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Effect of population density on water quality and economic impact

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ABSTRACT

The purpose of this study is to see the effect of population density on the quality of water clarity and the economic impact. The method used in this study is sampling method at three sample locations. The results of this study indicate that population density can affect the water quality and economy of the surrounding community. From this result, it can be seen from consumptive community activities that can increase household waste that can affect water quality. This data is expected to be a solution to reduce water pollution which can affect water quality in the community and improve the economy of the community.

Keywords: Economic impact; education; population density; water quality.

INTRODUCTION

The availability of clean water is closely related to population conditions in an area. Population and development are two things that cannot be separated, because development cannot occur without a population, so the population will not prosper without development (Hunter, 2000; Mujiyani *et al.,* 2006). It happens due to the high population growth which has an impact on the quality of clean water available in an environment. Population in the world has increased in triple times, but the use of clean water has increased sixfold; it is in line with the increasing income and with higher and different food demands (Alcamo *et al.,* 2000; Cosgrove and Rijsberman, 2014). Morikawa (2011) Population density can affect water quality and pollution; this is because the higher the population is, the more the waste production can pollute water quality, the same study from Villamagna *et al.* (2010) and Chen *et al.* (2016) concerning the effect of quality on the environment. This type of population that inhibits development and plays a role in water pollution is a type of population that tends to be consumptive. The nature of the consumptive population has a very important influence on the ecosystem and access to clean water. Population density affects the increase in economic income (Al-Najar and El Hamarneh, 2019). Judging from the increasing number of residents, higher potential customers and goods or services will be offered to community settlements. Almost all service industries studied, economies of scale that are significant, and economic densities are observed, where productivity increases by 7% to 15% when urban population density doubles. Tarigan *et al.* (2016) said that Bandung is the second biggest city after Jakarta. Bandung is currently one of the most populous and metropolitan cities in West Java (Arifwidodo *et al.,* 2011). One of the areas with high population density in Bandung is called Dago. This happened because of the many tourist sites, educational institutions, and residential areas with a population of 2.5 million. This is the reason why we chose Bandung as our research location. However, there is still less number of literatures that discuss the impact of population density and its influence on the economy. This is the reason the authors examined the impact of population density on water quality and its impact on the economy.

METHOD

The method used in this study is taking samples at three sample points. The data of this study was taken from three points. The authors took 2 liters of water sample at each point: the first sample was taken from Dago Curug, the second sample was taken from water flow after Curug Dago, and the last sample was taken from Dago Pojok (densely populated residential areas). This sample was tested at Labolatorium Balai Litbang Lingkungan Keairan Jl. Ir. H. Juanda 193, Bandung 40135.

Several methods are used to analyze the composition of water, including

- SNI 06-6989. 11-2004
- APHA-AWWA-WEF 2130-B-2017
- SNI 06-6989. 29-2005
- SNI 06-6989. 9-2004
- APHA-AWWA-WEF 4500-$S0_4^2$-E-2017

