THE IMPACT OF FARMING ACTIVITIES TO WATER QUALITY OF RIVER AND LAKE RAWA PENING
(Case study in Semarang Regency, Indonesia)

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master in Environmental Sciences

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THESIS

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PERNYATAAN

Saya menyatakan dengan sesungguhnya bawah tesis yang saya susun sebagai syarat untuk memperoleh gelar Magister dari Program Magister Ilmu Lingkungan seluruhnya merupakan hasil karya saya sendiri.

Adapun bagian-bagian tertentu dalam penulisan Tesis yang saya kutip dari hasil karya orang lain telah dituliskan sumbernya secara jelas sesuai dengan norma, kaidah dan etika penulisan ilmiah.

Apabila di kemudian hari ditemukan seluruh atau sebagian tesis ini bukan hasil karya saya sendiri atau adanya plagiat dalam bagian-bagian tertentu, saya bersedia menerima sanksi pencabutan gelar akademik yang saya sandang dan sanksi-sanksi lainnya sesuai dengan peraturan perundangan yang berlaku.

Semarang, 24 Agustus 2010

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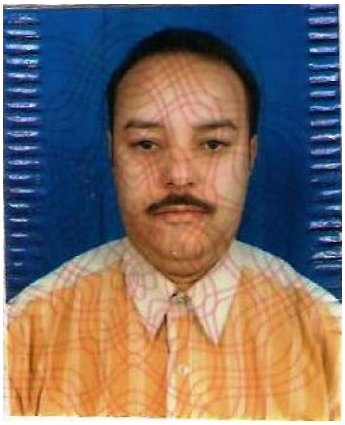
CURRICULUM VITAE



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ABSTRACT

Fertilizer is essential substance in agricultural activities around Rawa Pening Lake. However, it has caused water pollution in water bodies around the lake. This study was conducted to measure water quality parameters, especially the concentration of the potassium, nitrate and phosphate in the water of 6 input rivers of Rawa Pening Lake and in water hyacinth plant in the lake to see the impact of fertilizers use in rice fields around these watersheds to water quality.

This was a quantitative research. Samples of water from five different locations in the 6 input rivers and also water hyacinth from five different locations in the lake were taken during this study to be analyzed in the laboratory to get the concentration and load of (N), (P) and (K) in these waters and in water hyacinth in the lake .

What this study found was that among the six input rivers the highest concentration of (N) was found in Parat River (0.60 mg/l), (P) in Kedungringin River (0.29) and (K) in Torong River (2.48 mg/l). The total load of (N), (P) and (K) found in the output river (34,860 kg, 17,511.6 kg and 14,430 kg/season respectively) were lower than the total load of (N), (P) and (K) from the input rivers (17,308.8 kg, 2,554.8 kg and 11,869.2 kg/season respectively). This means that some amount of (N), (P) and (K) substances simply stayed and accumulated in the lake water (17,551.2 kg, 14,956.8 kg and 2,560.8 kg of (N), (P) and (K) respectively. From these amount of nutrients accumulated in the lake's water every season water hyacinth plant in the lake had in total absorbed around 73,560 kg of (N) 18.02kg of (P) and 21,120 kg of (K).

One recommendation which can be put forward here is for the farmers around the lake to reduce their fertilizers usage which can be absorbed by water hyacinth plant in the lake and compensate it by utilizing water from these input rivers which had already contain some amount of nutrients.

Keywords: Rawa Pening Lake, potassium, nitrate, phosphate, eutrophication

ABSTRAK

Penggunaan pupuk sangat penting dalam pertanian di sekitar Rawa Pening. Sayangnya hal ini mengakibatkan polusi di perairan sekitar danau. Penelitian ini dilakukan untuk mengukur parameter-parameter kualitas air, terutama konsentrasi kalium, nitrat dan fosfat di 6 sungai yang mengalir ke Rawa Pening dan di tanaman eceng gondok di danau, untuk melihat pengaruh penggunaan pupuk di areal persawahan sekitar sungai terhadap kualitas air.

Studi kuantitatif ini dilakukan dengan mengambil sampel air dari lima lokasi berbeda di masing-masing enam sungai input dan sampel tanaman eceng gondok dari lima lokasi berbeda di Rawa Pening agar bisa dianalisia tingkat konsentrasi (N), (P) dan (K) di laboratorium. Beban (N), (P) dan (K) juga dihitung.

Penelitian ini menemukan bahwa diantara enam sungai input konsentrasi (N) tertinggi ditemukan di Sungai Parat (0,60 mg / l), (P) di Sungai Kedungringin (0,29 mg/l) dan (K) di Sungai Torong (2,48 mg / l). Total beban (N), (P) dan (K) yang ada di sungai output (17,308.8 kg (N), 2,554.8 kg (P) dan 11,869.2 kg (K) per musim) lebih rendah dari total beban (N), (P) dan (K) dari sungai-sungai input (34.860 kg (N), 17,511.6 kg (P) dan 14.430 kg (K) per musim. Ini berarti sejumlah (N), (P) dan (K) tinggal dan terakumulasi dalam air danau (17,551.2 kg (N), 14,956.8 kg (P) dan 2,560.8 kg (K). Dari jumlah akumulasi nutrisi dalam air danau ini tanaman eceng gondok di danau itu secara total telah menyerap sekitar 73.560 kg (N) 18.02 kg (P) dan 21.120 kg (K).

