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SPATIAL DISTRIBUTION OF *FECAL COLIFORM* POLLUTION IN KARANG MUMUS RIVER, SAMARINDA, EAST KALIMANTAN, INDONESIA*

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Abstract

Samarinda is an urban area and the capital of East Kalimantan province, Indonesia. Karang Mumus River through the city of Samarinda and there are many settlement along the riverbank. Many socio-economic activities and societies are multi cultural. This research is purposed to investigate the spatial distribution of Fecal Coliform Bacteria base on its contents in Karang Mumus River, Samarinda. The methods used are observation, water sampling and laboratory test. The result is Fecal Coliform Bacteria content between 340 MPN/100mL and more than 1,600,000 MPN/100mL, exceeded the standard 1000 MPN/100mL base on Government Regulation in East Kalimantan (Perda Kaltim) No. 2/ 2011 about Management of Water Pollution. The highest contaminant of Fecal Coliform happened in urban area along the river. Its influence by many people living on the riverbank and defecating to the river. Average content of Fecal Coliform 2012-2016 in downstream is much bigger than upstream. Population in the downstream is more than upstream, especially many settlements on the riverbank in downstream area. Activity of slaughtering chickens on the market downstream and throwing their droppings directly into the river give impact Fecal Coliform increase. Livestock manure has a higher impact on the increasing Fecal Coliform content compared to the population. The solution is to treat wastewater communally by wastewater treatment plant and community assistance to instill clean and healthy living behavior.

Keywords: content, fecal coliform, river, urban

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1. Introduction

Water quality has deteriorated in Karang Mumus River. Karang Mumus River through the city of Samarinda and there are many settlement along the riverbank. There are socio-economic activities as traditional market, modern market, office, Hospital, Hotel and domestic industries dispose waste water to the river. This affects the quality of river water deteriorating. High BOD and COD content in upstream to downstream Karang Mumus River is influenced by community activities, especially in urban areas (Pramaningsih et al., 2018). Urbanization along the riverbank influence to the river water pollution (Kalavathy et al., 2011). Source of Fecal Coliform pollution come from wastewater such as septic tank and runoff in urban areas (Kelsey et al., 2004). Many settlements along the riverbank and defecate directly into the river. Report from Environment Government, Samarinda during 2010-2015 *Fecal Coliform* along Karang Mumus River exceeded the standard. High content of *Fecal Coliform Bacteria* have an impact on human health, especially the riverbank community. The use river water for daily needs such as bath, wash, latrines except for drink.

Condition of Karang Mumus River from upstream to downstream is presented in Fig. 1. Headwater condition is natural by any vegetation along the river and does not find community in riverbank. The river looks clean and clear. The other side in the downstream is no vegetation and many people live on the riverbank. The river looks dirty, smelly, lots of garbage in the river. River becomes polluted and there is no balance in the water ecosystem. Communities in the riverbank defecates and dispose of their wastewater directly into the river (Yuliana, 2013). Relocation community some area around riverbank in downstream was done. There are boats transportation from urban area to the downstream. There are port in Mahakam River estuary of Karang Mumus.

Seasonal variations give impact to the river flow and water level. In drought season, rivers water level decrease and water quality becomes worse. During wet season suddenly rivers water level increase, distribute particles of sediment and contaminant along the river give impact to the ecosystem (Chang et al., 2014). Estuary Karang Mumus is Mahakam River, that sometime Karang Mumus get effect of Mahakam flows. This project avoid Mahakam flows because we need water quality from the headwater of Karang Mumus.

Fig. 1. Karang Mumus River nearby Samarinda city
(a) upstream condition; (b) two centre segments: communities live in riverbank;
(c) downstream condition

The main objective of this study is to analyze Fecal Coliform content and spatial distribution of Fecal Coliform in Karang Mumus River.

For reaching the main goal the following tasks were solved:

- points selected of measurement along the Karang Mumus River from upstream to downstream base on pollution source potential;
- water samples collected at each of the points of measurement;
- laboratory analysis of and makes conclusion.

