

Study of Point and Non Point Sources Pollution – A Case Study of Timah Tasoh Lake in Perlis, Malaysia

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Abstract. Water resources in the catchment area come from various sources. Timah Tasoh catchment is surrounded with many types of land use activities ranging from urbanization to agriculture and quarrying. The objective of this study are to establish the number of point and non point sources pollution in the surrounding of Timah Tasoh Lake and to identify which area source pollutions are have potential to increase the pollution rate in Timah Tasoh Lake. This study involved both field and laboratory study. Field study has conducted to establish the number of point and non point sources pollution and in-situ measurement of selected variables; while the laboratory study has done to analyze the water quality parameters such as physical, chemical and biological. National Water Quality Standard (NWQS) for Malaysia and DOE Water Quality Index Classification applied in this study. Based on analysis of water quality that compliance with these standards, it can concluded that point and non point sources pollution that toward Station 1 (Tasoh River) and Station 2 (Pelarit River), both have potential to increase pollution rate in the Timah Tasoh catchment area.

Keywords: Point sources pollution, Non Point source pollution, Water Quality Analysis

1. Introduction

Timah Tasoh Lake, Perlis (6° 36'N and 100° 14'E) located approximately 13 km north of the Kangar town near the Thailand border. The average surface area of lake is 13.33 kilometer square and able to store capacity of appropriate 40 million meter cube. There are two main rivers which are Tasoh River and Pelarit River connects and gives inputs to the lake. These two main rivers supply approximately 97 million meter cube of volume of water into the lake annually. Agriculture area in its upstream catchments such as rubber, paddy, sugar cane and timber plantations are surrounding the lake. Urbanization and infrastructures development involved land clearing activities in Padang Besar, Perlis were surveyed to take place in the lake area due to it influenced the river water discharge of the Tasoh River. For Pelarit River catchment its encompass Wang Kelian and Kaki Bukit that includes area of agriculture land, quarrying and urbanization. Timah Tasoh Lake can be classified as medium size and shallow lake (Wan Ruslan et. al, 2002). The lake is important sources of water and has multiple functions. Timah Tasoh Lake mainly purpose to supply water for municipal and industrial use. Similarly, it is also used for agriculture as well as irrigation and flood control (Zati and Salmah, 2008). The lake plays important ecological function with regards to the water quality protection and biodiversity maintaining.

Human activities such as agriculture, housing and recreation contribute to the degradation of water quality of the lake. Excessive loadings of pollution into river, lakes, reservoir and estuaries have become contribution to major cause of water pollution. Source of pollution can be categorized in two types, point source pollution and non point source pollution. Point source pollution is a single identify localized source. Point sources are relatively easy to identify, quantify and control. Point sources of water pollution include discharge from municipal sewage treatment plant and industrial plant (Peavy et. al, 1985).

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While, non point sources are characterized by multiple discharge point. The pollution cannot be traced to a single point of discharge, difficult to monitor and control (Peavy et. al, 1985). Non point source pollution is water pollution affecting a water body from diffuse sources, such as human land use, land use changes, and pollutes runoff from agricultural areas draining into a river (Norazian et. al, 2009; Peavy et. al, 1985). Use of intensive mineral fertilizers associated with contamination of agricultural groundwater leads to increasing level of nutrients in ground and surface waters especially from non point sources due to difficult to prevent compared to point sources. An agriculture activity is major non point sources pollution includes used of nitrogen fertilizers, application of livestock manure, legume fixation and mineralization of soil nitrogen (Wan Ruslan, 2007). The objectives of this study are; (1) to establish the number of point and non point sources pollution in the Timah Tasoh Lake; and (2) to identify which area source pollutions are have potential to increase the pollution rate in Timah Tasoh Lake area. With determine number of point and non point source pollution, we can try to control the pollution. This research is benefiting us to know about basic information on how and what substances enter our waterways. The number of point and non point source pollution can be reduced and controlled if people and community leaders have the information they need.

2. Methodology

This study involved both field and laboratory study. The field study has conducted to establish the number of point and non point sources pollution and in-situ measurement of selected variables. There are three main river catchments in Timah Tasoh Lake catchment namely the Jarum River (64.4 km²), Upper Pelarit (42.7km²) and Chuchuh River (14.8 km²). The catchment of Jarum River upstream of station comprises 44.9% forest, 20% rubber and 18% sugarcane. The Upper Pelarit is gauged at Kaki Bukit comprises largely of forest 90.6% and a portion of land use 1.2 % is a quarry. Chuchuh River catchment is mostly forested 99% with most portion of the land use is teak plantation maintained by Forest Research Institute (FRIM) (Wan Ruslan, 2007). In order to further strengthen the report, activities and land use of upstream catchment area have been observed to determine the point source and non point source pollution. Most of Timah Tasoh catchment area had been observed surrounding by agriculture land farm and livestock, which are identified as non-point point source pollution. Meanwhile, domestic and industrial zone was categorized as point source pollution to the Timah Tasoh Lake (Peavy et. al, 1985).

