animal husbandry, class 4 for agriculture. The water quality standard used in this study is for Class II, since the class of river water has not been established [16].

River quality data is a random character data, which describes the character of river water as flowing and dynamic [13]. Thus, the index that describes the status of the level of river pollution also shows fluctuations. PI values at 6 monitoring points in each river ranged from 1 to 10.

The PI values show that from 2015 until now, Kandis River, Air Dingin River, Kuranji River, and Arau River from upstream to downstream area is in the lightly polluted to moderately polluted category with the pollution index in the range of 2.11 - 6.06. The data show that domestic waste is a major factor in decreasing river water quality in Padang. This is characterized by a high concentration of fecal coliform, from the upstream to the downstream of the river. Fecal coliform is the main indicator of domestic waste and is able to survive in the environment for a maximum of 30 days [14] [17]. The quality standard for fecal coliform parameters is <1000/100 ml, while the data show that the amount of fecal coliform at almost all monitoring points has exceeded the standard. Domestic waste is indeed one of the main polluting sources of rivers in Padang. Limited sanitation infrastructure, both in terms of quantity and quality, causes domestic waste to reach water bodies without going through processing first. The population growth which is characterized by the increasing number of residential developments is not accompanied by improved sanitation infrastructure. This is exacerbated by the presence of waste transport companies that dispose fecal waste in the river. The decline in water quality in the Kuranji River from upstream to downstream is due to the increasing number of settlements in the downstream area [16]. Degradation in the Arau River also occurs in the downstream, not in the upper and middle parts of the river [17-19]

Besides fecal coliform, it is seen that ammonia (NH_3) is also a contributing factor in reducing the quality of Kandis River, Air Dingin River, Kuranji River, and Arau River. From 2015 to 2016, there were several monitoring points that had ammonia concentrations above the applicable quality standard, but in 2017-2018, ammonia concentrations at all monitoring points in the Kandis River, Air Dingin River, Kuranji River, and Arau River were above the applicable quality standard. Through the pollution index method, information can be obtained on the main parameters causing a decrease in river water quality in Padang. In fact, contaminants from domestic wastecan are processed naturally through a self-purification mechanism [20-25] [15].

