Textile Industry Waste Pollution in the Konto River: A Comparison of Public Perceptions and Water Quality Data

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Abstract

Textile industry production activities in one of the Badas areas can have implications for the occurrence of dye liquid waste pollution in the Konto river flow. This implication leads to the public perception that there has been river pollution from textile dyeing liquid waste. In this case, public perceptions need to be analyzed as a form of river environmental monitoring activities. Therefore, public perceptions of pollution were compared with actual water quality data, especially related to dyes in river water, to link public perceptions with environmental resource management efforts. This study aims to analyze public perceptions of textile dye waste pollution and compare the analysis results with the river water quality analysis. Analysis of river water quality (dye content, BOD, COD) was conducted at five sampling points in Badas, Kuwik, Balungjeruk, and Wonorejo villages. Public perception was measured descriptively through interviews with respondents referring to the Slovin method. The analysis of public perceptions shows that the Public considers that there has been pollution of river water, mainly due to textile industry waste, along the Konto River. The results of the water quality analysis showed that dye concentrations were found at four sampling points except for Wonorejo Village. This result shows that the correlation between public perception and data on dye contamination only occurs in Badas, Kuwik, and Balungjeruk villages. In addition, the BOD/COD ratio indicates that pollution has occurred at all observation points in this study.

Keywords: Aquatic Ecosystem, Dyes, Pollution, Public Perception, Waste.

INTRODUCTION

The need for clothing has encouraged the development of the textile and textile product (TPT) industry in Indonesia. The development of TPT in Indonesia is driven by the increasing value of the investment. BPS (Statistic Center) noted that in 2021 there was an increase in the investment value from US$ 238.89 million to US$ 279.79 million, with total exports of apparel products amounting to 5,856,500 tons [1,2]. The development of textile production certainly encourages the growth of textile and textile product production. One of the main activities of TPT is fabric processing, which is divided into weaving and fabric dyeing activities.

One of the primary components needed in fabric coloring activities and can be a source of pollutants is the dye. In the textile industry, about 200,000 tons of dye are released into the environment each year as a result of the dyeing and finishing process [3]. In general, the textile industry uses more synthetic dyes. This is because synthetic dyes are stable, have many color choices, are easy to obtain and practical [4]. The use of synthetic dyes encourages the creation of waste that is harmful to the environment.

Dyestuff waste can cause continuous material damage to environmental components [5]. This impact comes from textile industry dye waste that pollutes the environment, especially in the aquatic environment. Dyestuff waste in waters will be difficult to degrade because bacteria unable to degrade dye waste. Thus, these polluted waters cannot be used as life support by humans [6]. Plants that have habitats around waters will experience a decrease in chlorophyll content so that the plant's metabolic system will be disrupted [7].

Consumption of water that has been contaminated by synthetic dyes will result in cell mutagenicity in living things, especially in humans, resulting in the emergence of cancer cells [8]. Side effects of dyes in humans also cause several diseases, such as kidney malfunction, reproductive system, liver, brain, and central nervous system [9].

The impact of continued contamination on humans occurs when the dye is in direct contact and over a long period. A large amount of direct human contact occurs when humans use water contaminated with liquid dye waste for their daily needs. Of course, the industry wants to get as much profit as possible but sometimes forgets

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about the environmental health aspects that must be met along with industrial activities It can trigger upheaval between the industry and the public with several complaints and even conflicts. Society certainly has a point of view that is connoted through perceptions that arise and develop in discrediting existing pollution [10]. People want the polluted environment to recover. However, the existing contamination has made the environment change in terms of environmental health.

Environmental health, especially the aquatic environment contaminated with textile waste, can be viewed from the content of textile waste in the waters. Decree No.P.16/MENLHK/SETJEN/KUM.1/4/2019 of the Minister of Environment concerning the Second Amendment to the Regulation of the Minister of the Environment Number 5 of 2014 concerning Wastewater Quality Standards has strictly regulated the content of waste that can be disposed of in waters. Among these several parameters, Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) are crucial in determining water quality. BOD is the amount of dissolved organic matter in the waters, while COD is the chemical oxygen demand used to describe the amount of dissolved organic matter in the solution.

BOD COD ratio can be used to determine the level of pollution in the aquatic environment [11]. From this indicator, there are no specific controls governing the concentration of dye waste allowed in the waters. It makes the perception of the industry and the public can be different. The industry has a strong assumption that the contamination of dye liquid waste is still in accordance with the existing quality standards. However, people do not understand it, and the perception that arises is a direct observation of the characteristics of the waste and the impact it has on the environment.

These different perspectives need to be clarified through scientific studies to obtain facts between the perceptions of the public and the industry regarding the state of the surrounding aquatic environment. Scientific studies that can be carried out are measuring and analyzing the content of dye waste in polluted waters, measuring several environmental parameters, and making observations about assumptions and perceptions that arise in the public. In this article, the results of the analysis carried out on the communities around the river flow affected by textile waste disposal, as well as direct analysis of the river water around the textile industry. This study aims to analyze public perceptions of textile dye waste pollution and compare the results with the analysis of river water quality.

MATERIAL AND METHODS

Research Design

The method used in this study is interviews with the public regarding perceptions of indications of river water pollution and laboratory tests to determine the truth of indication of pollution by textile industry waste. The study was conducted in January – April 2022. Interviews were conducted in Badas, Kuwik, Balungjeruk, and Wonorejo villages, with the total number of respondents measured by the Slovin formula [12]. The level of water pollution caused by textile industrial waste are carried out with several tests. It included testing the content of dyes in pure textile waste (before being discharged into waters), testing the levels of dyes in waters and testing environmental parameters that focus on the BOD and COD tests. The test was carried out at the Research Laboratory of the Department of Chemistry, State University of Malang.