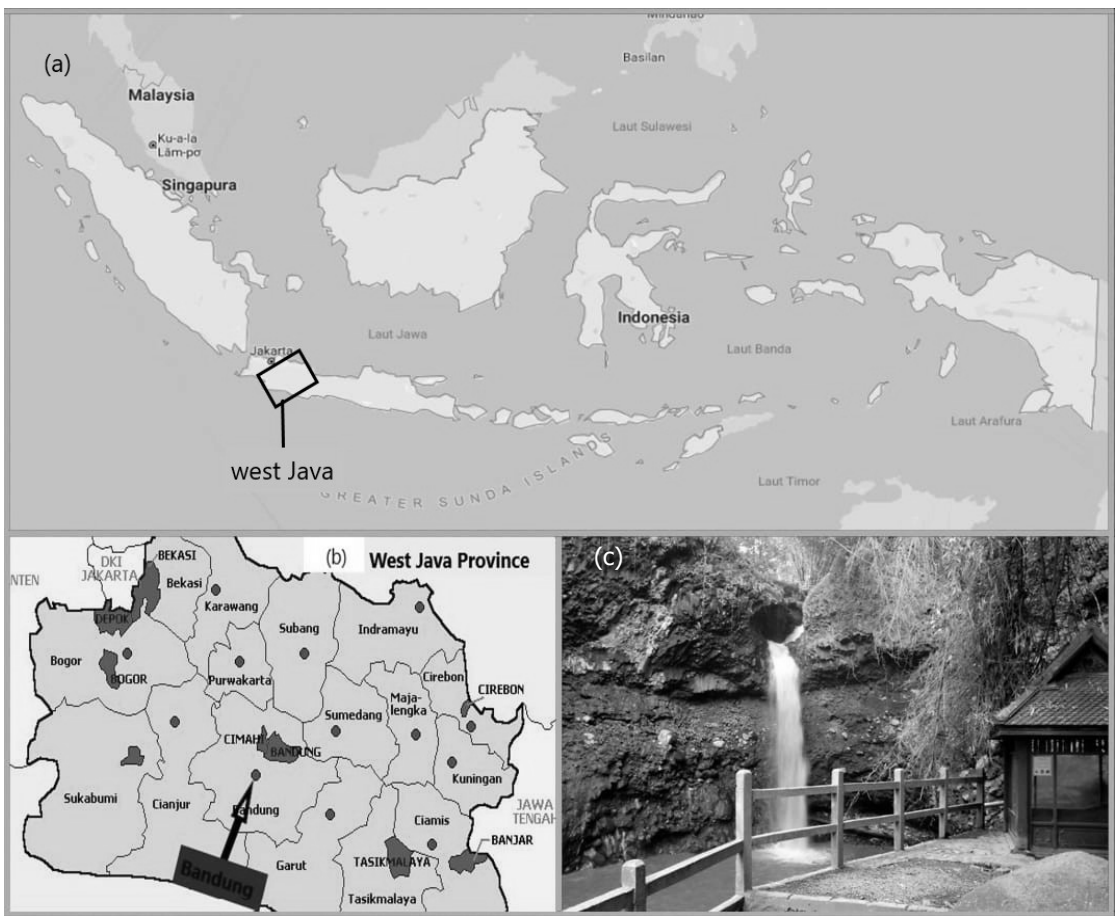

Fig. 1. Location object of research: (a) location of Java Island in Indonesian map. (b) Location of research object in Bandung city, West Java Province. (c) Location for taking water sample. Figures (a), (b), and (c) were taken from https://www.google.com/maps/place/ Indonesia/@-2.9750981,120.5268538,2911724m/data=!3m1!1e3!4m5!3m4!1s0x2c4c07d7 496404b7:0xe37b4de71badf485!8m2!3d-0.789275!4d113.921327; https://myeatandtravel story.files.wordpress.com/2017/01/cover-curug-dago-1280x853.jpg?w=1280&h=853& crop=1; and https://4.bp.blogspot.com/-bSzd2LXz2ug/WCLyBo2pVaI/AAAAAAAAHUM/7T2bnEDqmAsntMOkyyYjmVHJP-qowVA8QCLcB/s640/Peta%2BJawa%2BBarat% 2BLengkap%2BDengan%2BDaftar%2B18%2BKabupaten%2Bdan%2B9%2BKota.png, respectively.

RESULTS

Air condition

The authors were taking the first sample from the first point at Curug Dago; it is located on Jl. Dago Pojok, Dago, Coblong, Bandung, West Java. Curug Dago is a natural tourist location and far from residential areas. We tested the power of hydrogen from the sample. Laboratory power of hydrogen (pH) itself is defined as a tool to measure pH with a degree of acidity and a degree of acidity in a solution. The condition of the results from the first sample point shows that the water content is still good which is 6.90 NTU with a quality standard of pH 7.00. At the second location it shows 7.30 NTU which is located at a river after waterfall of Dago; at the second sample the number is increasing, 0.40 points. And at the third location is located in Dago Pojok; the point was decreased, 0.10 points, to 7.20 NTU.

And the results of the clarity from the water sample at this point are not clear, which is 116 mg/L with a quality standard of 5 mg / L, while at the second location the result is 114 mg/L which means the water is turbidity and the quality standard is still the same, which is 5 mg/L. As for the third location, it shows a decrease in turbidity until 22 mg/L. Although the results are still above the quality standard, but it had shown a significant decline. This is because there are several filters so that the water becomes clearer than that at the previous location. Nevertheless, the water still cannot be consumed according to SK MENKES NO. 907 / MENKES / SK / VII / 2002. The maximum level of turbidity figures allowed is NTU 5.

We also examined the fluoride content in water samples. Fluoride is defined as a negatively charged ion (Anion) derived from a halogen group element, Fluorine (F). This halide ion is widely used for oral and dental cleaning products, especially to avoid tooth decay due to bacteria. The level of fluoride at the first sample point is < 0.06 mg/L at a standard of 1.5 mg/L. The second sample was increasing from 3.95 to 4.01 mg/L. The last sample location was decreased again to 0.144 mg/L.

In the first sample the Nitrite content is 0.091 mg/L was still quite low from the standard quality determined at 10 mg/L. As for the second sample, it was decreased again to 0.208 mg/L. The third sample was increasing with the point of 0.57 to 0.161 mg/L. However, the sulfate contained in the first sample location is 11.6 mg/L of a standard quality (250 mg/L) which means the result is still under the standard that has been determined. The second location decreased significantly to < 0.001 mg/L with a decrease of 11.599 mg/L. As for the third location, it increases again to 10.1 mg/L (Table 1).