Table 5 Water quality of Kandis River

Year	Parameter	Standart	Stations					
			1	2	3	4	5	6
2015	TSS (mg/l)	50	3	13	12	17	11	22.5
	TDs (mgl)	1000	70	60	190	50	90	3285
	pH	6-9	6.2	6.3	6.3	6.2	6.3	6.9
	DO (mg/l)	4	8.7	8.1	7.5	7.1	6.84	6.1
	BOD (mg/l)	3	2	2	2	2.85	4.05	4.8
	NH_3 (mg/l)	0.02	0.002	0.003	0.003	0.004	0.004	0.005
	NO_2-N (mg/l)	0.06	0.09	0.1	0.12	0.09	0.1	0.09
	NO_3-N (mg/l)	10	2.6	2.4	2.7	2.9	4.3	4.6
	Total Phosphate (mg/l)	0.2	0.2	0.4	0.6	0.6	0.9	1.6
	Fecal Coliform	1000	1100	1100	1100	1100	1100	1100
	COD (mg/l)	25	4.1	4.1	4.1	4.28	5.86	24.2
	Temperature (°C)	Dev 3	27	27.1	27.6	27.7	27.8	29
Pollution Index			**4.45**	**4.47**	**4.47**	**4.49**	**4.51**	**4.61**
Status			**Light**	**Light**	**Light**	**Light**	**Light**	**Light**
2016	TSS (mg/l)	50	32.5	8	72.5	74.5	3.84	2.74
	TDs (mgl)	1000	120	120	470	310	280	7810
	pH	6-9	7.18	6.62	6.56	6.23	5.83	5.36
	DO (mg/l)	4	9.72	7.99	7.88	7.78	6.37	4
	BOD (mg/l)	3	2	2	2	2	4.64	17.1
	NH_3 (mg/l)	0.02	0.1	0.397	0.304	0.331	0.278	0.288
	NO_2-N (mg/l)	0.06	0.02	0.04	0.06	0.07	0.05	0.02
	NO_3-N (mg/l)	10	0.1	1.6	1.3	0.8	0.5	1.8
	Total Phosphate (mg/l)	0.2	0.078	0.037	0.042	0.08	0.058	0.03
	Fecal Coliform	1000	2400	2400	2400	2400	2400	2400
	COD (mg/l)	25	6.97	8.84	7.56	7.51	8.44	33
	Temperature (°C)	Dev 3	24	26	28	28	28	29
Pollution Index			**3.24**	**5.71**	**5.73**	**5.74**	**5.73**	**5.88**
Status			**Light**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**
2017	TSS (mg/l)	50	2.5	16.5	20.5	28	48.5	57
	TDs (mgl)	1000	90	170	100	230	140	190
	pH	6-9	7.77	7.34	7.45	7.29	7.07	7.02
	DO (mg/l)	4	6.85	4.35	5.76	3.5	3.52	3.04
	BOD (mg/l)	3	2	2.31	2.57	3.14	3.22	4.01
	NH_3 (mg/l)	0.02	0.1	0.1	0.1	0.145	0.366	0.1
	NO_2-N (mg/l)	0.06	0.01	0.05	0.12	0.12	0.13	0.02
	NO_3-N (mg/l)	10	0.1	1.6	1.3	0.8	0.5	1.8
	Total Phosphate (mg/l)	0.2	0.051	0.144	0.063	0.314	0.325	0.061
	Fecal Coliform	1000	1100	440	2400	2400	1100	1100
	COD (mg/l)	25	4.1	11	15.6	24.2	24.2	23.3
	Temperature (°C)	Dev 3	28.5	29	29.5	29.7	29.7	30
Pollution Index			**3.21**	**3.22**	**3.27**	**3.89**	**5.28**	**3.26**
Status			**Light**	**Light**	**Light**	**Light**	**Light**	**Light**
2018	TSS (mg/l)	50	5.9	6.4	15.6	31.9	29.6	176
	TDs (mgl)	1000	81	190	125	210	163	191
	pH	6-9	8.11	7.76	7.93	7.37	7.16	6.93
	DO (mg/l)	4	2.92	4.03	5.33	3.52	2.11	1.21
	BOD (mg/l)	3	2.6	19.2	2	3.4	6.93	15.8
	NH_3 (mg/l)	0.02	0.1	0.1	0.1	0.1	0.1	0.1
	NO_2-N (mg/l)	0.06	0.041	1.03	0.197	0.2	0.116	0.104
	NO_3-N (mg/l)	10	0.52	5.31	2.37	2.79	2.21	2.78
	Total Phosphate (mg/l)	0.2	0.01	0.01	0.01	0.1	0.01	0.01
	Fecal Coliform	1000	1100	2400	2400	1100	2400	1100
	COD (mg/l)	25	10	46.9	26.3	11.5	19.1	30.5
	Temperature (°C)	Dev 3	27	28	29	28	28.5	30
Pollution Index			**3.22**	**5.29**	**3.30**	**3.28**	**3.32**	**3.48**
Status			**Light**	**Light**	**Light**	**Light**	**Light**	**Light**

Source: Data Analysis, (2019).