Public Perception Data Collection

Interviews were conducted on public perceptions of textile industry waste pollution. The selection of the number of respondents was based on several considerations. The respondent's residence must be close to the river flow through which the waste passes, and the respondent must be at least 17 years of age and over so that their opinion can be justified. The determination of the number of respondents being interviewed is determined by the Slovin formula [12]. The results of calculations using the Slovin method show that the number of respondents needed to meet the public perception data is 100 respondents.

$$n = \frac{N}{1 + N(e)^2} \qquad n = \frac{16{,}658}{1 + 16{,}658(0.1)^2}$$

$$n = 99{,}403 \approx 100$$

Description:

- n = Number of samples (number of respondents)
- N = Total Population (16,658)
- e = Error Tolerance Limit (0.1)

Water Sampling

Samplings of deep river water measure the concentration of dyes discharged in the waters and measurement of water quality parameters COD and BOD using a random pumping test [13]. The sampling point taken is shown in Figure 1.

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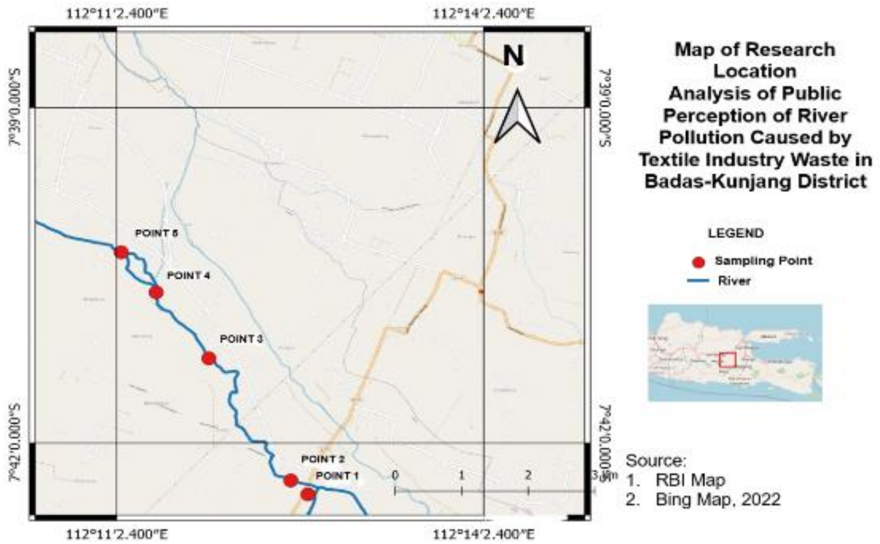

Figure 1. Sampling Points of Konto River

Measurement of Dyestuff Concentration in Pure Waste

Information on the type of dye used is known directly from the textile industry concerned. The dyes used are Yellow RGB, Yellow HR, Red 3BS, Red RGB, Everzol Black GSP, Reactive Black WNN, Remazol Navy RGB, and Turq-Blue. Pure dyes are also obtained directly from the textile industry. The related textile industry states that it emits 600-700 m^3 of liquid dye waste daily.

Measurement of various concentrations of dyes in the waste begins by making various mother liquors with a concentration of 100 ppm pure dye, which is then converted into five concentrations of solutions with the same concentration range. Then each absorbance was measured at the maximum wavelength possessed by the dye. The absorbance value obtained is plotted on a calibration curve with the ordinate axis of absorbance and the abscissa axis being the concentration of waste with the general equation $\mathbf{y = a + bx}$.

Measurement of Dye Concentration in Konto River Water Samples

River water samples were measured at each of the characteristic wavelengths of the dye using UV-Vis Spectronics. The absorbance value is plotted on the line equation $\mathbf{y = a + bx}$ between the abscissa axis ($\mathbf{x}$) is the concentration, and the ordinate axis is ($\mathbf{y}$) the absorbance value.

COD Test

The COD test was carried out by taking 10 mL of river water, which was suspected to be contaminated with textile waste, and was put into a 250 mL reflux vessel. The solution was added 0.2 g of $HgSO_4$ and 25 mL of $K_2Cr_2O_7$ 0.25 N. Then 20 mL of concentrated H_2SO_4 was added. The mixture was refluxed for 2 hours and then cooled to room temperature. After cooling the solution, ± 50 mL of distilled water and three drops of ferroin indicator were added. The resulting reflux solution was titrated with 0.25N $Fe(NH_4)_2SO^4$ until the color changed from blue-green to reddish-brown. COD results can be calculated by the equation:

$$COD\ Level = \frac{1000}{V_{sample}} |A - B| \times N \times 8$$

Description:

A = Volume of $Fe(NH_4)_2SO_4$ solution used in blank titration

B = Volume of $Fe(NH_4)_2SO_4$ solution used in sample titration

N = Normality of $Fe(NH_4)_2SO_4$ solution

BOD Test

BOD measurement is carried out by pouring the diluted sample into 1 300 mL Winkler bottle and 1 bottle of Winkler 150 ml. The solution in a 300 mL Winkler bottle was put into an incubator at 20 oC for 5 days which was then used to measure BOD_5. The sample for measuring BOD0 was added 1 mL of 50% $MnSO_4$. The mixture that has been formed is then added with 1 mL of NaOH and 1 mL of KI. The mixture was then added ± 4 mL of 4N H_2SO_4 and titrated with 0.1 N $Na_2S_2O_3$ until a light yellow color appeared. After that, 5 drops of starch indicator were added until the solution turned blue and the titration was continued until the blue color disappeared. BOD results can be calculated by the equation below along with the calculation of 5-day BOD (BOD5).