2. Materials and methods

This project used method field observation, water sampling and laboratory test. Standard parameter used Government Regulation in East Kalimantan (Perda Kaltim) No. 2 / 2011 about Management of Water Pollution. Spatial distribution of pollutant analysis by ArcGIS tools, to give specific location that highest *Fecal Coliform Bacteria* contaminant. Water sampling was done 17 point measurement depend on effluent waste water to the river and separate in 5 segment. There are 7 location in main river and 10 location in small river flows to main river.

3. Results and discussion

Fecal Coliform Bacteria densities base on Government Regulation in East Kalimantan (Perda Kaltim No. 2, 2011) about Management of Water Pollution, more than standard 1000 MPN/100mL, are around 340 until 1,600,000 MPN/100mL. Karang Mumus river has been polluted of *Fecal Coliform.* Result of laboratory test is presented in Table 1. Highest *Fecal Coliform Bacteria* densities happened in urban area and community riverbank area. It's caused domestic waste from residence and there are privy along the river then entering feces to the river.

Water quality of the river in the upstream of the city has been polluted and unfit for human consumption toward the downstream area (Kalavathy et al., 2011). Industrial wastes containing high concentration of microbial nutrient would promote significantly high *coliform* type and other microbial (Kanu et al., 2011). There are domestic industry in upstream of Karang Mumus River that entering wastewater to the river. Water quality of Karang Mumus river has been polluted base on report Environmental Government (BLH) around 2009-2012. It's happen because of government have not yet relocation communities lives in the riverbank (Yumita et al., 2014). *Fecal Coliform* pollution in the river also happened in tourist place, caused any human activity (Kumar et al., 2010).

Urban land use activity increase, rainfall increase, *Fecal Coliform* densities also increase. It is important parameter to identification *Fecal Coliform* in the river (Kelsey et al., 2004). These result are consistent with previous study regarding effect land use and impact of rainfall on *fecal coliform* pollution (Kelsey et al., 2004). Strategies to reduction *Fecal Coliform* are used impervious surface and redirection of storm water into wetland area, grassy swales or porous surface (Kelsey et al., 2004). Then hypothesized that pets were a substantial contributor of *Fecal Coliform* contamination. Reduction of pet waste also may be effective in reduce *fecal* pollution. The major source of *fecal* pollution come from sewage source, such as septic tank and also from stormwater runoff in urban land use (Kelsey et al., 2004).

E. Coli in water indicates contamination by human feces as pathogenic bacteria (Effendi, 2014). *Fecal Coliform* is part of *total Coliform*, 97% found in human feces and also found in animal feces. *Fecal Coliform* contamination in the surface water still below on the

standard with human activity such as washing and bathing without privy (Widyastuti and Haryono, 2016).

Table 1. Laboratory result of *Fecal Coliform* Bacteria in Karang Mumus River

#	Location	Code	Segment	*Fecal Coliform* (MPN /100mL)	Normal	Source of Pollution
1	Bridge after Benanga Reservoir	A1	1	340	1000	A little bit residence, traditional market
2	Lempake Jaya River	B2		140000	1000	
3	Bengkuring River	B3		> 1600000	1000	
4	Tepian Lempake Bridge	A2		340	1000	
5	Mugirejo-Gn. Lingai River	B4	2	> 1600000	1000	A little bit residence, traditional market
6	Gunung Lingai (Jl. P.M. Noor)	A3		13000	1000	
7	Sempaja River	B5	3	> 1600000	1000	A lot of residence
8	A.Yani (Gelatik-Pemuda) Drainage	B6		> 1600000	1000	
9	Pramuka-UNMUL River	B7		> 1600000	1000	
10	Gelatik Bridge	A4		5400	1000	
11	Lembuswana-Vorvoo Drainage	B8	4	> 1600000	1000	A lot of residence, big market, hotel, a lot of community riverbank area, centre of the city
12	S. Parman Bridge	A5		> 1600000	1000	
13	Perniagaan Bridge	A6		> 1600000	1000	
14	Jl. Gatot Subroto Drainage	B9	5	> 1600000	1000	A lot of residence, big market, hotel
15	Jl. Lambung Mangkurat Drainage	B10		> 1600000	1000	
16	P. Hidayatullah Drainage	B11		> 1600000	1000	
17	Sei Dama Bridge	A7		> 1600000	1000	