Table 6 Water quality of Air Dingin River

Year	**Parameter**	**Standart**	**Stations**					
			1	**2**	**3**	**4**	**5**	**6**
2015	TSS (mg/l)	50	7	8	8	4	11	21
	TDs (mgl)	1000	120	150	140	110	160	320
	pH	6-9	7.56	7.37	7.4	7.12	7.19	6.08
	DO (mg/l)	4	9.4	8.91	7.8	6.85	6.4	5.8
	BOD (mg/l)	3	2	2	2	2	2.86	6.5
	NH_3 (mg/l)	0.02	0.004	0.005	0.004	0.005	0.005	0.008
	NO_2-N (mg/l)	0.06	0.09	0.06	0.08	0.07	0.08	0.09
	NO_3-N (mg/l)	10	1.9	4.5	2.4	3.2	2.5	2.6
	Total Phosphate (mg/l)	0.2	0.5	0.5	0.5	0.4	0.7	0.6
	Fecal Coilform	1000	2400	4400	1100	1100	1100	1100
	COD (mg/l)	25	4.1	4.1	4.1	4.15	5.86	24.3
	Temperature (^oC)	Dev 3	27	27.1	27.1	27.6	27.8	29
Pollution Index			**2.2**	**3.05**	**4.46**	**4.45**	**4.47**	**4.59**
Status			**Light**	**Light**	**Light**	**Light**	**Light**	**Light**
2016	TSS (mg/l)	50	5	3	5	4	6	20.5
	TDs (mgl)	1000	150	110	280	210	190	1120
	pH	6-9	7.41	6.95	6.68	6.76	6.94	7.24
	DO (mg/l)	4	9.33	9.22	9.72	9.52	9.7	8.62
	BOD (mg/l)	3	2	2	2.25	2.7	4	6.27
	NH_3 (mg/l)	0.02	0.065	0.057	0.038	0.053	0.074	0.098
	NO_2-N (mg/l)	0.06	0.002	0.01	0.01	0.01	0.01	0.02
	NO_3-N (mg/l)	10	0.1	0.1	0.1	1.6	1	0.4
	Total Phosphate (mg/l)	0.2	0.018	0.02	0.019	0.033	0.021	0.044
	Fecal Coliform	1000	2400	2400	2400	2400	2400	2400
	COD (mg/l)	25	4.1	14.2	14.2	14	12.2	13.7
	Temperature (^oC)	Dev 3	26	26	26	26	30	28
Pollution Index			**3.02**	**5.65**	**5.65**	**5.65**	**5.67**	**5.70**
Status			**Light**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**
2017	TSS (mg/l)	50	2.5	2.5	2.5	3	3	7
	TDs (mgl)	1000	70	80	110	150	140	250
	pH	6-9	7.27	7.8	7.78	8	8.03	7.36
	DO (mg/l)	4	7.18	8.48	8.69	6.08	7.76	7.72
	BOD (mg/l)	3	2	2	2	2.72	2.53	3.17
	NH_3 (mg/l)	0.02	0.1	0.1	0.1	0.1	0.1	0.1
	NO_2-N (mg/l)	0.06	0.01	0.01	0.01	0.01	0.01	0.02
	NO_3-N (mg/l)	10	0.1	0.1	0.1	1.6	1	0.4
	Total Phosphate (mg/l)	0.2	0.056	0.058	0.058	0.05	0.048	0.048
	Fecal Coliform	1000	2400	1100	1100	2400	2400	1100
	COD (mg/l)	25	4.1	7	5.77	13.5	4.81	20.1
	Temperature (^oC)	Dev 3	25	26	27	27	27.5	30
Pollution Index			**3.23**	**3.21**	**3.21**	**3.24**	**3.23**	**3.22**
Status			**Light**	**Light**	**Light**	**Light**	**Light**	**Light**
2018	TSS (mg/l)	50	2.8	1.8	2	5.55	47.3	34.4
	TDs (mgl)	1000	34.5	41	102	124	186	252
	pH	6-9	8.07	8.04	8.45	8.32	8.93	7.17
	DO (mg/l)	4	5.04	5.84	4.53	6.44	4.63	2.92
	BOD (mg/l)	3	2.82	2	2	2	2	2.82
	NH_3 (mg/l)	0.02	0.1	0.1	0.1	0.1	0.1	0.1
	NO_2-N (mg/l)	0.06	0.015	0.017	0.01	0.01	0.029	0.016
	NO_3-N (mg/l)	10	0.18	0.19	0.21	0.24	0.32	0.28
	Total Phosphate (mg/l)	0.2	0.01	0.01	0.01	0.01	0.01	0.01
	Fecal Coliform	1000	4400	4400	4400	1100	1100	1100
	COD (mg/l)	25	8.36	12.4	16.6	15.5	12.3	16.9
	Temperature (^oC)	Dev 3	24	25	29	28	29	30
Pollution Index			**3.21**	**3.21**	**3.21**	**3.22**	**3.24**	**3.23**
Status			**Light**	**Light**	**Light**	**Light**	**Light**	**Light**

Source: Data Analysis, (2019).