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$$DO\ Level = \frac{1000\ x\ V_1\ x\ N_{thio}}{(V_2 - 2)} \times 8$$

Description:
DO = Dissolved Oxygen
V_1 = Volume of Na_2SO_3 used for titration
N_{thio} = Concentration of $Na_2S_2O_3$ solution
V_2 = Volume of water sample tested

$$BOD_5 = DO_0 - DO_5$$

Description:
BOD_5 = Biochemical Oxygen Demand (mg.L^{-1})
DO_0 = Dissolved oxygen value test on the 0 day (mg.L^{-1})
DO_5 = Dissolved oxygen test value on 5th day (mg.L^{-1})

RESULTS AND DISCUSSION

Analysis of Public Perception

Public perceptions are divided into three general categories, which are: (1) public perceptions of the physical characteristics of waste, (2) impacts on agriculture, and (3) environmental health. Physical waste characteristics are divided into two indicators, consisting of the level of odor and color change. The impact of waste on agriculture can be seen in terms of quantity and quality of agricultural products. Meanwhile, the impact of textile industry waste pollution can be categorized into the impact on public health and the effect on the number of aquatic flora and fauna.

Physical characteristics of waste

The level of odor is related to the comfort of the Public around the watershed affected by textile industry waste, where this odor level will significantly correlate with air pollution. The results of public recognition in the four areas affected by the waste flow on the level of odor are shown in Table 1.

Table 1. Public Perception of the Odor Level of Waste along the River Flow

Village	Odor Level		
	Very Stink	Stink	No Stink
Badas	2	9	14
Kuwik	3	7	15
Balungjeruk	0	4	21
Wonorejo	0	2	23
Total	**5**	**22**	**73**
Percentage	**5%**	**22%**	**73%**

In general, the public perception of the level of odor states that the characteristics of the waste flowing along the river flow do not cause a strong odor. This result is indicated by the statement of 73% of the respondents interviewed. Meanwhile, 22% of respondents stated that the smell of waste felt by the public was stink. This statement is mostly made by people in the Badas area, where this area is the initial area that waste passes through. Of these areas, the Wonorejo area contributed the least to the level of this pungent odor. It is because the distance between the initial center of the waste and the Wonorejo area is already ±2 km apart. From the results presented in Table 1, it can also be seen that the farther the distance from the disposal center to the flow area, the lower the odor level.

The second physical indicator observed is the change in the color of river water caused by contamination of textile industry waste. This indicator is easy to observe because the color of river water before and after contamination from dye waste is clearly distinguished. Public perception of the change in the color of the flowing waste is shown in Table 2.

Table 2. Public Perception of Textile Waste Color Level

Village	Color Change Rate		
	Significantly changed	Temporarily Changed	No changes
Badas	1	23	1
Kuwik	1	24	0
Balungjeruk	0	25	0
Wonorejo	1	20	4
Total	**3**	**92**	**5**
Percentage	**3%**	**92%**	**5%**

Textile waste contamination can be observed from the aspect of the color changing of river water, which previously appeared colorless to several striking colors such as blue, green and other colors. A total of 92 respondents stated that the color changes that occur in river water only change temporarily. From the large number of respondents, it seems that the respondents from the Balungjeruk Public are compact in saying that the color changes that occur are only temporary. It is because the people of Balungjeruk still seem to use river water in their daily activities such as washing and bathing. When the waste flows, people have a tendency to use river water until it appears that the flowing waste has run out or the river water has returned to normal. Documentation of indications of pollution that people complained about is shown in Figure 2.

Figure 2. Indications of Pollution Complained by the Public (**Source:** Personal Documentation)

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People thought there was no change at all in river water because the waste flow, is only 5% or five respondents, with 4 out of 5 respondents stating this is from the Wonorejo Village Public. It is possible because the waste that flows in the river has been distributed and used by the Public in previous villages such as Badas, Kuwik, and Balungjeruk villages so that the concentration of color is relatively reduced. The facts are supported by direct observations from waste sampling at the first point of waste disposal. The color obtained from the observations at the waste source is shown in Figure 3.

Figure 3. Observations at Waste Sources

Public assumptions regarding changes in water color also state that river water has changed significantly. The magnitude of this assumption is relatively small compared to the total assumptions obtained from respondents, which is only 3%. The significant change in question is a permanent change in the color of river water.

Impacts on agriculture

The villagers of Badas, Kuwik, Balungjeruk, and Wonorejo generally make a living as rice farmers [14]. Public work indirectly demands the use of river water as material for agricultural irrigation. Along the watershed, there are many rice fields and fields, so the use of river water is the primary thing for the Public. Land use along the area around the Konto River can be seen in Figure 5.

The river water that is contaminated by textile waste is still used to meet agricultural irrigation needs. The public does not seem to have deeper knowledge about the use of water contaminated by the textile waste in processing rice fields. Textile waste can certainly affect the quality and quantity of existing agricultural products [15].

The accumulation of textile waste in water used in irrigating rice fields will directly pollute plants and soil. Soil, as a primary component for plants, will be disturbed in its composition due to the presence of pollutants. Djuwansah [16] suggested that textile industrial waste contains NaHPO_4.2H_2O. This content can cause soil salinity to increase so that plant growth rates will decrease due to decreased osmotic pressure. The problem of decreased quality of food products has also been observed by several related farmers. Several opinions regarding the effect of textile waste contamination on agricultural products can be seen in Table 3.

Table 3. Public Perception of Agricultural Product Quality

Village	Agricultural Product Quality		
	Not Worth Selling	Quality decrease	No effect
Badas	0	2	23
Kuwik	0	8	17
Balungjeruk	0	2	23
Wonorejo	0	2	23
Total	**0**	**14**	**86**
Percentage	**0%**	**14%**	**86%**