Salah satu rekomendasi yang dapat diajukan di sini adalah agar para petani di sekitar danau mengurangi penggunaan pupuk mereka yang dapat diserap oleh tanaman air eceng gondok di danau dan menggantinya dengan memanfaatkan air dari sungai-sungai input yang sudah mengandung nutrien.

Kata kunci: Rawa Pening Lake, kalium, nitrat, fosfat, eutrofikasi

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CHAPTER I
INTRODUCTION

1.1 Background

Rawa Pening Lake is an important water body in the Semarang area which has been utilized for many things from irrigation, tourism object and even hydropower generation. The lake's existence however, is under serious threat due to pollution in its water. The study wanted discover some of the problems that affect the lake's environment, especially in connection with the agricultural activities around the lake and usage of fertilizers.

Water quality can decrease if organic material in the water becoming excessive as a result of the entry of wastes of human activity (such as organic waste from industry). This will mean the provision of carbon is very abundant, causing the rate of growth of microorganisms to double. In turn this will mean also the increased demand for oxygen, while the amount of supply of oxygen from the air remains constant. In this case, the balance between oxygen in the water with that used by organisms in the water is not balanced, resulting in a deficit of oxygen dissolved in the water. If the maximum level of dissolved oxygen remained close to zero, plants and aquatic animals that need oxygen will die and be replaced with the growth of microbes that do not require oxygen or microbial anaerobic. Similarly, bacterial aerobic and anaerobic microbes also take advantage of carbon dioxide from organic material.

Problems that emerged in the region as a whole in Rawa pening Lake area are the problems of pollution and environmental damage caused by high levels of sedimentation, and high rates of growth and development of aquatic plants, which resulted in reduced water quality. In addition to this there is also other problem associated with conflict of interest in the utilization of Rawa Pening Lake. Water hyacinth plant, for example, has covered around 30% of the water surface in the lake. This large presence of water hyacinth has brought negative.

In Rawa Pening Lake's ecosystem, water hyacinth is one of the vital components that play a role as producer of oxygen with the help of solar energy and chlorophyl in the leaves. Water hyacinth has also become source of food for different kinds of organisms that live in Lake Rawa Pening, such as insects, fish, shellfish and other species. In Lake Rawa Pening, water hyacinth is often used as a place to post eggs for some animals. Some bird species also make the mass of water hyacinth in the lake's surface as a place to nest. This plant is useful for the growth of different fungi and bacteria, as well as organisms in the lake.

The presence of Water hyacinth in the lake Rawa pening has also become a shelter of different types of aquatic animals such as fish and aquatic insects, animals. Rats, frogs and various other animals would also like to make use the vast population of water hyacinth in the lake. Area under the water hyacinth is a comfortable place fish species in Rawa Pening Lake. Water hyacinth is capable also of absorbing many nutrients and pollutants, including heavy metals, released into the lake due to agricultural activities and fish farming. Dead water hyacinth will sink under the water and accumulate at the bottom.

Partially decomposed and released nutrients in the different aquatic environments that can be used again for many objects in the water. The parts that did not decompose will form organic layer in the bottom water, called a layer of peat. Community around the lake used peat as a solid fertilizer and they usually call it green manure. Green manure can improve soil quality by increasing the organic content of the soil. Communities also made use of water hyacinth as food ingredients and media for growing mushrooms, handicraft and to cover the ground (PSDA Jateng, 2008).

Water content in water hyacinth is very high, so it is very important to make the introduction of technology to reduce the water content to make utilization of the plant more successful. Around 90% of water hyacinth's content is water (Navarro and Phiri, 2000). In addition to benefits mentioned above, water hyacinth can also be used as raw material for the manufacture of paper, crafts, and to produce biogas. Today we can see many people depend their livelihood on the utilization of water hyacinth. According to a study in 2002, it was estimated that water hyacinth had covered an area of up to 30% of

the surface water in the lake, and in subsequent years, the number was expected to continue to rise. The results from the study showed that there are two forms of growth and growth of any growth of abnormal and normal. Excessive growth of water hyacinth plant in Rawa Pening Lake, however, can lead to many problems.

Runoff of agricultural and human waste laden with nutrients (nitrates and phosphates, for example) can lead to eutrophication and degrade water quality which then leads to the deterioration of system performance of an ecosystem. Once beyond certain limits, the system may change to a very different state and collapse. For example, excessive nutrients in freshwater and coastal ecosystems can cause sudden and large-scale changes, which may lead to a proliferation of algae and the depletion of oxygen, which makes the most of animal life impossible.