Table 7 Water quality of Air Dingin River

Year	Parameter	Standar	Stations					
			1	2	3	4	5	6
2015	TSS (mg/l)	50	2.5	2.5	6	3	8	73.5
	TDs (mgl)	1000	45	55	65	70	73	1601
	pH	6-9	6.25	7.25	7.62	6.61	6.7	6.74
	DO (mg/l)	4	8.59	8.26	8.5	9.92	6.6	5.39
	BOD (mg/l)	3	2	2	2	2	2	2
	NH_3 (mg/l)	0.02	0.003	0.004	0.003	0.003	0.011	0.008
	NO_2-N (mg/l)	0.06	0.08	0.08	0.05	0.05	0.06	0.09
	NO_3-N (mg/l)	10	1.5	2.5	4.4	2	25	2.7
	Total Phosphate (mg/l)	0.2	0.1	0.4	0.4	0.2	0.6	0.6
	Fecal Coliform	1000	4400	24000	24000	24000	24000	24000
	COD (mg/l)	25	4.1	4.1	4.41	4.1	20.4	44.4
	Temperature (^oC)	Dev 3	26.5	27	27.3	27.4	27.6	28
Pollution Index			**3.03**	**5.65**	**5.65**	**5.63**	**5.71**	**5.74**
Status			**Light**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**
2016	TSS (mg/l)	50	3	4	26.5	44.5	22.5	56
	TDs (mgl)	1000	80	50	110	70	90	1680
	pH	6-9	7.6	7.68	7.73	7.85	7.57	7.25
	DO (mg/l)	4	7.6	9.29	7.89	8.74	7.89	5.77
	BOD (mg/l)	3	2	2	2	2	7.89	14.2
	NH_3 (mg/l)	0.02	0.1	0.1	0.1	0.1	0.202	0.47
	NO_2-N (mg/l)	0.06	0.02	0.02	0.02	0.02	0.02	0.02
	NO_3-N (mg/l)	10	2	2.4	2.4	0.7	0.7	1
	Total Phosphate (mg/l)	0.2	0.011	0.015	0.015	0.023	0.056	0.038
	Fecal Coliform	1000	2400	24000	24000	24000	24000	24000
	COD (mg/l)	25	8.38	4.1	5.52	8.04	21.8	43.6
	Temperature (^oC)	Dev 3	27	29	29	28	29	30
Pollution Index			**3.21**	**5.66**	**5.67**	**5.67**	**5.72**	**5.84**
Status			**Light**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**
2017	TSS (mg/l)	50	3	5	6	12.5	15	70
	TDs (mgl)	1000	80	110	130	120	150	750
	pH	6-9	7.71	7.64	7.35	7.53	7.5	7.21
	DO (mg/l)	4	9.24	7.61	8.81	8.92	5.22	1.91
	BOD (mg/l)	3	2	2	3.2	4.13	5	5.76
	NH_3 (mg/l)	0.02	0.1	0.1	0.1	0.1	0.1	0.118
	NO_2-N (mg/l)	0.06	0.01	0.01	0.001	0.01	0.02	0.03
	NO_3-N (mg/l)	10	2	2.1	2.4	0.7	0.7	1
	Total Phosphate (mg/l)	0.2	0.053	0.051	0.054	0.056	0.067	0.082
	Fecal Coliform	1000	1100	4400	1100	2400	1100	1100
	COD (mg/l)	25	9.04	10.6	12	13.2	14.5	16
	Temperature (^oC)	Dev 3	29.4	29.7	27	30	30	29.3
Pollution Index			**3.21**	**3.21**	**3.22**	**3.24**	**3.24**	**3.53**
Status			**Light**	**Light**	**Light**	**Light**	**Light**	**Light**
2018	TSS (mg/l)	50	4.7	7.3	10.2	16.7	47.9	137
	TDs (mgl)	1000	76	92.5	116	186	217	142
	pH	6-9	7.46	7.2	7.31	7.07	6.77	6.02
	DO (mg/l)	4	6.84	6.24	5.84	5.43	2.62	1.01
	BOD (mg/l)	3	2.02	2	2	2	19.8	12.8
	NH_3 (mg/l)	0.02	0.1	0.1	0.1	0.1	0.185	0.1
	NO_2-N (mg/l)	0.06	0.003	0.012	0.013	0.02	0.05	0.035
	NO_3-N (mg/l)	10	0.05	0.15	0.17	0.25	0.58	0.37
	Total Phosphate (mg/l)	0.2	0.01	0.01	0.058	0.01	0.01	0.01
	Fecal Coliform	1000	440	1100	1100	2400	2400	2400
	COD (mg/l)	25	0.741	12.1	6.41	27.9	57.3	37.9
	Temperature (^oC)	Dev 3	28	29	29.4	29.7	29.8	30
Pollution Index			**3.20**	**3.21**	**3.21**	**3.25**	**4.31**	**3.40**
Status			**Light**	**Light**	**Light**	**Light**	**Light**	**Light**

Source: Data Analysis, (2019).

