Analisis Spasial dan Temporal Beban Pencemar Organik dan Nutrien dari DAS ke Badan Air - Studi Kasus : Sungai Ciliwung = A Spatiotemporal Analysis of Organic Pollutants and Nutrients Loading from Watershed to the Water Body in Ciliwung River, Indonesia

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Abstrak

Sungai Ciliwung merupakan salah satu sungai di Pulau Jawa yang tercemar oleh limbah dari aktivitas rumah tangga, komersial/industri serta pertanian. Pesatnya pertumbuhan penduduk akan memicu adanya perubahan tata guna lahan. Seiring dengan pertumbuhan penduduk dan perkembangan aktivitas manusia di berbagai sektor, pencemaran air sungai menjadi masalah serius yang dihadapi oleh manusia. Tujuan dari penelitian ini adalah untuk melakukan analisis spasiotemporal terhadap konsentrasi dan beban pencemar air Sungai Ciliwung serta korelasinya dengan tren perubahan tata guna lahan untuk mengetahui faktor-faktor dominan yang memengaruhi beban pencemaran sungai tersebut. Analisis dilakukan terhadap parameter pencemar organik dan nutrien (BOD, COD, DO, TSS, NH3, NO2, NO3 dan Total Fosfat) dengan menggunakan data debit dan kualitas air Sungai Ciliwung dari BBWS Ciliwung – Cisadane. Secara spasial, konsentrasi dan beban pencemar organik dan nutrien dari hulu ke hilir cenderung menunjukkan peningkatan dari hulu hingga ke hilir. Sedangkan secara temporal, konsentrasi pencemar organik (BOD dan COD) memuncak di tahun 2018 kemudian mengalami penurunan hingga tahun 2020. Kemudian, konsentrasi pencemar nutrien (NH3, NO3, T-P) dan TSS paling tinggi adalah pada tahun 2020. Tren beban BOD, NH3, NO2dari tahun 2016 – 2020 meningkat, sedangkan tren beban COD, TSS, NO3, dan Total Fosfat dari tahun 2016 – 2020 menurun. Bila dilihat dari tren perubahan tutupan lahan dan nilai koefisien korelasi, peningkatan persentase lahan permukiman menyebabkan meningkatnya beban pencemar. Hal tersebut ditunjukkan dari hasil uji korelasi yang positif kuat-moderat antara keduanya. Sedangkan hasil uji korelasi persentase lahan pertanian dengan beban pencemar menunjukkan korelasi negatif moderat dengan lahan pertanian. Dari hasil uji tersebut dapat diperkirakan bahwa limbah aktivitas pertanian secara kuantitas tidak lagi signifikan terhadap pencemaran di badan air bila dibandingkan dengan kegiatan domestik. Selain itu, rata-rata rasio BOD/COD didapatkan kurang dari 0,3 (bersifat non-biodgradable) sebagai indikator adanya pencemaran dari kegiatan non-domestik seperti kegiatan komersil/industri dan TPA. Hasil penelitian menunjukkan bahwa aktivitas antropogenik yang paling dominan memengaruhi beban pencemar organik dan nutrien di DAS Ciliwung dalam penelitian ini adalah kegiatan domestik (secara khusus akibat limbah greywater), serta limbah kegiatan komersil/industri yang tidak memenuhi standar yang ditetapkan namun langsung dibuang ke saluran air dan mengalir ke badan air.

.....Ciliwung River is one of many rivers on the Java Island which is polluted by waste from domestic, commercial/industrial and agricultural activities. The rapid population growth caused changes in land use. Along with population growth and the development of human activities in various sectors, river pollution became a serious problem for humans. The purpose of this study is to conduct a spatiotemporal analysis of the concentration and pollutant load of the Ciliwung River and its correlation with the trend of land use changes to determine the factors that dominantly influence the river pollution. The analysis was carried out on the parameters of organic pollutants and nutrients (BOD, COD, DO, TSS, NH3, NO2, NO3 and Total

Phosphate) using the flow and water quality data of the Ciliwung River from BBWS Ciliwung – Cisadane. Spatially, the concentration of organic pollutants and nutrients increased from upstream to downstream. Spatial variations in organic and nutrient pollutant loads also tend to show an increase from upstream to downstream. Meanwhile, temporally, the concentration and load of organic pollutants (BOD and COD) peaked in 2018 and then decreased until 2020. Then, the concentration and load of nutrient pollutants (NH3, NO3, T-P) and the highest TSS was in 2020. The trend of BOD, NH3, and NO2 loads from 2016 – 2020 increased, while the trend of COD, TSS, NO3, and Total Phosphate loads from 2016 – 2020 decreased. From the trend of land cover changes and the value of coefficient correlation, an increasing percentage of residential land caused an increasing pollutant load. This is indicated by the results of a strong-moderate positive correlation test between those two. While the results of the correlation test of the percentage of agricultural land with the pollutant load showed a negative correlation. From that results, it can be estimated that the waste of agricultural activity is no longer significant in terms of pollution in water bodies compared to domestic activities. In addition, the average BOD/COD ratio was found to be less than 0,3 (non-biodgradable) as an indicator of pollution from non-domestic activities such as commercial/industrial activities or landfill runoff. The results showed that the most dominant anthropogenic activities affecting organic and nutrient pollutant loads in the Ciliwung watershed in this study were domestic activities (particularly due to greywater waste), as well as the waste of commercial/industrial activities that did not meet the established standards but were directly discharged and flowed into a water body.