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# Input Of Nutrient (Nitrogen And Phosphorus) From The Catchment Area Into Rawapening Lake Of Central Java

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**Abstract—**Nutrients (Nitrogen and Phosphorus) enter the waters in dissolved form or in sediment particles that reflect to condition of landuse activities that occur in the catchment area. This condition will determine the quality of the water and the lake productivity or trophic status. The purposes of this study were to assess how much nutrients input (N and P) that goes to Rawapening Lake and assess the biological response induced by lake. The observations was done by 4 times (2 times in the rainy season and 2 times in the dry season) in 9 of the river into the lake (River of Rengas, Panjang, Torong, Galeh, Parat, Legi, Muncul, Sraten, Kedungringin, Tuntang) as well as in 12 loc ations in the lake waters: area of Brebesan, Tourism of "Bukit Cinta", Spring area, net cage 1, net cage 2, Kedungringin River estuary, and the outlet. The results showed that the TN input was up to 154,62 mg/sec and TP was up to 10,32 mg/sec. The Rawapening Lake had a deficit of TP up to 64.9% and TN up to 67.25%. It could be concluded that Rawapening lake had an acting as a sink and further it could served as a source of nutrients that lead to eutrophication condition.

**Keywords—**Nitrogen, Phosphorus, Eutrophication, Rawapening Lake

## INTRODUCTION

In order to overcome the problem of eutrophication, it is necessary to study on the nutrient balance about input and output in the lake/reservoir. The balance of these nutrients can be used to assess the nutrient budget which aims to knowing the origin of the nutrients, whether from external or internal loading and how the amount of nutrients that enter and exit (DNR, 2005).

Nutrients causing eutrophication in lakes and reservoirs come from two sources, that are from watersheds (DAS) that are affected by natural and anthropogenic factors, and come from the internal processes from the waters itself. The input of nutrients from the catchment area through river flows into lake would affect the dynamics or changes in the concentrations and distribution of nutrients in the lake. Fluctuations in nutrients from the environment would be expressed by the aquatic ecosystem, and further physical-chemical conditions of the waters. This condition will further be responded by organisms that live in these waters.

In order to overcome the problem of eutrophication, it is important to know where the source and the amount of nutrients in the lake including the balance of 2 nutrients and its distribution in the lake. The lake nutrient balance can determine the role of lake whether as a source or the storage of nutrients (a sink). The purposes of this study were to assess the spatial distribution of nutrients, as well as reviewing the biocapacity and the balance of nutrients in the Rawapening lake. n the implementation of the zoning area of Surabaya.

## METHODS

This study was conducted by a survey method with quantitative approach by taking the samples and perform measurements and calculations on the research variables to assess how much nutrients (N and P) that goes to Lake Rawapening and examine the biological response induced by the lake. Observations and sampling was done for 4 times at intervals of two months (2 times in the rainy season and 2 times in the dry season). Method of measuring parameters and sampling using grab sampling (technique of taking a moment that has not changed for a time period) and composite sampling (the sampling technique at the same place at intervals different) (Brower et al., 1990; Sugiharto, 1996). Water sampling to assess the amount of nutrients coming into the lake Rawapening carried out at 10 locations that are 9 locations inflows from rivers, namely: 1) S. Rengas, 2) S. Ngaglik, 3) Muncul S. Panjang and S. Torong , 4) S. Galeh, 5) S. Parat, 6) S. Legi, 7) S. Muncul, 8) S. Sraten, 9) S. Kedungringin, as well as one location in the flow out of the lake which S. Tuntang.

The main parameters include river discharge water into and out of the lake, TP, TN in rivers and lakes. To assess the nutrient input toward the biocapacity of lake, it was analyzed by estimating the nutrient balance between inlet, outlet and accumulated in Lake Rawapening (Emmanuel, et al., 2009). Furthermore, this estimation can be use to evaluate the lake's role whether as a source (surplus nutrient) or as a sink (a deficit of nutrients).

## RESULT AND DISCUSSION

Lake ecosystems consists of two unitary landscape of the cathcment area (CA) and the lake itself. It means that human activities in the CA will impact to the lake ecosystem (Sudarmadji, 2003). Hart et al, (2004) states that the nutrients from the river into the lake is a reflection of the condition of land use and activities that occur in the catchment area (forest, agricultural, industrial, residential) and determines the quality of the water and the fertility status (trophic) lake (McFarland & Hauck 2001). The erosion in DTA coupled with high fertilizer use may increase the rate of N and P are transported into the lake in the form of dissolved or bound to soil particles.