Eutrophication process, including the one going on in Rawa Pening Lake, has become one of complicated problems in Indonesia due to its relation with the community's activities living around the water body under threat from eutrophication process. Because many people depend their livelihood on the lake necessary actions should be taken to protect the lake from threat of extinction.

In Rawa Pening Lake sedimentation has caused the lake water to overflow and inundated rice fields in its immediate area. The sediments in the lake was present in the lake due to erosion materials brought into it by its nine watersheds and the decaying water hyacinth plant that submerged below the lake's surface. According to local people water hyacinth plant has also affected tourism activities, especially in the boat renting business, because many tourists did not want to travel around the lake on boat for fear of the plant would trap their boat in the middle of the lake (Kompas, 2010).

This research will speak on the environmental impact of fertilizers on water quality in the Rawa Pening Lake. In Indonesia there has been increasing contamination in the water as a result of the neglecting of environmental assessment due to the rapid economic growth. About 40% of java population does not have excess to clean drinking water. Eight major rivers on the northern coasts are seriously contaminated, and with the consequent withdrawal of groundwater, salt water intrusion into aquifers that provide

water for domestic use is also happening. These activities affect upon the environment in similar ways on a large scale, in the form of soil erosion, degradation of rivers and alteration of hydrological systems. Another important source of pollution is disposal of industrial effluents in the water, which is the inevitable consequence of industrialization. One place where this phenomenon happened was in Rawa Pening, where many people depend their livelihood on it. This is the main reason for choosing this study on the Rawa Pening Lake. The most important thing is many people depend upon it, some depend upon planting the rice and another depends on the fishing. Thus we must protect the lake from becoming harmful for the general health.

Awarded funding in some work units at the regional level in Central Java to the rescue programs did not reduce the rate of environmental degradation in Rawa Pening, Semarang Regency. The problems faced by the lake are the relatively large accumulation of sediment and water pollution as results of erosion of particles in nine sub-watersheds flowing to Rawa Pening water and the disposal of household waste, waste from agricultural activity, and the vast presence of water hyacinth.

Water hyacinth plants proved to be a problem in Rawa Pening because of their growth, which has reached 20-30% of the surface area of water. For comparison, 0.5 hectares of water hyacinth can weigh more than 200 tons. This large presence of water hyacinth in the Rawa Pening has reduced the volume of water, increased sedimentation rate, decreased concentration of oxygen in the water, and inhibited irrigation channels, fishing and transportation activities.

This natural reservoir in the area of Semarang has become smaller due to high sediment and water pollution. Without a concerted effort to address this matter, it is expected that the lake area of 2600 hectares will dry up and turn into dry land in 2015 or 2020. As a result, 18,784 hectares of irrigated rice fields and will be left without irrigation, hydropower plant with a capacity of 25 megawatts cannot work and the amount of water for industry will also stall.

Pessimistic forecast on the lake’s future has also been voiced. Based on satellite imagery 2001-2007 this natural reservoir had experience shrinkage due to high

sedimentation and land utilization activities in its critical watersheds areas. Nine rivers which flow into the lake discharged 778 tons of sediments per year. And trace of water contamination in the lake has also been found, as shown in the nutrients content in the water.

High nutrients content in the water encourages more rapid growth of water hyacinth as the organic matters needed for life are abundant. Water hyacinth coverage in the lake's surface was currently estimated at 30 percent, which exceeded the safe limit of 5 percent.

Agricultural activities around the lake were thought to be one of the causes of this phenomenon as materials from fertilizers such as phosphorus; potassium and nitrogen were released from rice fields into the rivers around it, and subsequently, the lake. It has caused many problems in the lake as it has induced the growth of algae, bacteria and water plant, while also caused reduction of oxygen in the water. Villages on the banks of the Rawa Pening, as of 2008 complained of a decline in fishing. A good policy as a whole in the area of Pening Rawa and its watersheds is needed to address these issues.

1.2 Problem of study

Residual of fertilizer has had its impact on water quality in the water bodies around Rawa Pening Lake. It has also promoted water hyacinth growth and accelerated eutrophication process in the lake. The growth of water hyacinth in it was very fast, because the concentration of P, K, and, N fertilizer in the lake water were high.

1.3 Research Objectives

1. To measure concentration and load of the potassium, nitrate and phosphate in the water of Rawa Pening Lake's, six up Stream Rivers (Legi, Sraten, Kedungringin, Torong, Parat and Ringin) and downstream river (Tuntang).

2. To study the environmental impact of fertilizers usage in Rawa Pening Lake's catchment areas.

1.4 Significance of Study

This research is very important to ascertain the water pollution problem in Rawa Pening Lake and its surrounding rivers. This research can also give a true picture on the state of water quality in connection with the pollutant contributed by fertilizers usage in agricultural activities so that some actions and mitigation plan can be taken to improve the quality of water of the lake and rivers from being seriously polluted.

1.5 Benefits of Study

The findings in this study can provide the data in monitoring water quality levels in Rawa Pening Lake and its surrounding rivers. It is also hoped that the findings and recommendations suggested in this study can be used as input in managing the level of fertilizers usage in rice fields near water bodies around the lake.