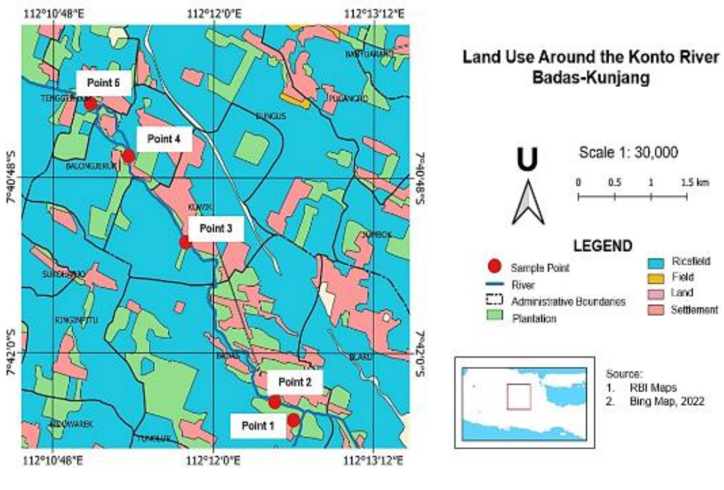

Figure 5. Land Use around the Konto River

Public opinion polls regarding the impact of waste contamination on the quantity of agricultural products indicated a decrease in the quality of agricultural products. However, the general public also believed that agricultural products were not affected by contamination. According to the Public, textile waste contamination does not cause agricultural products to become unfit for sale so that agricultural products can still be consumed as usual. Nevertheless, they admit that there is a decrease in the quality of agricultural products, which is indicated by the weight of the harvest that is no longer what it used to be (reduced).

A total of 14% of respondents stated an indication of a decrease in the quality of the harvest compared to before the textile waste contamination. Eight respondents from Kuwik dominate the public's assumption that there is a decline in the quality of agricultural products. It is possible because the land use around the watershed that passes through Kuwik Village is mostly used as agricultural land [14].

In general, the public states that the contamination of textile waste flowing along the river does not affect the quality of the harvest. As many as 86% of the total respondents assumed that there was no effect on the quality of the harvest. This assumption was made on the basis that during the research process, the agricultural yields fluctuated. The public also mentioned that, for now, some farmers tend to drain their farms with water from bore wells. Therefore, the exact impact on the quality of agricultural products due to the contamination of textile products cannot be ascertained directly by farmers.

The impact on the quality of agricultural products is also supported by data on the quantity of agricultural products. The data are obtained as long as there is the contamination of waters by textile waste. Plants that are in the spotlight due to textile waste contamination are rice plants. The effect of textile waste contamination on the quantity of agricultural products can be seen from the perception of people who are livelihoods as rice farmers. Some public perceptions of the quantity of agricultural products are presented in Table 4.

The results of interviews with the surrounding public revealed that the contamination of textile waste on rice plants did not cause a significant impact on rice yields in quantity. The existing impacts do not cause crop failure so that rice growth is still in a relatively good realm.

Table 4. Public Perception of Agricultural Product Quantity

Village	Agricultural Produce Quantity		
	Crop Failure	**Yield Declining**	**No Effect**
Badas	0	2	23
Kuwik	0	5	20
Balungjeruk	0	1	24
Wonorejo	0	2	23
Total	**0**	**10**	**90**
Percentage	**0%**	**10%**	**90%**

A number of respondents stated that the existing contamination did not seem to have any impact on the quantity of agricultural produce. It can be seen that 90% of the respondents stated that the quantity of existing agricultural products was still relatively the same in the conditions before and after the textile waste contamination. However, there were several respondents who stated that there was an impact on the quantity of yields, namely a decrease in the quantity of yields that was quite felt by farmers. This opinion is supported by the presence of 10% of the total respondents expressed this.

Environmental health

The public also expressed their perception of the primary aspect apart from the impact of agriculture, namely in the field of environmental health. The environmental health highlighted is divided into two important aspects, namely public health and the impact on the Public population. Interviews to explore people's assumptions about environmental health are directly related to public health itself.

Some people still use polluted river water for bathing and washing purposes. Such water is still widely used by the people of Balungjeruk Village. This habit is of course understandable because of the breakdown of the Ketandan Dam, which makes several rivers right in front of residential areas. The use of contaminated water is also still widely used by several communities in Badas, Kuwik and Wonorejo villages.

Several respondents stated that the public was actually afraid to do bathing and washing activities, but the existence of a deep-rooted habit made the public continue to carry out these activities. If the contamination is obvious, the public will wait until the striking water color changes fade, then bathing and washing activities will be carried out again. The existing pattern of water use is still likely to have a direct impact on public health. Public perceptions of the direct perceived impact of the use of contaminated river water can be seen in Table 5.

Table 5. Public Perception of Public Health

Village	Public Health		
	Cause Chronic Disease	Cause Minor Disease	Does not cause disease
Badas	0	13	12
Kuwik	0	14	11
Balungjeruk	0	15	10
Wonorejo	0	16	9
Total	**0**	**58**	**42**
Percentage	**0%**	**58%**	**42%**

All respondents answered in unison that the use of contaminated water does not cause chronic disease directly. Chronic diseases in question are cancer, severe digestive disorders, and the emergence of various deadly diseases. There is a strong assumption expressed that the use of river water has caused some minor ailments such as itching. However, the assumption is opposed by the assumption that the use of river water does not cause any disease. The difference in assumptions, which is only 16% of the total assumptions, has made contradictory assumptions. It makes a possible impact on public health that cannot be measured by the results of a poll of respondents alone.

The health impacts due to the contamination of liquid dye waste are not only in humans, but also in aquatic flora and fauna that are in direct contact with the waters. Aquatic flora that is commonly monitored by residents includes water spinach, water hyacinth, and bamboo. In addition, some people also plant elephant grass around the watershed (DAS). Meanwhile, the aquatic fauna that is most easily observed by residents is in the form of various types of fish, such as *wader* fish (Cyprinidae), *keting* fish (*Mystus nigriceps*), *sili* fish (*Macrognathus aculeautus*) and shrimp.

Since the liquid dye waste was discharged into the waters, 26% of respondents said that there was a decline in the population of aquatic fauna. Some of these were seen floating on the water's surface when the waste flowed into the waters. This observation is not permanent at all times, but temporarily adjusts the arrival time of waste in each area. Some fish contaminated with the waste looked like they were drunk but did not die.