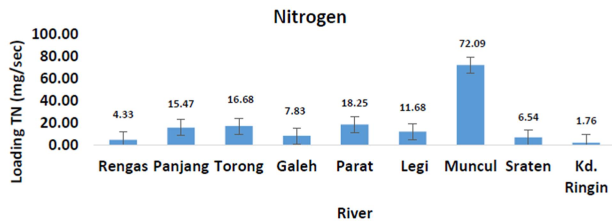
suspended in sediments that cause cultural eutrophication (McDowell & Wilcock, 2004). During the study the average load of nutrients (TN) and Total Phosphorus (TP) of the catchment area (DTA) through nine rivers that enter the lake Rawapening showed in Table 1. Based on Table 1, it was showed that the TN loading into the lake was up to 154.62 mgN/sec and and phosphorus was up to 10.32 mgP/sec.

Tabel 1. Input nutrient TN dan TP dari DTA ke Danau Rawapening

| No | Sungai | Loading TP (mg/dt) | | | | Total | Rata-rata |
|---|---|---|---|---|---|---|---|
| | | Feb | Maret | Juli | Agust | | |
| 1 | Rengas | 0.06 | 0.18 | 0.31 | 0.28 | 0.83 | 0.21 |
| 2 | Panjang | 0.63 | 0.73 | 0.92 | 1.20 | 3.49 | 0.87 |
| 3 | Torong | 0.64 | 1.32 | 2.04 | 0.63 | 4.63 | 1.16 |
| 4 | Galeh | 0.78 | 1.90 | 0.22 | 0.36 | 3.27 | 0.82 |
| 5 | Parat | 1.40 | 2.35 | 1.39 | 1.52 | 6.67 | 1.67 |
| 6 | Legi | 1.56 | 1.26 | 0.34 | 0.40 | 3.55 | 0.89 |
| 7 | Muncul | 3.66 | 5.34 | 4.05 | 3.68 | 16.72 | 4.18 |
| 8 | Sraten | 0.39 | 0.30 | 0.44 | 0.43 | 1.56 | 0.39 |
| 9 | Kd. ringin | 0.11 | 0.26 | 0.13 | 0.06 | 0.56 | 0.14 |
| Total Input TP | | 9.23 | 13.64 | 9.85 | 8.56 | 41.28 | 10.32 |

| No | Sungai | Loading TN (mg/dt) | | | | Total | Rata-rata |
|---|---|---|---|---|---|---|---|
| | | Feb | Maret | Juli | Agust | | |
| 1 | Rengas | 0.94 | 3.10 | 6.89 | 6.39 | 21.64 | 4.33 |
| 2 | Panjang | 10.10 | 13.81 | 17.05 | 20.92 | 77.35 | 15.47 |
| 3 | Torong | 8.20 | 18.97 | 27.19 | 12.34 | 83.38 | 16.68 |
| 4 | Galeh | 6.09 | 17.04 | 2.47 | 5.72 | 39.15 | 7.83 |
| 5 | Parat | 12.28 | 24.94 | 15.79 | 19.98 | 91.25 | 18.25 |
| 6 | Legi | 17.78 | 19.36 | 4.90 | 4.69 | 58.41 | 11.68 |
| 7 | Muncul | 58.44 | 100.56 | 48.06 | 81.27 | 360.43 | 72.09 |
| 8 | Sraten | 7.61 | 4.40 | 4.62 | 9.51 | 32.68 | 6.54 |
| 9 | Kd. ringin | 1.45 | 3.12 | 1.85 | 0.63 | 8.81 | 1.76 |
| Total Input TN | | 122.89 | 205.30 | 128.83 | 161.46 | 773.10 | 154.62 |

The amount of nutrient loads (TN and TP) that goes to Lake Rawapening depending on the area of the river sub-basins and types of activities or existing land use in the region (Asdak, 2007). The greatest rivers supplying TN and TP to the Rawapening lake came from the Muncul River (Figure 1 and 2).




*Figur 1. Nitrogen Loading into the Rawapening Lake*

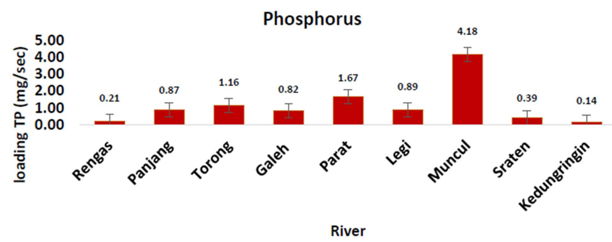



*Figure 2. Phosporus Loading into the Rawapening Lake*

The Muncul River is the main river that is included in the subzone Parat passing through the area in District Banyubiru (Gedong Village and Village Kebumen), District Tuntang (Gedangan village, village and village Kalibeji Rowosari). Parat subzone is located in the south of Lake Rawapening, with an area of 4638.35 ha widest covering 16 villages of the District 3 (Banyubiru, Getasan and Tuntang) Semarang District. The Muncul River is one of the important rivers that drain the lake Rawapening with the spring fairly clean, clear and fresh. Unfortunatelly, when the river utilized as a tourism area as a pool, fishing and restaurant and factories of bottled water resulted in decreasing the water quality of the river that characterized by high nutrient supply TN and TP to the lake.