Source: Measurement 2016

Fecal Coliform contamination Karang Mumus River from upstream to downstream have got increasing. Distribution of *Fecal Coliform* contamination in Karang Mumus River is presented in Fig. 2. *Fecal Coliform* content increase from point B5 to downstream area. It's happened because a lot of residence along the river. A lot of community in the riverbank area a long B8 to B10. Many human activity from the big market, residence and community in the riverbank area entering waste to the river. Point B10 until estuary already arrange the community in the riverbank area, but still high *Fecal Coliform* impact from upstream. Nothing Waste Water Treatment found along the river. Then community in the riverbank area is a culture of the human in Samarinda, East Kalimantan. Waste Water Treatment can remove *fecal Coliform* content, but there are affecting factor such as river flow, rainfall,

groundwater movement and seasonality (Bhat, 2011). Urban area give impact to the water quality. Karang Mumus River flows through centre of Samarinda City.

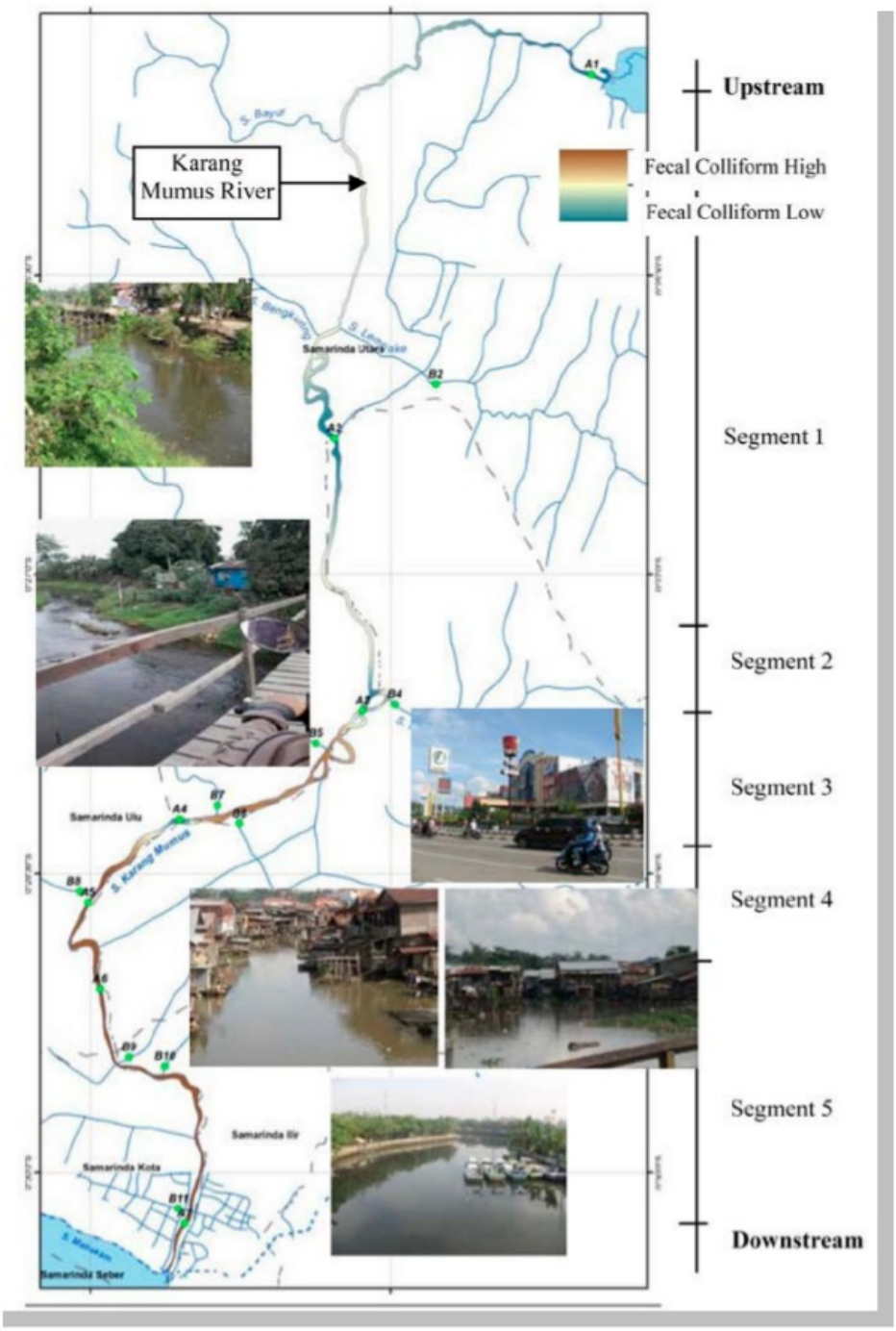

Fig. 2. Spatial distribution of *Fecal Coliform* in Karang Mumus River from Upstream to Downstream

Average content of Fecal Coliform and the percentage of pollution at least 5 years in the Karang Mumus Watershet, is presented in Fig. 3. Average Fecal Coliform is obtained from the average amount of Fecal Coliform content at each measurement point each year

from 2012-2016. Population is obtained from the percentage of population in the region that is represented at each measurement point.

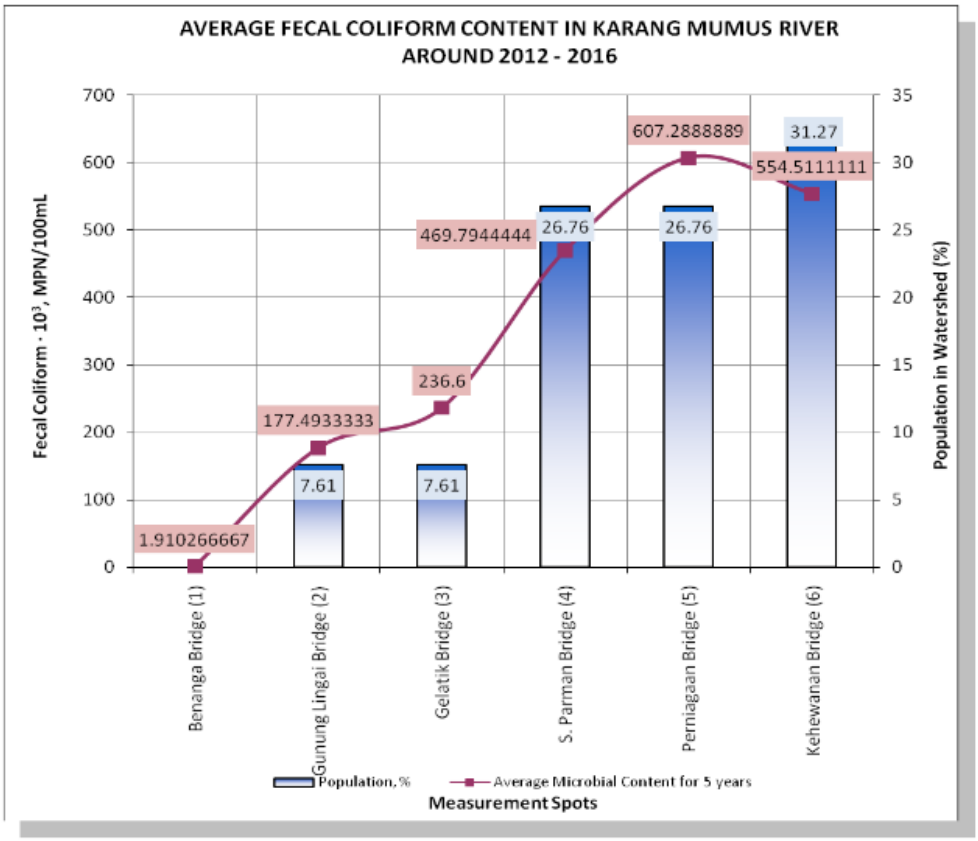

Fig. 3. Average *Fecal Coliform* content around 2012-2016 from Upstream to Downstream