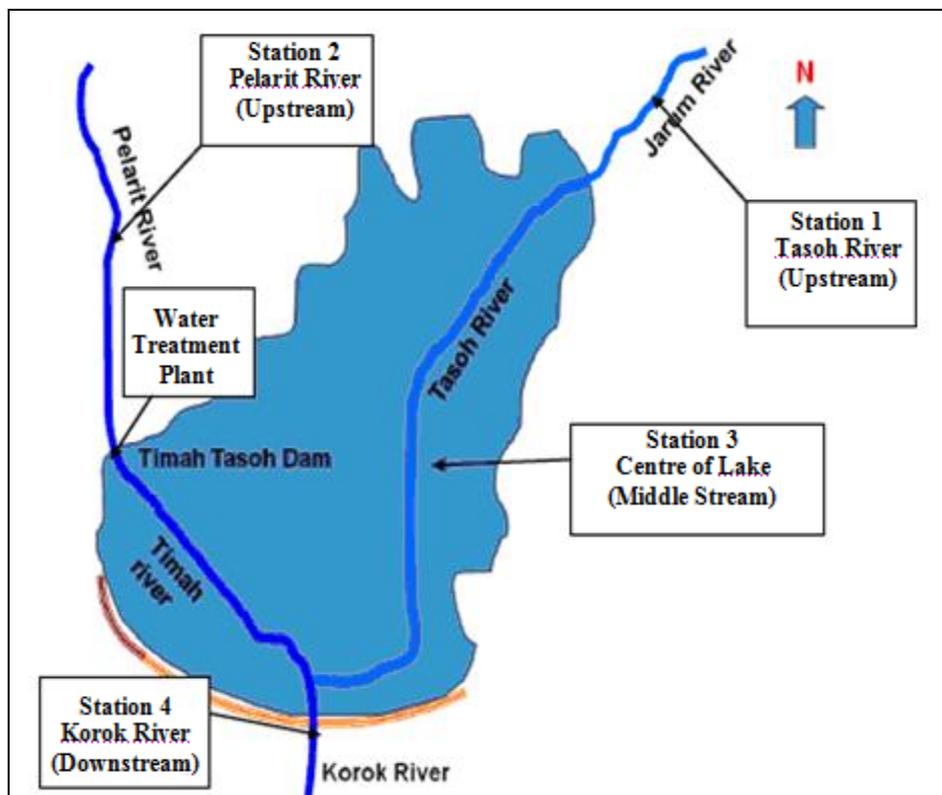


Fig. 1: Sampling point selected at Timah Tasoh Lake area.

In-situ measurement is measuring the physical parameter such as pH, DO, temperature and turbidity using YSL 556. While, for laboratory study, the parameters involved are divided into three categories which are physical, chemical and biological parameters. These parameters are selected based on National Water Quality Standard (NWQS) for Malaysia and DOE Water Quality Index Classification by Department of Environmental (DOE, 2007). The physical parameter involved pH and turbidity. While, for chemical parameter analysis involved Ammonia Nitrogen (NH₃-N), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and Dissolved Oxygen (DO) (APHA, 2000). The biological parameter is E- Coli. The total of sampling points in this study is four points which are located upstream, mid-lake and downstream. Two upstream sampling points selected at Station 1 (Tasoh River) and Station 2 (Pelarit River) which both are nearby inlet of the lake. One sampling points selected at Station 3 (Centre of Lake) and one point from downstream selected at Station 4 (Korok River). Fig. 1 shows the sampling point selected at Timah Tasoh Lake area.

3. Result and Discussion

3.1. Number of Source Pollution in Tasoh and Pelarit River

Tasoh and Pelarit Rivers are major rivers that give sources pollution to Timah Tasoh Lake included Center of Lake and Korok River. There are many districts along the both river namely Wang Kelian, Kaki Bukit, Padang Besar, Beseri, Mata Ayer, Kok Mak Village, Titi Tinggi Village and Wang Mu Village. There are many point sources pollution found in these districts area such as industries and factories, residential and domestic areas. Most of industries found at this area were registered and unregistered under Ministry of International Trade and Industry (MITI), Malaysia. Example of industries and factories located in Padang Besar such as textile industry, fiberglass industry, chemical industry, agricultural industry, rubber made industry and food industry. The wastewater discharged from these industries were directly gives highly pollutants to the river and Timah Tasoh Lake.