This phenomenon has attracted the attention of residents because some residents still use several types of fish as a source of food. Public assumptions due to indications of the influence of aquatic flora and fauna populations can be seen in Table 6.

Table 6. Public Perception of Aquatic Flora and Fauna Population

Village	Aquatic Flora Fauna Population		
	Significantly Decreased	Decreased Slightly	No Effect
Badas	0	5	20
Kuwik	0	11	14
Balungjeruk	0	5	20
Wonorejo	1	5	19
Total	**1**	**26**	**73**
Percentage	**1%**	**26%**	**73%**

The existence of this problem makes people afraid to use fish as usual. This assumption mostly comes from the respondents of the Kuwik Village Public. It is because some communities are in direct contact with the river in their daily activities, so observations about the decline in the population of aquatic flora and fauna can be taken into consideration. However, 14 respondents from Kuwik Village stated that there was no effect on the aquatic flora and fauna due to textile waste contamination.

In general, 73% of the total respondents from various villages stated that there was no effect caused by textile waste contamination on the population of aquatic flora and fauna. The assumption held by respondents who think so is because respondents thought that contamination does not affect the population because fish are still able to survive. Fish can still regenerate despite exposure to waste contamination, but to know for sure the impact of textile waste contamination on aquatic flora and fauna, further studies and research need to be carried out.

Analysis of Dyestuff Content in Pure Waste

Analysis of the dye content in pure waste was carried out with the aim of knowing the concentration of each pure dye contained in the waste. The waste sample is waste that has not been disposed of in the waters. The concentration of pure dye in the waste has been identified by measurement using a UV-Vis Spectrophotometer. The identification of the concentration of dyes contained in the textile waste can be seen in Table 7.

Table 7. Concentration of Dyes in Waste

Dye	Wavelength (nm)	Ref	Waste Concentration (ppm)
Yellow RGB	410	[17]	56.00
Yellow HR	416	[18]	90.26
Red 3BS	512	[19]	22.80
Red RGB	520	[20]	28.54
Everzol Black GSP	596	[21]	34.97
Reactive Black WNN	596	[22]	39.61
Remazol Navy RGB	620	[23]	44.27
Turq-Blue	662	[24]	11.60

In Table 7, it can be seen that textile dye waste has eight dye contents with different concentrations. The highest concentration of dye produced is Yellow HR. The dye belongs to the azo type with a character that is difficult to decompose naturally. It is because the dye have a nitrogen group with double bonds (R-N=N-R) [25]. This group of dyes are generally carcinogenic and harmful to the environment. It is because the dyes are resistant to degradation by light, microorganisms and processing carried out by related industries [26].

Analysis of Dyestuff Content in the Konto River

Analysis of dye concentration in the Konto River refers to the initial dye that has been identified in the pure dye waste. The concentration of dyes in the Konto River is shown in Table 8. Waste at the first and second sampling points comes only from textile industry waste, while waste at the third, fourth and fifth sampling points can come from textile industry waste and household waste. It is supported by the fact that the first and second sampling points are not located near people's homes, while the third to fifth sampling points of the Konto river water sampling are already in a densely populated area.

The concentration of dyes in the waste appears to have decreased compared to the concentration of dyes in pure waste, before being discharged into the waters. It is made possible by the dilution of river water so that the concentration of waste decreases. This decrease is also influenced by the Konto river water discharge. Sampling was taken during the rainy season so that the river's water discharge was also large. Wonorejo Village does not appear to have experienced any contamination at all. It is due to the distance and branching of the river.

At the first point of sampling, river water showed differences in the concentration of dyes compared with the results of measurements at the second point. Even though the distance between the first and second points is not too far, only ± 100 m, the intensity of the waste that is flowed by the factory three times a day with a total discharge of waste water issued is ± 700 m^3. The large volume of wastewater that flows into the Konto River does not seem to change the characteristics of the Konto River permanently.

Table 8. Concentration of Dyes in the Konto River Flow

Dye	Waste Concentration (ppm)				
	Point 1 (Waste disposal starting point)	Point 2 (Badas Village)	Point 3 (Kuwik Village)	Point 4 (Balungjeruk Village)	Point 5 (Wonorejo Village)
Yellow RGB	22.42	12.99	10.67	10.67	0
Yellow HR	68.13	53.21	46.16	45.34	0
Red 3BS	5.30	0.13	0	0	0
Red RGB	12.68	8.40	0	0	0
Everzol Black GSP	2.08	0.95	0	0	0
Reactive Black WNN	5.37	2.22	0	0	0
Remazol Navy RGB	3.70	1.63	0	0	0
Turq-Blue	0.15	0.35	0	0	0

COD Analysis

COD is a parameter used to measure the ability of aquatic microorganisms to decompose organic substances by an oxidation process so that it can result in a decrease in dissolved oxygen in the waters [27]. The permissible level of COD in waters due to the presence of textile industry waste is 150 $mg.L^{-1}$. COD parameter measurements were also carried out at several points in each village which was fed by the Konto River. The results of measuring COD parameters at each sampling point are shown in Table 9.

One of the factors that can affect COD in water is the presence of inorganic molecules that interact with dichromate [28]. Dichromate in water is an oxidizing agent that causes pollutants in the form of carbon dioxide in the waters [29]. Carbon dioxide in the waters is needed in the decomposition carried out by bacteria. In a state of excess carbon dioxide in the waters, it inhibits the binding of oxygen by aquatic organisms so that the metabolism will be disrupted. The disturbance of the metabolic process in question is in the process of photosynthesis by aquatic organisms.

The measurement results shown in Table 9 show that the COD levels have exceeded the predetermined limit, namely at sampling points 2 and 4. The observations showed that the COD levels at points 2 and 4 were caused by several factors. The sample at point 2 was taken right at the Konto dam, so a lot of dye waste may settle on the riverbed so that the COD level of the waters is high. Point 4 (Balungjeruk Village) shows COD levels exceed the limit as in the COD level measurement at point 2. It is possible because of the use of Konto River water by the people of Balungjeruk Village for washing clothes and bathing.