Highest percentage of population is at measurement point of Kehewanan Bridge (6) reaching 31.27% and lowest is in Gunung Lingai Bridge (2) and Gelatik Bridge (3) reacing 7.61%. Kehewanan areas are densely populated urban areas and a variety of community activities. Gunung Ligai and Gelatik areas are sub urban. Highest average Fecal Coliform in Perniagaan Bridge (5) reaching 607.29 x 10^3 MPN/100mL and the lowest in Benanga Bridge (1) reaching 1.91 x 10^3 MPN/100mL. Amount of Fecal Coloform content is influenced by the population. The high population will impact to Fecal Coliform content increase in the waters. Septic tank and runoff from urban areas are important indicators of Fecal Coliform content estuary (Kelsey, et al. 2004). Although urban areas have an impact on the high content of Fecal Coliform in the estuary but there are other factors as livestock manure. Perniagaan Bridge (5) has a lower population than Kehewanan Bridge (6) but Perniagaan (5) has a higher Fecal Coliform content than Kehewanan (6). It happens because in Perniagaan (5) areas there is a large market that traders slaughtered chickens and dumped their manure direcly in to the river. It causes a high Fecal Coliform content in that area. Animal feces were identified to be more dominant sources of high Fecal Coliform content than sourced from septick tank (human) (Whitlock et al., 2002).

Karang Mumus River water discharge at 5 measurement points is presented in Fig.4. Highest discharge occurred at Perniagaan bridge (5) reaching 6.405 m^3/sec and lowest occurred at Gunung Lingai Bridge (2) reaching 1.724 m^3/sec.