Table 1. Test result for water condition before and after the water treatment.

Parameter	Unit	Test Result			Quality Standards*
		Curug Dago	A River After Waterfall of Dago	Dago Pojok	
Ph Laboratorium	NTU	6.90	7.30	7.20	7 NTU
Turbidity	mg/L	116	114	22	5 mg/L
Fluoride	mg/L	<0.06	4.01	0.144	1.5 mg/ L
Nitrite	mg/L	0.091	0.208	0.161	10 mg/ L
Sulfate	mg/L	11.6	<0.001	10.1	250 mg/ L

Population conditions around the river stream

Badan Pusat Statistik Kota Bandung stated that during the period of 2013 - 2014 the population of Coblong District continued to increase. In 2015 the population of Coblong District was recorded as 132,002 people, with a population growth rate of 0.5 percent per year. This population is distributed to 69,030 male population and 62,972 female population (Figure 1).

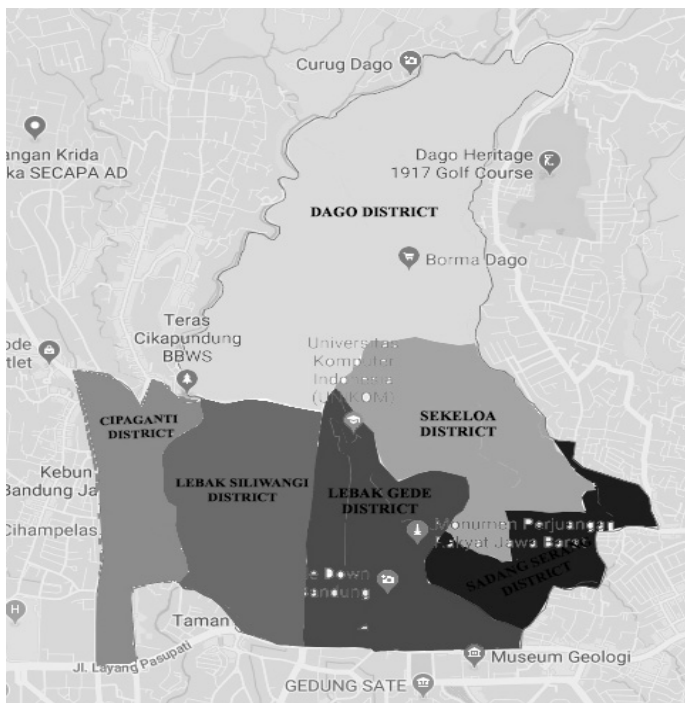

Fig. 1. Coblong district map.

With an area around 743.3 ha, the population density in 2015 reached 17,882 people/ha. This is an indication that a population growth rate of 0.5 percent will have an impact on increasing population density, which is quite high. The characteristics of the Coblong Subdistrict, which is dominated by the education sector, are the main attraction for migrants to go to school and settle in Coblong Subdistrict in a certain period.

Based on land use around the location of the river flow originating from waterfall of Dago, the purpose of land is dominated by housing from low, medium, to high density, with the population in Dago Village amounting to 29.9% of the total population in Coblong District or 29,970 inhabitants.

Economic condition of the population

In 2015 the city BPS recorded that there were around 47,194 households living in Coblong sub-district. 21,141 households had a floor area of less than 20 m^2 or around 43.84 percent. If one household is assumed to have 4 household members, then there are around 84,564 people living on a floor area of < 5 m^2. This situation reflects a slum settlement, especially if it is correlated with the population of Coblong sub-district which is so dense. The condition of the population that is relatively irregular and vulnerable to undesirable things such as house fires is an important note for the Bandung city government in general, especially the Government in Coblong Subdistrict level, the importance of the availability of housing that is suitable for the community.

DISCUSSION

Definition of used parameters

pH lab

Laboratory pH meter is a tool to measure pH condition in a solution.

Turbidity

It is one of the common tools commonly used for water or solution turbidity analysis. Turbidity Meter is a hardness testing device with optical properties due to light dispersion and can be expressed as a comparison of light reflected against the coming light. This tool is widely used in clean water treatment to ensure that the water to be used has good quality seen from its frequency level.

Fluoride

Fluoride is a negatively charged ion (Anion) derived from a halogen group element, Fluorine (F). This one halide ion is widely used for oral and dental cleaning products especially to avoid tooth decay due to bacteria.