The use of Konto River water by the people of Balungjeruk Village is driven by several factors, such as knowledge, attitudes, and actions of the Public in using river water in daily activities [30]. Knowledge, attitudes, and actions can be formed because of the convenience of the Public in utilizing river water for bathing and washing purposes. Surfactants from bathing and washing activities can reduce water quality [31]. Surfactants in waters contain alkyl benzene compounds, which are non-biodegradable and can increase COD levels in waters [32].

Table 9. COD Parameter Measurement Results

Sampling Point	COD level (mg.L^{-1})	Description
Sampling Point 1	40	Do not exceed the quality standard
Sampling Point 2	320	Exceeding the quality standard
Sampling Point 3	40	Do not exceed the quality standard
Sampling Point 4	220	Exceeding the quality standard
Sampling Point 5	100	Do not exceed the quality standard

Table 10. BOD Parameter Measurement Results

Sampling Point	BOD Level (mg.L^{-1})	Description
Sampling Point 1	5.7240	Do not exceed the quality standard
Sampling Point 2	3.0574	Do not exceed the quality standard
Sampling Point 3	2.6363	Do not exceed the quality standard
Sampling Point 4	5.0925	Do not exceed the quality standard
Sampling Point 5	5.8644	Do not exceed the quality standard

Table 11. BOD/COD Ratio Value of Konto River

Sampling Point	BOD/COD Ratio Value	Description
Sampling Point 1	0.1400	Non-Biodegradable
Sampling Point 2	0.0095	Non-Biodegradable
Sampling Point 3	0.0650	Non-Biodegradable
Sampling Point 4	0.0230	Non-Biodegradable
Sampling Point 5	0.0580	Non-Biodegradable

BOD Analysis

BOD is the amount of dissolved oxygen needed by aquatic organisms in decomposing organic matter [33]. BOD analysis is needed to determine the amount of oxygen needed by aquatic organisms in stabilizing organic matter in waters. The BOD content that is allowed in waters due to the presence of textile industry waste is 60 mg.L^{-1}. Measurement of BOD in the Konto River was carried out by taking samples of the water from the Konto River that flows in the villages of Badas, Kuwik, Balungjeruk, and Wonorejo. The results of BOD measurements on the Konto River are shown in Table 10.

The results of the BOD measurement shown in Table 10 are that none of the BOD levels in all analyzed river water samples exceeded the predetermined quality standard. The value of BOD in waters is due to textile waste influenced by the concentration of dyes and the presence of surfactants in the production process [34]. Dyes and surfactants in waters cause the BOD value to increase due to dye and surfactant waste which can form dissolved compounds, colloids, and suspension compounds. The formation of colloids due to textile industry waste substances will result in the need for oxygen in oxidizing organic matter to increase.

BOD levels are related to dissolved oxygen in the water. If the BOD level is high, it will result in a decrease in dissolved oxygen, and it can reduce water quality, especially in the life of aquatic organisms [35]. Dissolved oxygen plays a role in degrading pollutants by aquatic organisms. It is because dissolved oxygen (DO) can help the oxidation and reduction of pollutants. Low DO conditions in the waters cause the waters to be anaerobic. This situation will trigger the decomposition of organic substances into carbon dioxide gas and methane gas, while nitrogen compounds in the water will turn into ammonia. This situation can be exacerbated as follow. If

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DO sulfur in the waters is low, it will turn into sulfide acid, which makes the waters smell badIt is because sulfide acid is a source of unpleasant odors, a smell like rotten eggs. The results of the BOD measurement in the waters shown in Table 10 show that DO in the river in each village is still good. It indicates no shortage of dissolved oxygen needed by aquatic organisms.

BOD/COD Ratio Analysis

The biodegradability of waste in waters can be seen from the large ratio of BOD/COD. It is related to the ability of the waters to decompose pollutants [36]. The value of the BOD/COD ratio can be classified into three groups, namely biodegradable, slow biodegradable, and non-biodegradable [37]. Analysis of the BOD/COD ratio can be used to measure the quality of the indications of pollution in the Konto River. The value of the BOD/COD ratio at several sampling points of the Konto River is shown in Table 11.

The results of the calculation of the BOD/COD ratio in the Konto River at five sampling points indicate that the textile industry dye waste is non-biodegradable. It shows that the Konto River has been polluted by dye waste. The status of the largest pollution is at sampling point 2. It is possible because the sampling point is a dam, so it is possible for dye waste to form in the waters. This deposit may continue to grow along with the textile industry's dyestuff waste disposal activities. Over time the quality at sampling point 2 will deteriorate.

Analysis of the Correlation of Public Perceptions with Water Quality Data

The results of interviews with public perceptions indicate that there was a temporary change in the color of the river, which caused some minor illnesses River pollution, according to the public, does not result in a decrease in the quality and quantity of agricultural products. Indications of existing pollution also do not cause a decrease in aquatic flora and fauna. The impact on the agricultural sector and the population of aquatic flora and fauna cannot be observed by the public in detail. The public issued a complaint about the textile industry's dye waste, especially on changes in river color. This indicator of color change is the basis for the strongest assumption by the public, which states that there is river water pollution.

Public perception of the indications of water pollution in the Konto River was studied scientifically by measuring the concentration of dye in the Konto River, testing the levels of COD and BOD as indicators to prove the presence of water pollution that occurred. The measurement of the dye concentration showed that the presence of the dye was found at several sampling points. At the first sampling point (the point of direct waste disposal), the largest concentration of dye was Yellow HR. The concentration of yellow HR at the first point is 68.13 ppm. The concentration of this dye in pure waste was found to be 90.26 ppm. This dye was still dominantly found at several sampling points from the second to the fourth, namely 53.21 ppm, 46.16 ppm, and 45.34ppm, respectively. At sampling point five in Wonorejo Village, there was no concentration of dye waste found, so there was no dye pollution in this area. It can happen because there is a decrease in the concentration of pollution along with the flow of river water.