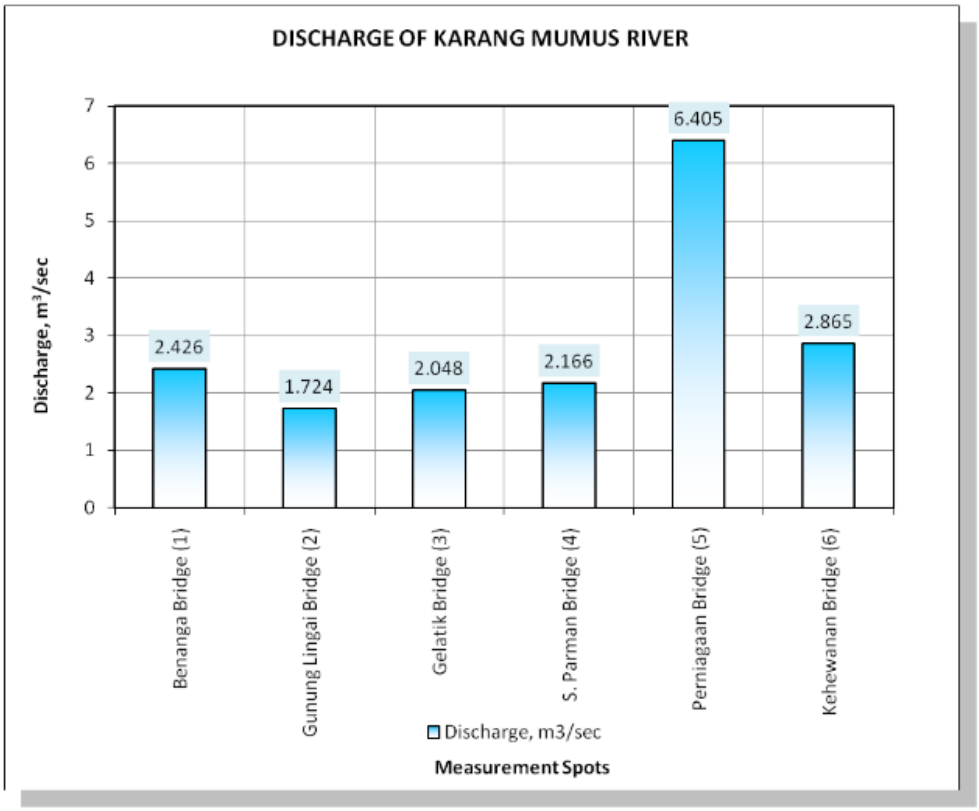

Fig. 4. Discharge of Karang Mumus River from upstream to downstream

Discharge in Perniagaan (5) areas high due to high community from market, hotel,offices and settlement. Discharge decrease significantly at Kehewaan Bridge (6) reaching 2.865 m^3/sec. It happens because width of the river in Kehewanan area is wider than in the Perniagaan area. A river with large width has a smaller flow velocity, thus affecting a smaller discharge. Base on the result of the discharge and Fecal Coliform content analysis shows that the higher discharge will impact to Fecal Coliform content increase. Average Fecal Coliform content in the last 5 years in Karang Mumus River is presented in Fig. 5.

High Fecal Coliform content occurred in July Juli (695 x 10^3 MPN/100mL), November (683 x 10^3 MPN/100mL), August (665 x 10^3 MPN/100mL) dan March (555 x 10^3 MPN/100mL). Low Fecal Coliform content occurred in September (112 x 10^3 MPN/100mL), May (191 x 10^3 MPN/100mL) and June (186 x 10^3 MPN/100mL). Content of Fecal Coliform is affected by runoff (Kelsey, et al. 2004). Amount of run off depents on the intensity of the season. Total Coliform content is high in the rainy season while the Escheria Coli content is not affected by the season because difference of a mount is not significant (Nguyen et al., 2016). Fecal Colifrom content in water decrease after there is an Waste Water Treatment Plant (WWTP) that treat liquit waste befor entering to the river (Kacar and Gungor, 2010).

4. Conclusions

Distribution of *Fecal Coliform* in Karang Mumus River upstream to downstream found increase and exceeded the standard. High Fecal Coliform content is influenced by population, human feces and especially animal feces. Fecal Coliform content is influence by

the discharge. Problems solving to reduce Fecal Coliform content in Karang Mumus River should be made Communal WWTP in each tributary and drainage.

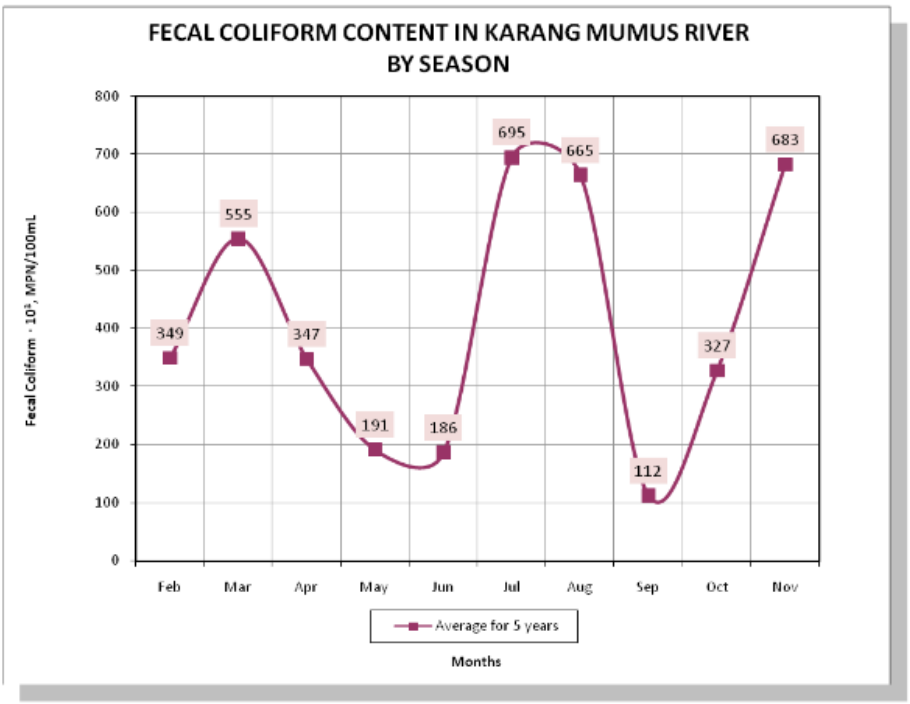

Fig.5. Fecal Coliform Content in Karang Mumus River by Season

Traders who slaughter chickens in the market must be disciplined because market position is on the riverbank. The construction of WWTP and provision of trash can in the community will improve river water quality. Relocation of the riverbank community aims to organize settlements along the riverbank and no one throws garbage and defecate directly to the river. Community assistance for instilling hygiene and healthy living behavior.