Table 8 Water quality of Arau River

Year	Parameter	Standar	Stations 1	2	3	4	5	6
2015	TSS (mg/l)	50	2.5	122.5	15	2.5	10	25.5
	TDs (mgl)	1000	90.5	98.6	105.2	182.4	286.6	2940
	pH	6-9	6.81	7.2	7.31	6.89	7.26	7.14
	DO (mg/l)	4	8.67	8.87	6.6	6.71	5.94	4.4
	BOD (mg/l)	3	2	2	2.74	3.07	5.37	4.23
	NH_3 (mg/l)	0.02	0.009	0.013	0.013	0.014	0.016	0.018
	NO_2-N (mg/l)	0.06	0.05	0.06	0.08	0.08	0.14	0.12
	NO_3-N (mg/l)	10	2.4	1.9	2.5	57.2	22.8	4.4
	Total Phosphate (mg/l)	0.2	0.3	0.4	0.4	0.9	1	0.8
	Fecal Coliform	1000	2400	24000	24000	24000	24000	24000
	COD (mg/l)	25	4.1	6.85	11.6	10.3	18.4	20.4
	Temperature (^{o}C)	Dev 3	26.5	27.1	27.6	27.5	27.7	28.7
Pollution Index			**2.11**	**5.68**	**5.67**	**5.75**	**5.77**	**5.77**
Status			**Light**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**
2016	TSS (mg/l)	50	3	11	22.5	23.5	41	17
	TDs (mgl)	1000	30	150	90	60	40	840
	pH	6-9	7.2	7.28	7.43	7.55	7.49	7.21
	DO (mg/l)	4	8.75	8.31	8.31	7.45	5.72	5.51
	BOD (mg/l)	3	2.42	2.46	2.29	3.46	9.82	29.1
	NH_3 (mg/l)	0.02	0.003	0.011	0.04	0.293	0.58	0.459
	NO_2-N (mg/l)	0.06	0.002	0.002	0.002	0.002	0.04	0.04
	NO_3-N (mg/l)	10	1	1.4	0.8	1.3	2.9	3.1
	Total Phosphate (mg/l)	0.2	0.037	0.011	0.05	0.243	0.096	0.095
	Fecal Coliform	1000	2400	24000	24000	24000	24000	24000
	COD (mg/l)	25	10.4	10.3	8.02	11.7	17.3	18.3
	Temperature (^{o}C)	Dev 3	23	25	28	29.5	29.5	29
Pollution Index			**2.07**	**5.63**	**5.64**	**5.71**	**6.06**	**5.82**
Status			**Light**	**Moderate**	**Moderate**	**Moderate**	**Moderate**	**Moderate**
2017	TSS (mg/l)	50	2.5	3	3	9	15	43.5
	TDs (mgl)	1000	60	40	70	180	530	425
	pH	6-9	7.21	7.42	7.65	7.66	7.06	7.99
	DO (mg/l)	4	10	6.74	5.22	3.59	3.15	2.17
	BOD (mg/l)	3	2	2	2	2	5.2	3.88
	NH_3 (mg/l)	0.02	0.1	0.1	0.1	0.1	0.195	0.132
	NO_2-N (mg/l)	0.06	0.002	0.01	0.03	0.03	0.09	0.08
	NO_3-N (mg/l)	10	1	1.4	0.8	1.3	2.9	3.1
	Total Phosphate (mg/l)	0.2	0.055	0.056	0.074	0.183	0.184	0.276
	Fecal Coliform	1000	2400	1100	1100	2400	2400	1100
	COD (mg/l)	25	9.94	9.62	6.13	10.9	20.6	23.2
	Temperature (^{o}C)	Dev 3	26.8	29.4	29.5	29.7	29.8	30
Pollution Index			**3.23**	**3.21**	**3.22**	**3.25**	**4.34**	**3.72**
Status			**Light**	**Light**	**Light**	**Light**	**Light**	**Light**
2018	TSS (mg/l)	50	1.8	1.7	13.8	13.9	18.1	27.4
	TDs (mgl)	1000	25.5	55	74	116	274	370
	pH	6-9	7.7	7.56	7.65	7.49	7.21	6.66
	DO (mg/l)	4	7.65	6.14	6.04	6.24	6.04	5.74
	BOD (mg/l)	3	2	2	2	5.54	5.44	23.8
	NH_3 (mg/l)	0.02	0.1	0.1	0.1	0.1	0.157	0.1
	NO_2-N (mg/l)	0.06	0.01	0.01	0.016	0.076	0.117	0.022
	NO_3-N (mg/l)	10	0.17	0.23	0.24	0.73	1.24	0.29
	Total Phosphate (mg/l)	0.2	0.01	0.01	0.01	0.14	0.358	0.34
	Fecal Coliform	1000	1100	2400	2400	1100	2400	2400
	COD (mg/l)	25	0.334	2.92	0.334	16.2	2.16	37.1
	Temperature (^{o}C)	Dev 3	22	27	29	28	29.8	30
Pollution Index			**3.21**	**3.22**	**3.23**	**3.26**	**4.01**	**4.07**
Status			**Light**	**Light**	**Light**	**Light**	**Light**	**Light**