The results of the measurement of dyes in Wonorejo Village can be an indication that there is a difference between public perception and data on dye concentration. However, from COD measurements, the results of COD in Wonorejo Village have exceeded the quality standard limit. Based on these facts, the high COD results may not be caused by the concentration of textile industry dyes. The results of the analysis of the water quality of the Konto River in the villages of Badas, Kuwik, Balungjeruk, and Wonorejo stated that the pollution in the Konto River was non-biodegradable. It is indicated by the high value of the COD/BOD ratio.

This fact corresponds with the results of interviews with Public perceptions with data on dye concentrations and water quality tests only in Badas, Kuwik, and Balungjeruk villages. Wonorejo Village also experienced water pollution, but the water pollution that occurred was not due to dye contamination in the waters, as people said. This result is supported by the absence of dye concentration in Wonorejo Village, but the COD/BOD ratio indicates the presence of pollutants in Wonorejo village.

Sources of pollution based on public perception may differ from actual conditions. It may be due to the influence of the time of observations made during the rainy season. Research shows that river water quality analysis must be carried out comprehensively. Not only based on public perception but also water quality data. Public perception can be used as an indicator in measuring water quality. Further research needs to be done by taking samples during the dry season to determine the level of river pollution that occurs throughout the year.

CONCLUSION

The public perception of the indications of water pollution in the Konto River by textile waste is proven to correspond. It shows a corresponding between dye concentration measurement and water quality in Badas, Kuwik, and Balungjeruk villages. However, it was notcorrespond with Wonorejo Village because the dye concentration was not found at the measurement point in the Wonorejo Village flow. On the other hand, the measurement of water quality in Wonorejo Village shows that there is pollution based on the analysis of the BOD/COD ratio, but it is not because of the dye liquid waste but the presence of other pollutant sources.

REFERENCE

[1] Indonesian Statistic Center (BPS). 2018. Realisasi penanaman modal luar negeri menurut sektor ekonomi (juta US$), 2016-2018. Indonesian Statictic Center. Jakarta.

[2] Indonesian Statictic Center (BPS). 2021. Ekspor pakain jadi (konveksi) dari tekstil menurut negara tujuan utama, 2012-2020. Indonesian Statictic Center. Jakarta.

[3] Chequer, F.M.D., G.A.R. de Oliveira, E.R.A. Ferraz, J. Carvalho, M.V.B Zanoni, D.P. de Oliveir. 2013. Textile dyes: Dyeing process and environmental impact. In: Günay, M. (Ed). Eco Friendly Textile Dye and Finishing. 157-175.

[4] Kartina, B., T. Ashar, W. Hasan. 2012. Karakteristik pedagang, sanitasi pengolahan dan analisa kandungan rhodamin B pada bumbu cabai giling di pasar tradisional Kecamatan Medan Baru Tahun 2012. *Lingkungan dan Keselamatan Kerja*. 1(2). 1–7.

[5] Lim, S.L., W.L. Chu, S.M. Phang. 2010. Use of *Chlorella vulgaris* for bioremediation of textile wastewater. *Bioresour. Technol.* 101(19). 7314–7322.

[6] Dewi, R.S., S. Lestari. 2010. Dekolorisasi limbah batik tulis menggunakan jamur indigenous hasil isolasi pada konsentrasi limbah yang berbeda. *Molekul.* 5(2). 75-82.

[7] Rasiska, S., M. Yasin, C. Nasahi, S. Hidayat, O. Mulyani. 2018. Efek limbah cair industri tekstil pasca IPAL terhadap pertumbuhan tanaman kubis dan preferensi oviposisi imago *Plutella xylostella* L. *Soilrens*. 16(2). 1-7.

[8] Nekouei, N., S. Nekouei, I. Tyagi, V.K. Gupta. 2014. Kinetic, thermodynamic and isotherm studies for acid blue 129 removal from liquids using copper oxide nanoparticle-modified activated carbon as a novel adsorbent. *J. Mol. Liq.* 201. 124–133.

[9] Asgher, M., H.N. Bhatti. Evaluation of thermodynamics and effect of chemical treatments on sorption potential of citrus waste biomass for removal of anionic dyes from aqueous solutions. *Ecol. Eng.* 38(1). 79–85.

[10] Astuti, A. 2015. Persepsi masyarakat terhadap keberadaan industri tepung ikan ditinjau dari tingkat kebauan, bau dan air limbah (studi kasus di Desa Purworejo Kecamatan Pati. *Jurnal Litbang.* 11(2). 113–123.

[11] Royani, S., A.S. Fitriana, A.B.P. Enarga, H.Z. Bagaskara. 2021. Kajian COD dan BOD dalam air di lingkungan tempat Pemrosesan Akhir (TPA) Sampah Kaliori Kabupaten Banyumas. *Jurnal Sains dan Teknologi Lingkugan*. 13(1). 40–49.

[12] Rahmadani, R.D., I.A. Ridlo. 2020. Perilaku masyarakat dalam pembungan tinja ke sungai di Kelurahan Rangkah, Surabaya. *Jurnal Promkes: The Indonesian Journal of Health Promotion and Health Education.* 8(1). 87-98.

[13] Putra, A.Y., P.A.R. Yulia. 2019. Kajian kualitas air tanah ditinjau dari parameter pH, Nilai COD dan BOD pada Desa Teluk Nilap Kecamatan Kubu Babussalam Rokan Hilir Provinsi Riau. *Jurnal Riset Kimia.* 10(2). 103–109.

[14] Kediri Regency Statistic Center. 2021. Kecamatan Kunjang dalam Angka. BPS-Statistic of Kediri Regency. Kediri.