Based on observation at Tasoh River, there are 7 industrial and 16 domestic areas were identified as point sources. While, 21 agriculture activities, 10 workshops, 5 livestock and erosion from construction site are considered as non point source. The industries found in Padang Besar such as diesel factory and plaster ceiling factory. The domestic areas were residential areas and co-curriculum centre. During the observation, children of Mata Ayer Village were bathing and playing in the river. Some residents used river water to washing clothes with soap. Contaminants and faecal pollutant come from human body and soap will contribute pollution into stream nearby villages. The major sources of pollutant due to existing of residential near the river are generated of domestic wastes (solid waste and sewage) which were disposed directly into the river (Nur Shahidah, 2010). Surface runoff from nearby villages along the lake causes much more pollution to the lake (Wan Ruslan, 2007). Non point sources was organic or inorganic pollutants on ground surface bring by rainfall and runoff into river. Agriculture activities could found in huge area of Timah Tasoh catchment. Agriculture activities were mixed crops, sugarcane, paddy, rubber state, scrubland and forest. Fertilizer and pesticides gives high input of ammonia nitrogen into river brought by runoff and rainfall (Nur Shahidah, 2010). The waste from livestock produces unwanted faecal contamination and toxic into river and could harm the aquatic life (Ain Nihla et. al, 2010).

From observation at Pelarit River, there are 8 domestics were identified as point source. While, 8 agriculture activities, 2 livestock and a logging are considered as non point source. In Pelarit River, there was no any industry or factory found but 8 point sources found namely Base Camp Wang Kelian, Biro Tata Negara (BTN), Program Latihan Khidmat Negara (PLKN) and some residential areas. Biro Tata Negara (BTN) and Program Khidmat Latihan Negara (PLKN) located in Wang Kelian were using Hi-Clean Sewage Treatment Plant and create wastewater into stream. During the observation in fish temple at Kaki Bukit, there was an illegal dumping wastes accumulated in an end of stream nearby fish temple. Major agriculture activities nearby Pelarit River are mix crop, sugarcane, paddy, rubber state, scrubland and forest. Improper control of animal wastes and animal healthy could give significant bad impact and contamination to the river and fish in the living tank. Fig. 2(a) and (b) shows the source of pollution in Tasoh and Pelarit River. Fig. 2(a) shows number of point sources identified at Tasoh River is 23, while Pelarit River is 8, respectively. While, Fig. 2(b) illustrates number of non point sources identified at Tasoh River is 37, while at Pelarit River is 11.

Total numbers of point source pollution of both rivers are 31, while non point source pollutions are 48. Thus, total of point source and non point source pollution of upstream catchment area can be concluded as 79. And we can see that the number of non point source pollution was higher than point source pollution.

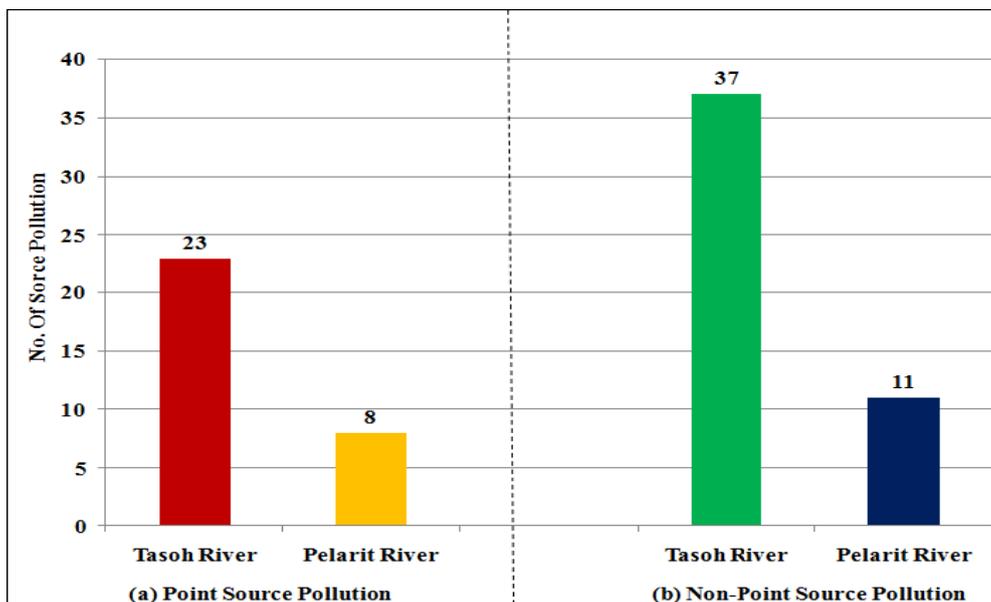


Fig. 2: (a) Point Source Pollution and (b) Non Point Source Pollution in Tasoh River and Pelarit River

