ORIGINAL RESEARCH PAPER

Environmental Science

THE IMPACT OF AGRICULTURAL ACTIVITIESON LOAD CAPACITY IN THE UPPER CIMANUK WATERSHED, WEST JAVA, INDONESIA

KEY WORDS: pollutant load, agricultural activities, load capacity

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ABSTRACT

The upper Cimanuk Watershed is dominated by agricultural activities as much as 72% of the existing land area. Agricultural activities have contributed as the largest pollutant source besides livestock and industry. 10% of dryland farming is on very steep land, 32% of dryland farming and 25% of rice fields are in steeplands, 42% of dryland farming and 33% of rice fields are on rather steep. Agricultural on land with a very steep slope up to a steep slope, has greater potential than sloping and flat. The erosion of topsoil is a major source of pollutants from dryland farming. Increased agricultural activity by 10% can decrease the capacity of 12.55%. If the agricultural activity of 10% is converted to forest then there is an increase of capacity as much as 8%. Restrictions on the size of agricultural land need to be done to prevent the decrease of river water quality. It can be done by arranging the layout of agricultural land so as not to reduce agricultural productivity.

INTRODUCTION

Uncontrolled land use of the upper Cimanuk watershed causes a decrease in river water quality. The status of the average water quality in Cimanuk River based on the Water Quality Standard is heavily polluted where the parameters of Total Suspende Solid (TSS), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), detergent, stool, nitrate, nitrite, sulfide, and Disolved Oxygen (DO) has exceeded the class II water quality standard (Environmental Management Agency of West Java, 2012)

The heavily polluted Cimanuk water quality is also mentioned by Yuanda et al. (2012). In the condition of water quality is weighted heavy, if there is addition of pollutant load into the waters then the waters are no longer able to accept pollutant load.

The upper Cimanuk watershed is dominated by agriculture activities of 75%, which includes dryland farming, rice fields, and plantations. It is possible that agricultural activities become the biggest contributor to the poor quality of Cimanuk River water.

According to the description above, it needs to conduct an analysis of pollutant load potential of agricultural activities in the upper Cimanuk watershed. The result is expected to be one of the guides in arranging a management of the upper Cimanuk watershed in the future.

METHODOLOGY

Research Location

The research location covers 2 administrative areas of Sumedang and Garut regencies. The upper Cimanuk watershed area from the foot of Mount Papandayan up to a height of + 750 m (a.s.l). It located between 107°42'16'' - 108°10'54'' EL and 06°45'00'' - 07°24'30'' SL with an area of ± 152,982 , 67 ha (Territory Agency of Cimanuk Cisanggarung Rivers, 2013). The location of the research can be seen in Figure 1.

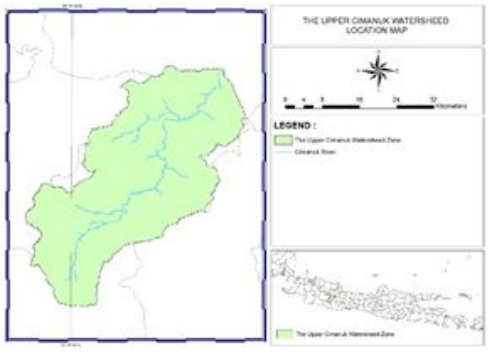

Figure 1: research location
Sources: Territory Agency of Cimanuk Cisanggarung Rivers, 2013

Data Collection Technique

Data collection technique of this research is direct measurement method in field for primary data. Case study and literature for obtaining secondary data from related institution i.e. Environmental Management Agency of West Java, Watershed Management Agency of Cimanuk-Citanduy, Territory Agency of Cimanuk Cisanggarung Rivers, and Water Resources Center of West or literature on research results with similar cases

Analysis of Load pollutant potential

Analysis of pollution load potential based on land use as emission factor. Potential pollutant loads of agricultural activities affect the parameters of BOD, N, P, TSS, and pesticide. Analysis based on land use as an emission factor (Fatmawati et al., 2012).

Analysis of Load Capacity

Method for determining the load capacity of water pollution on water source using QUAL2Kw model (Pelletier et al. 2006). QUAL2Kw modeling applies the process of dissolving oxygen dissolution (deoxygenation) due to bacterial activity in integrating

organic material in water (Kalburgi, 2012). The process of increasing dissolved oxygen (reaeration) QUAL2Kw is a river water quality model for steady flow that includes many new elements (Lestari, 2012). Conventional sensitivity analysis is done by varying the important parameters that have an effect on the output model (Kannela et al. 2012). Water quality management uses several scenarios created by changing the input parameter model (Kori et al. 2012).

CASE STUDY

The upper of Cimanuk watershed land use can be seen in figure 2.