[15] Komarawidjaja, W. 2016. Sebaran limbah cair industri tekstil dan dampaknya di beberapa desa Kecamatan Rancaekek Kabupaten Bandung. *Jukung (Jurnal Teknik Lingkungan).* 17(2). 118–125.

[16] Djuwansah, M. 2013. Status natrium pada tanah tercemar limbah lndustri tekstil di Rancaekek, Kabupaten Bandung. *Jurnal Tanah dan Iklim.* 37(1). 25-33

[17] Priya, E.S., P.S. Selvan, A.N. Umayal. 2015. Biodegradation studies on dye effluent and selective remazol dyes by indigenous bacterial species through spectral characterisation. *Desalination and Water Treatment.* 55(1). 241–251

[18] Ahmed, L.M., F.T. Tawfeeq, M.H.A. Al-Ameer, K.A. Al-Hussein, A.R. Athaab. 2016.

Photo-degradation of reactive yellow 14 dye (a textile dye) employing ZnO as photocatalyst. *J. Geosci. Environ. Prot*. 4(11). 34–44.

[19] Othman, N., R. Djamal, N. Mili, S.N. Zailaini. 2011. Removal of Red3BS dye from wastewater using emulsion liquid membrane process. *J. Appl. Sci*. 11(8). 1406-1410.

[20] Srinivasan, S., S.K. Sadasivam, S. Gunalan, G. Shanmugam, G. Kothandan. 2019. Application of docking and active site analysis for enzyme linked biodegradation of textile dyes. *Environ. Pollut.* 248. 599–608.

[21] Ince, N.H., D.A. Hasan, B. Üstün, G. Tezcanli. 2002. Combinative dyebath treatment with activated carbon and UV/H_2O_2: A case study on Everzol Black-GSP®. *Water Sci. Technol.* 46(4–5). 51–58.

[22] Lucas, M.S., J.A. Peres. 2006. Degradation of reactive black 5 by Fenton/UV-C and Ferrioxalate/H_2O_2/solar light processes. *Dyes Pigm.* 74(3). 622–629.

[23] Bristy, S.S., H. Ahmad. 2017. Studies on Adsorption performance of reactive dye Remazol Navy RGB (RN-RGB) via epoxide functional magnetic γ-Al_2O_3 nanocomposite particles. *J. Sci. Res*. 9(4). 421–429.

[24] Soonmin, H., 2018. Removal of dye by adsorption onto activated carbons: Review. *Eurasian J. Anal. Chem.* 13(4). 332–338.

[25] Jannah, F., A. Rezagama, F. Arianto. 2017. Pengolahan zat warna turunan azo dengan metode fenton (Fe^{2+} + H_2O_2) dan ozonasi (O_3). *Jukung (Jurnal Teknik Lingkungkungan)*. 6(3). 1-11.

[26] Sweta, S.K. Tank. 2019. Bioremediation of remazol blue RGB by newly isolated *Bacillus* strain. *Austin J. Microbiol*. 5(1). 1024.

[27] Estikarini, H.D., M. Hadiwidodo, V. Luvita. 2016. Penurunan kadar COD dan TSS pada limbah tekstil dengan metode ozonasi. *Jukung (Jurnal Teknik Lingkungkungan)*. 5(1). 1-11.

[28] Nurjanah, S., B. Zaman, A. Syakur. 2017. Penyisihan BOD dan COD limbah cair industri karet dengan sistem biofilter aerob dan Plasma Dielectric Barrier Dischare. *Jukung (Jurnal Teknik Lingkungkungan)*. 6(1). 1-14.

[29] Juliasih, N.L.G.R., R.F. Amha. 2019. Analisis COD, DO, kandungan posfat dan nitrogen limbah cair tapioka. *Analit: Analytical and Environment Chemistry*. 4(1). 65–72.

[30] Kospa, H.S.D., R. Rahmadi. 2019. Pengaruh perilaku masyarakat terhadap kualitas air di Sungai Sekanak Kota Palembang. *Jurnal Ilmu Lingkungan.* 17(2). 212-221.

[31] Larasati, N.N., S.Y. Wulandari, L. Maslukah, M. Zainuri, Kunarso. 2021. Kandungan pencemar detergen dan kualitas air di perairan muara Sungai Tapak, Semarang. *Indonesian Journal of Oceanography*. 3(1). 1-13.

[32] Wulandari, W.A., E.S. Soedjono. 2017. Penurunan COD dan deterjen pada saluran Kalidami Kota Surabaya dengan oksidator H_2O_2 dan $KMnO_4$. *Jurnal Teknik ITS*. 6(2). F445-F450ss

[33] Andika, B., P. Wahyuningsih, R. Fajri. 2020. Penentuan Nilai BOD dan COD Sebagai parameter pencemaran air dan baku mutu air limbah di Pusat Penelitian Kelapa Sawit (PPKS) Medan. *Quimica: Jurnal Kimia Sains dan Terapan.* 2(1). 14-22.

[34] Lolo, E.U., Y.S. Pambudi. 2020. Penurunan parameter pencemar limbah cair industri tekstil secara koagulasi flokulasi (studi kasus: IPAL Kampung Batik Laweyan, Surakarta, Jawa Tengah, Indonesia. *Serambi Engineering.* 3. 1090-1098.

[35] Daroini, T. A., A. Arisandi. 2020. Analisis BOD (Biological Oxygen Demand) di perairan Desa Prancak Kecamatan Sepulu, Bangkalan. *Juvenil*. 1(4). 558–566.

[36] Tamyiz, M. 2015. Perbandingan rasio BOD/COD pada area tambak di hulu dan hilir terhadap biodegradabilitas bahan organik. *J. Res. Technol.* 1(1). 9-15.

[37] Yustiani, Y.M., L. Mulyatna, M.A. Anggadinata. 2020. Studi identifikasi kualitas air dan kapasitas biodegradasi Sungai Cibalgio. *INFOMATEK*. 22(1). 23–30.