Nitrite

Nitrite (NO2) is a form of switching between ammonia and nitrate (nitrification) and between nitrate with nitrogen gas (denitrification). Therefore, nitrite is unstable with the presence of oxygen. Nitrite content of natural waters contains nitrite of approximately 0.001 mg/L. Nitrite levels more than 0.06 mg/L are toxic to aquatic organisms

Sulphate

Sulphate is a type of polyatomic anion with the formula SO4 2- which has a molecular mass of 96.06 atomic mass units. The sulfate ion consists of a central sulfur atom surrounded by four oxygen atoms in a tetrahedral arrangement. Negatively charged sulfate ion is two and is a conjugate base of hydrogen sulfate ion (bisulfate), HSO4- which is the conjugate base of sulfuric acid, and H2SO4 is just as what Sinaga (2016) said.

The reason of changes at three locations

At the first sample location, it shows water content of 6.90 NTU with a quality standard of pH 7.00; it can be said that water quality is still in a good condition, but at the clarity level the first point is at 116 mg/L, and the turbidity level of the first point can be said that the turbidity level is very high because the turbidity standard quality is determined at 5 mg/L. The level of fluoride at the first sample location is < 0.06 mg/L with a quality standard at 1.5 mg/L. Nitrite content at the first sample location only 0.091 mg/L is still quite low from the specified standard quality 10 mg/L. At the first sample location, the changes occur because the water flowing comes directly from a river, so there is no filtering process. As for the second location, it shows 7.30 NTU and at this point the water content is still in a normal range where the quality standard is pH 7.00. So it can be said that, at the second location, the water quality is still in an unfavorable condition. At the turbidity level the second location is 114 mg/L and it only differs slightly from the first location, where the turbidity level is still very high considering the turbidity quality standard that is determined at 5 mg/L. The Florida in second location was increased from 3.95 to 4.01 mg/L. The nitrite content in the second sample decreased once again to 0.208 mg/L. At the second sample location, water changes because the water flow has some filtration and pollution so that the water is not a pure water from the first sample location and it has done several filtering processes. At the third location, pH was decreasing from 0.10 to 7.20 NTU that lower than the second location. As the turbidity level of the third location shows a decrease in turbidity until the number of 22 mg/L, it is still above from the standard quality, but it has shown a significant decrease. At the last sample point, the Florida decreased to 0.144 mg/L. At the third location the nitrite content increased to 10.1 mg/L. There is also a fairly high decreased of water pollution at the third location. It happens because the water obtained was the water that had received a filtering process from the second location, so that the water contained only a small amount of pollution.

CONCLUSION

It is concluded that, from the population density of each region, it can affect air quality and increase in the area. It is because more residents can get more activities that change the initial allocation that improves the quality of water from an area that can also change including economic improvement. Consumptive indigenous people are very concerned about ecosystems and access to obtaining clean water.

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REFERENCES

Alcamo, J., Henrich, T. & Rosch, T. 2000. World Water in 2025 - Global Modelling and Scenario Analysis for the World Commission on Water for the 21st Century. Kassel World Water Series. Centre for Environmental System Research, University of Kassel, Kassel, Germany.

Al-Najar, H. & El Hamarneh, B. 2019. The Effect of Education Level on Accepting The Reuse of Treated Effluent in Irrigation. Indonesian Journal of Science and Technology, **4**(1): 28-38.

Arifwidodo, S.D. & Perera, R. 2011. Quality of life and compact development policies in Bandung, Indonesia. Applied Research in Quality of Life **6**(2): 159-179.

Chen, Q., Mei, K., Dahlgren, R.A., Wang, T., Gong, J. & Zhang, M. 2016. Impacts of land use and population density on seasonal surface water quality using a modified geographically weighted regression. Science of the total environment **572**: 450-466.

Cosgrove, W.J. & Rijsberman, F.R. 2014. World water vision: making water everybody's business. Routledge.

Hunter, L.M. 2000. The environmental implications of population dynamics. Rand Corporation, Santa Monica.

Morikawa, M. 2011. Economies of density and productivity in service industries: An analysis of personal service industries based on establishment-level data. The Review of Economics and Statistics **93**: 179-192.

Mujiyani, Rachmawati, L. & Hidayati, D. 2006. Pemetaan Penduduk, Lingkungan dan Kemiskinan: Provinsi-Provinsi Indonesia. Pusat Penelitian Kependudukan LIPI, Jakarta.

Sinaga, F.N. 2016. Analisis Kadar Sulfat pada Air Minum Isi Ulang dengan Metode Spektrofotometri UV-Vis.

Tarigan, A.K., Sagala, S., Samsura, D.A.A., Fiisabiilillah, D.F., Simarmata, H.A. & Nababan, M. 2016. Bandung City, Indonesia. Cities **50**: 100-110.

Villamagna, A.M. & Murphy, B.R. 2010. Ecological and socio-economic impacts of invasive water hyacinth (Eichhornia crassipes): a review. Freshwater biology **55**: 282-298.