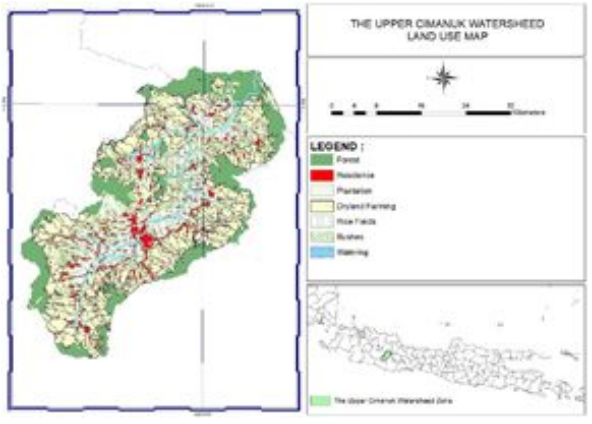

Figure 2: the upper cimanuk watershed land use map

Sources: Planology and Forestry Agency, 2013

The upper Cimanuk watershed land use consist of forest 20.42%, dryland farming at 47,01%, rice field at 24,25%, plantation at 1,15%, bushes at 0,72%, residence at 6,43%, and watering at 0,03%.

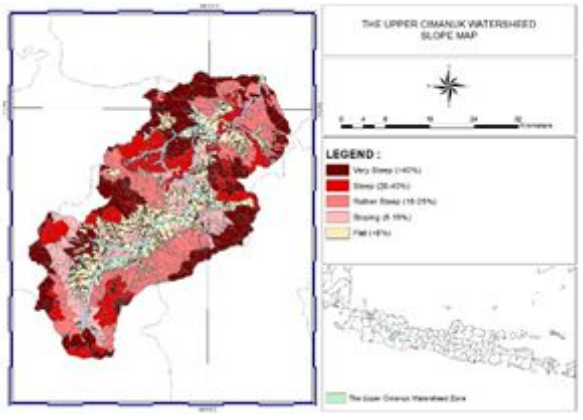

Figure 3: the upper cimanuk watershed slope map

Sources: Planology and Forestry Agency, 2013

The composition of the upper cimanuk watershed slope consist of very steep at 29.99%, steep at15.60%, rather steep at 20.81%, sloping at 11.20%, and flat at 22.4%. 10% of dryland farming is on very steep land, 32% of dryland farming and 25% of rice fields are on steep fields. 42% of farming land agriculture and 33% of rice fields are on rather steep land. The rest on the land is flat and flat.

Based on storet analysis, water quality of Cimanuk upstream for Boyongbong is -75, Sukaregang equal to -85, and Wado equal to -69. All three locations have a heavily polluted status (Environmental Management Agency of West Java, 2015)

The upper Cimanuk watershed pollutant load is influenced by land use as pollution load pollution factor. Pollutant load potential calculations also consider the activities of communities in the basin area. These activities include livestock, industry and domestic activities (residence, hospitals, & hotels).

POLLUTANT LOAD POTENTIAL OF AGRICULTURAL ACTIVITIES

The area of agricultural land in the Upper Cimanuk watershed consists of rice fields of 29,808.79 ha and dryland farms of 59,197.48 ha Agricultural activities contribute to the increase of BOD, N, P, TSS, and pesticides. The contribution of dryland farming as a source of pollutant load in BOD parameter amounts to 15143.66 kg/day ; N parameter at 4,85 kg/day; P parameter at 34924.91 kg/day; TSS parameter at 1,17 kg/day; and pesticide parameter at 558.80 kg/day.

Agriculture on land with a very steep, steep, and rather steep slope, has greater potential than sloping or flat. The erosion of topsoil is a major source of pollutants from dryland farming. It also has the potential to increase TSS in river waters. The area adjacent to the river is dominated by rice fields. This causes the potential of pollutant load, especially pesticides that enter the waters.

The distance from the pollutant source to the river affects the amount of pollutant load of river water. If the location of the polluter source is far from the water, it is possible to have self purification before entering the river.

The contribution of agriculture as a source of pollution is seen in the high value of BOD and TSS. High BOD shows the high organic material entering the river. The source of pollutants comes from the erosion of humus on dryland farms. TSS illustrates the high rate of erosion on farmland. Based on the results of analysis of domestic waste pollutant sources illustrates that the contribution of domestic waste to the increase of BOD is only 2%. This explains that the main cause of high BOD is agricultural activities.

Agricultural activities should be conducted in areas with flat, sloping and slightly steep slopes to minimize the occurrence of humus and soil erosion. Agricultural activities should be carried out in areas far enough from the river that allow agricultural waste to decompose before entering the river. This should also be balanced by maintaining the water quality in the tributaries to support the occurrence of self purification.

ANALYSIS OF LOAD CAPACITY CHANGES

Based on the analysis of Qual2Kw illustrates that all sections of the river have exceeded the standard quality of class 2. Increased agricultural activity by 10% can decrease the capacity of 12.55%. If the agricultural activity of 10% is converted to forest then there is an increase of capacity as much as 8%. This happens because the forest is also a source of pollutants so that it becomes a contributor in the decline in capacity.

If it is converted to settlements, livestock and industry, the rising pollution load depends not only on the area of land converted but also the number of pollutants.

CONCLUSIONS

The area of agricultural land in the Upper Cimanuk watershed is 42% and agricultural activities contribute 23% of all pollutant sources. Restrictions on the size of agricultural land need to be done to prevent the decrease of river water quality. Prevention of river water quality degradation can also be done by arranging the layout of agricultural land. It does not reduce agricultural productivity.

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