3.2. Pollution Rate in Timah Tasoh Lake Area

In this study, result of water quality parameter analysed to be identifying average value and classes of physical, chemical and biological parameters. The average values of $\text{NH}_3\text{-N}$ from Station 1 to Station 4 are 0.07 mg/L, 0.04 mg/L, 0.03 mg/L and 0.05 mg/L, respectively and all results were classified as Class I. The BOD values recorded from Station 1 to Station 4 are 12.21 mg/L, 13.71 mg/L, 13.97 mg/L and 14.62 mg/L, respectively and all results were classified into Class V. For COD, it is 51 mg/L recorded in Station 1 and classified into Class IV. COD in Station 2 is 30.83 mg/L and classified into Class III. Result of COD is slightly lower in Station 3 and Station 4 which are 22 mg/L and 23.67 mg/L, respectively and both classified into Class IIA. While, results of DO for four stations are 1.33 mg/L, 1.32 mg/L, 1.40 mg/L and 1.46 mg/L, respectively and all results were classified into Class IV. The E-coli for four stations recorded as 363.03 MPN/100 mL, 299.65 MPN/100 mL, 62.95 MPN/100 mL and 23.48 MPN/100 mL, respectively. Station 1 and Station 2 classified into Class IIB, while Station 3 and Station 4 classified into Class IIA. The pH value recorded as 7.75, 8.05, 8.4 and 8.27, respectively for four stations, all values categorized into Class I. The turbidity in Station 1 recorded as 76.46 NTU and classified into Class V. While, turbidity from Station 2 to Station 4 recorded as 30.96 NTU, 5.87 NTU and 5.55 NTU, respectively which are categorized into Class IIA.

The levels of $\text{NH}_3\text{-N}$ and pH are classifying into Class I which is water quality are acceptable and suitable for conservation of natural environment water supply. Meanwhile, the levels of BOD, COD, DO, E-coli and turbidity are classify into classes range of IIA to V. Based on these classes of water quality, they are identifying as polluted water according to classification of river water, NWQS for Malaysia and DOE Water Quality Index Classification (DOE, 2007). There is emphasized that class of COD levels in Station 1 (Class IV) is slightly polluted than Station 2 (Class III). While, levels of COD for Station 3 and Station 4 are lower which are classified into Class IIA. Turbidity in Station 1 is a Class V which is most polluted water quality compared with Station 2 to Station 4 which is Class IIA, respectively (DOE, 2007).

From results discussed, it can conclude that water quality parameters level in Station 1 (Tasoh River) and Station 2 (Pelarit River) are more polluted compared than Station 3 (Center of Lake) and Station 4 (Korok River). On the other hands, source pollution along the Tasoh River and Pelarit River is definitely having a potential to increase the pollution rate in the Timah Tasoh Lake. The agricultural soils surrounding Timah

Tasoh catchment could contribute pollutant in river water due to intensive use of fertilizers that exceeds the nutrient requirements of the crop (Wan Ruslan, 2007). Human activities such as deforestation or construction transported toxin into river reached the lake and contaminated aquatic habitats (Wan Ruslan, 2007).

4. Conclusion

This study not only presents the water quality of Timah Tasoh Lake, but the important sources of pollution that threaten water quality were also identified. Based on the analysis of water quality, both Tasoh River and Pelarit River were identified as source of pollution to Timah Tasoh Lake including Center of Lake and Korok River. This study also revealed both the point sources and non point sources pollution that threaten water quality. By establish number of point source and non point source in the catchment area of Timah Tasoh Lake, totally 79 point and non point sources pollution were identified, which is 31 point sources and 48 non point sources pollution were identified in Tasoh River and Pelarit River.

Based on water quality analysed, the level of BOD, COD, DO, E-coli and turbidity were identified as polluted water quality were classified into classes which range of IIA to V according to classification of river water standard, NWQS for Malaysia and DOE Water Quality Index Classification. Due to water quality in Class IIA to V, water only suitable for sensitive aquatic species, conventional and extensive treatments were required. The level of pH and NH₃-N was classified into Class I which is acceptable concentration. For overall, we can conclude that the point and non point sources pollution of Tasoh River and Pelarit River, both have potential to increase the pollution rate in the lake areas and also Korok River.

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