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References

Bhat S., Danek L.J., (2012), Comparition of fecal coliform before and after wastewater treatment facility: a case study bear a coastal town in the Southeastern USA, *Water Air Soil Pollution*, **223**, 1923-1930.

Chang F.J., Tsai Y.H., Chen P.A., Coynel A., Vachaud G., (2014), Modelling Water Quality in an urban river using hydrological factor – Drata driven approach', *Journal of Environmental Management*, **151**, 87-96.

Effendi H. (2014) *Telaah Kualitas Air*, Kanisius, Yogyakarta, Indonesia.

Kacar A., Gungor F., (2010), Comparison of fecal coliform bacteria before and after waste water treatment plant in the Izmir Bay (Eastern Aegean Sea), *Environmental Monitoring and Assessment*, **162**, 355-363

Kalavathy S., Sharma T.R., Sureshkumar P., (2011), Water Quality Index of River Cauvery in Tiruchirappalli District, Tamilnadu, *Archives of Environmental Science,* **5**, 55-61.

Kanu Ijeoma O.K., (2011), Industrial effluents and their impact on water quality of receiving rivers in Nigeria*, Journal of Applied Technology in Environmental Sanitation,* **1**, 75-86

Kelsey H., Peter D.E., Scott G., Neet M., White D., (2004), Using geographic information systems and regression analysis to evaluate relationship between land use and fecal coliform bacterial pollution, *Journal of Experimental Marine Biology and Ecology,* **298**, 197-209.

Kumar A., Bisht B.S., Joshi V.D., Singh A.K., Talwar A., (2010), Physical, chemical and bacteriological study of water from Rivers of Uttarakhand, *Journal of Human Ecology*, **32**, 169-173.

Nguyen H.T.M, Phuong Q.T., Garnier J., Janeau J.L., Newall E.R., (2016), Seasonal variability of fecal indicator bacteria numbers and die-off rates in the Red River Basin, Nort Viet Nam, *Scientific Reports,* **6**, 21644, On line at: www.nature.com/scientificreport/.

Pramaningsih V., Suprayogi S., Purnama S.Ig.L, (2018), Kajian Persebaran Spasial Kualitas Air Sungai Karang Mumus, Samarinda, Kalimantan Timur, *Jurnal Pengelolaan Sumberdaya Alam,* **7**, 211-218.

Perda Kaltim No. 2, (2011), Water Quality Management and Water Pollution Control, (in Indonesian: Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air, On line at: tentang Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air.

Widyastuti M., Haryono E., (2016), Water quality characteristics of Jonge Telaga (Doline Pond) as water resources for the people of Semanu District Gunungkidul Regency*, Indonesian Journal of Gheography*, **48**, https://doi.org/10.22146/ijg.17595.

Whitlock J.E., Jones D.T., Harwood V.J., (2002), Identification of the source of fecal coliforms in an urban watershed using antibiotic resistance analysis, *Water Research*, **36**, 4273-4283

Yuliana I., (2013), Study of community knowledge of the environmental conditions of population settlements on the banks of the Karang Mumus River (in Indonesian: Studi tentang Pengetahuan Masyarakat terhadap Kondisi Lingkungan Pemukiman Penduduk di Bantaran Sungai Karang Mumus)*, eJournal Sosiatri-Sosiologi*, **1**, 20-30, On line at: http://e-journal.sos.fisip-unmul.org.

Yumita N.D.S., Sina L., Wardana K.W., (2014), Tinjauan Yuridis Dampak Relokasi Warga terhadap Lingkungan Hidup di Sungai Karang Mumus Kecamatan Samarinda Ilir, *Jurnal Beraja Niti*, **3**, http://e-journal.fhumnul.ac.id/index.php/beraja

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