Carrying capacity of the lake to the nutrient input is reflected in the trophic levels that indicate fertility waters and also shows the status of the water quality. When in the lake there is a balance of nutrients between input and output, then the lake is less likely to experience eutrophication (Horn & Goldmann, 1994). Balance of nutrients (TN and TP) in Lake Rawapening showed that TN and TP incoming (input) to the lake larger than the exit (output). For the average TP input to the lake at 10:32 mg/sec and output amounted to 3.61 mg/sec so that the lake TP deficit amounted to 6.71 mg / dt or by 64.9% deposited in the lake waters (Table 2).

Table 2. Phosphorus Balance and lake's role concerning with Nutrient Status

| No | Time Period | *Loading* TP (mg/sec) *in* | *out* | Deficit / surplus | % | Role |
|---|---|---|---|---|---|---|
| 1 | Feb | 9.23 | 4.98 | 4.25 | 46.03 | *a sink* |
| 2 | Maret | 13.64 | 3.84 | 9.80 | 71.87 | *a sink* |
| 3 | Juli | 9.85 | 2.68 | 7.17 | 72.82 | *a sink* |
| 4 | Agustus | 8.56 | 2.96 | 5.60 | 65.42 | *a sink* |
| | Total | 41.28 | 14.46 | 26.82 | 64.98 | *a sink* |
| | Rata - rata | 10.32 | 3.61 | 6.71 | 64.98 | *a sink* |

The Nitrogen in Rawapening also had a deficit up to 103.98 mg/sec or 67.25% from the total loading (Table 3). Deposition occurred in sediment pore through various processes including sedimentation, adsorption and precipitation (Theis, T.L., and P.J. McCabe, 1978, Stewart, J.W.B., and H. Tiessen, 1987; Carignan & Kalff 1982). In this condition, the sediments have an important role in the process of eutrophication due to sediment can act as a source of phosphorus.

Table 3. Nitrogen Balance and lake's role concerning with Nutrient Status

| No | Time Period | *Loading* TN (mg/sec) *in* | *out* | Deficit / surplus | % | Role |
|---|---|---|---|---|---|---|
| 1 | Feb | 122.89 | 56.73 | 66.16 | 53.84 | *a sink* |
| 2 | Maret | 205.30 | 46.44 | 158.86 | 77.38 | *a sink* |
| 3 | Juli | 128.83 | 44.03 | 84.80 | 65.82 | *a sink* |
| 4 | Agustus | 161.46 | 55.37 | 106.09 | 65.71 | *a sink* |
| | total | 773.10 | 253.21 | 519.89 | 67.25 | *a sink* |
| | Rata - rata | 154.62 | 50.64 | 103.98 | 67.25 | *a sink* |

It was concluded that the TN input into Rawapening Lake of 154.62 mg/sec and TP of 10.32 mg/sec, meant that the ratio of TN/TP of 1: 15. Based on nutrient balance analysis showed that Rawapening Lake had TP deficit up to 6.71 mg/sec (64.9%) and 103.98 mgTN/sec (67.25%). It meant that Rawapening lake acted as a sink and served as a source of nutrients that could enhance the eutrophication process in Rawapening Lake .

## REFERENCES

[1] Carignan, R., and J. Kalff. 1982. Phosphorus sources for aquatic weeds: Water or Sediments? *Science* **207:987-989**.

[2] Emmanuel, P; Mwanusi, F and Kimwaga, R., 2007. Study of Nitrogen Transformation in Lake Victoria. http ://www. epa. gov. Tanggal akses 31 Maret 2009.

[3] Hart, M.R. ; Quin, B.F. ; and Nguyen, M.L., 2004. Phosphorus Runoff from Agricultural Land and Direct Fertilizer Effects : A Review. Journal of Environmental Quality. 33 : 1954 –1972.

[4] Horne, A.J. and Goldman, C.R., 1994. Lymnology. Second edition. McGraw Hill, Inc. New York.

[5] Kementrian Lingkungan Hidup, 2011. Profil 15 Danau Prioritas Nasional. Jakarta

[6] Kwang-Guk-An & Dong-Su-Kim, 2003. Response of Reservoir Water Quality to Nutrient Inputs From Streams And In-Lake Fishfarm. Water, Air, and Soil Pollution. 149 : 27 –49, 2003

[7] McDowell, R.W., and Wilcock, R.J., 2004. Particulate Phosphorus Transport within Flow of an Agricultural Catchment. J. Envirn. Qual. 33 : 2111 – 2121.

[8] McFarland, A.M.S. and Hauck, L.M. 2001. Determining Nutrient Export 6