Source: Analysis data, (2019).

3.2 Calculation of Water Quality Index

The National Sanitation Foundation Water Quality (NSF-WQI) or Water Quality Index is determined to assess the level of water quality. This water quality index is based on 9 parameters which include: BOD, DO, nitrate, total phosphate, temperature, turbidity, total solid, pH, and fecal coliform. In this study only 7 parameters were used without BOD and Turbidity. Therefore, the weight of each parameter is modified. The total weight of the 7 water quality parameters used is still 1. The modification is done by adding the weight of the parameters that are removed to each of the proportional weight parameters of the water used. The calculation results of the NSF-WQI method for rivers in the Padang is presented in Table 9.

At all stations, it is seen that the rivers water quality in Padang is almost at the same quality, which is in the bad category with NSF-WQI values in the range of 29.27-48.75. Only the Kuranji River in the upstream part has a medium category in 2017 and 2018 (NSF-WQI value 50.01 and 50.51); however the middle and downstream parts of the river are in the bad category. Based on these data, it appears that the overall water quality of rivers in Padang is in bad category.

Table 9 NSF-WQI value of rivers in Padang

Year	Station	River	Value	River	Value	River	Value	River	Value
2015	1	Kandis	40.78	Air Dingin	43.44	Kuranji	42.86	Arau	44.3
	2		39.19		40.05		42.44		42.73
	3		37.08		41.75		40.03		42.62
	4		36.51		41.63		43.15		29.27
	5		32.99		40.15		32.46		32.77
	6		34.37		35.81		39.07		36.58
2016	1	Kandis	48.92	Air Dingin	48.48	Kuranji	48.15	Arau	48.5
	2		43.97		45.85		46.09		46.76
	3		43.88		44.68		45.78		36.84
	4		41.94		44.81		46.1		39.98
	5		39.85		45.36		46.1		45.45
	6		37.6		46.32		46.02		44.74
2017	1	Kandis	48.25	Air Dingin	48.24	Kuranji	48.53	Arau	48.13
	2		49.51		48.72		50.01		48.45
	3		47.69		48.6		48.71		48.19
	4		45.16		46.33		47.69		46.4
	5		45.9		46.52		48.48		45.71
	6		47.93		48.75		48.27		44.67
2018	1	Kandis	46.74	Air Dingin	49.57	Kuranji	50.51	Arau	49.74
	2		43.95		49.59		48.74		47.89
	3		46.68		46.66		48.73		47.92
	4		48.53		46.2		47.38		48.36
	5		47.23		43.22		46.11		44.79
	6		46.27		48.38		41.89		43.17

Source: Analysis data, (2019).

4. CONCLUSION

Information about the river water quality can be obtained through the Pollution Index and NSF-WQI method. From the results, it is concluded that the quality of 4 major rivers in Padang, i.e Kandis River, Air Dingin River, Kuranji River, and Arau River, has the pollution index in the range of 2.11-6.06. The PI values show that from 2015 until now, the four rivers from upstream to downstream area are in lightly polluted to moderately polluted category as referred to Government Regulation No 82/2001 (class 2 for water recreation). Based on the calculation with the NSF-WQI method, it is seen that at all stations of the four rivers, the water quality is almost the same, which is in the bad category with the NSF-WQI value in the range of 29.27-48.75. Kuranji River is the only river that has a medium category in 2017 and 2018 (NSF-WQI value 50.01 and 50.51), but in the middle and downstream parts of this river, the water quality is in a bad category.

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