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Potentially Land Used Pattern Contributing Pollution Source Towards Water Quality: A Case Study of UTM River

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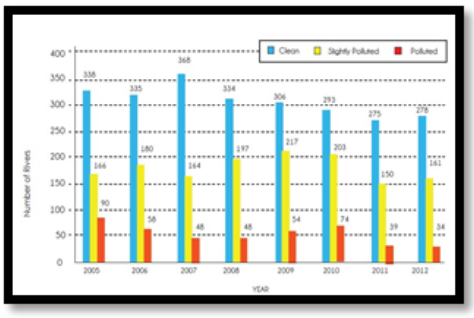
Abstract
UTM River water quality detected decreased due to human activities in land used development. This research study carried out to determine the status of water quality and investigate possibilities pollutant sources that contribute contamination into UTM River. 7 sampling stations cover upstream river, middle-stream river, and downstream river that test on 6 physico-chemistry parameter namely DO, pH, BOD, COD, SS, and NH_3N. River water are analyzed based on APHA 2005 that divided into two categories, *in-situ* or onsite analysis for DO and pH, and *ex-situ* or laboratory analysis for BOD, COD, SS and NH_3N. Result indicates UTM River is majority in class 1 and class 2. However, uncontrolled and unmanageable of rapid development in land used activities will possibility and probability to cause river water pollution to increase into class 3 and class 4. Therefore, investigation towards possibilities of pollutant sources that contribute contamination into UTM River through land used activity are detected namely residential activity, agricultural activity (small scale), road and bridges construction activity, building construction activity, and sedimentation activity. Hence, human should respect, protect and responsible towards river water quality from being destructed through pollution that may destroy the environmental-nature as a whole.
Keywords: water quality, land used development, uncontrolled, unmanageable

1. Introduction

According to Department of Environment (DOE) [Malaysia report in 2012 [3], about 473 rivers are being monitored with a total of 5,083 samples taken for water quality assessment. Among 473 rivers (Figure 1), 832 are manually water quality monitoring (MWQM) and 10 are continuous water quality monitoring (CWQS) for early detection of pollution influx [3]. Based on the current report for 473 rivers, 278 or 59% rivers are considered clean, while 161 or 34% rivers having slightly polluted and 34 or 7% rivers are polluted [3]. The major pollutants detected were biochemical oxygen demand (BOD), ammoniacal nitrogen (NH_3N), and suspended solid (SS); which can be attributed to inadequate treatment of sewage or effluent from agro-based and manufacturing industries, while SS are connected with the improper earthworks and land clearing activities [3, 6].

Figure 1: Monitoring of river water quality trend from year 2005 to 2012, Malaysia.



Source: DOE report, 2012.

Generally, river water pollution can be detected from two sources, namely point source and non-point sources pollution [5]. Point source pollution can be defines as 'any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory' [4]. In other words, contamination sources through domestic sewage, animal husbandry waste, and industrial waste, are easily detected with naked eye that disposed directly into rivers. Meanwhile, non-point source pollution is defined as 'diffuse or runoff pollution that inputs and impacts occur over a wide area and are not easily attributed to a single source' [8]. Possible pollutants to contribute nonpoint source pollution are animal husbandry waste, agricultural waste, forestry, rural-

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suburban-urban development, and so on. Both of point and nonpoint source pollution brings negative impact such as disruption of food-chains, brings death to aquatic animals, spreading disease, causing destruction of ecosystem, and so on. Hence, the source of pollutants can be reduced by controlling the land used that carried out for human activity.

River water pollution are no exceptional to happen in Malaysia [7], especially UTM River that flow across engineering and chemistry faculty, several food courts, laboratories, and football field before entering the Skudai river. On the other hands, there are several constructions in process for new building within the university to provide facilities for UTM students. UTM River water quality is suspected to be affected due to human activities that carry out within the river. Therefore, this research study is conducted to determine the status of water quality and investigate possibilities pollutant sources that contribute contamination into UTM River.

2. Methods and Materials

Water samples are collected along the UTM River. Seven (7) sampling stations are determined based on upstream river, middle-stream river, and downstream river (Figure 2). The water samples are collected using 'grab sampling' and it will be analyzed based on physic-chemical parameter namely Dissolved Oxygen (DO), acidic/basic water (pH), biological oxygen demand (BOD), chemical oxygen demand (COD), suspended solid (SS), and ammoniacal nitrogen (NH_3N). Analysis of physico-chemical parameter is divided into two categories, namely *in-situ* or onsite analysis for DO and pH, and *ex-situ* or laboratory analysis for BOD, COD, SS and NH_3N. Raw water sample are analysis based on APHA 2005 methods [1], for example BOD based APHA 5210-B, COD based APHA 5220-C, SS based APHA 2540-D, and NH_3N based 5220-C. Before collecting data for water quality assessment, site observation is carried out to determine the access of sampling area to avoid difficulties in obtaining the results.

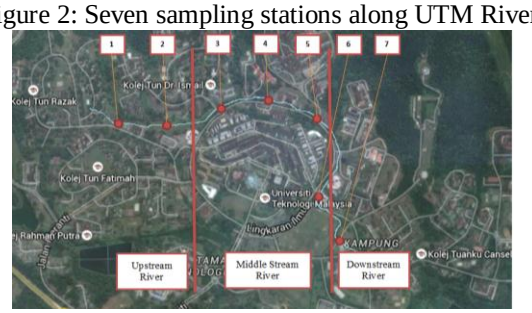
Table 1: National Water Quality Standards for Malaysia.

Category (Unit)	Class					
	I	IIA	IIB	III	IV	V
pH (-)	> 7.0	6.0 – 7.0	6.0 – 7.0	5.0 – 6.0	< 5.0	> 5.0
SS (mg/L)	25	50	50	150	300	300
BOD (mg/L)	1	3	3	6	12	>12
COD (mg/L)	10	25	25	50	100	>100
DO (mg/L)	7	5 – 7	5 – 7	3 – 5	< 3	< 1
NH3N (mg/L)	0.1	0.3	0.3	0.9	2.7	> 2.7

(DO means Dissolved Oxygen; BOD means Biological Oxygen Demand; COD means Chemical Oxygen Demand; SS means Suspended Solid; pH means Acidic or Basic water; NH_3N means Ammoniacal Nitrogen)

Source: DOE (Malaysia) report, 2012

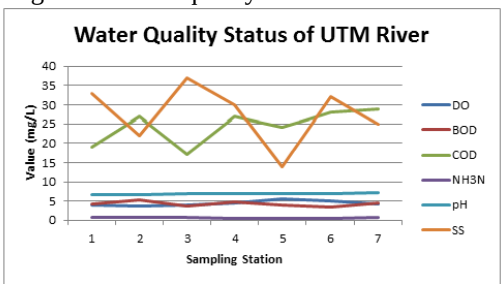
Figure 2: Seven sampling stations along UTM River.



3. Results and Discussion

Figure 3 indicate water quality status of UTM River for DO, BOD, COD, pH, SS, and NH_3N in 7 sampling stations. According to the Table 1 of National Water Quality Standards for Malaysia, BOD and NH_3N parameter indicate class 2 and class 3. Continuously, DO parameter show majority water quality are in class 3, except station 5 that resulted in class 2. Next, SS parameter explained station 2 and station 5 are in class 1, while others are in class 2. Lastly, COD parameter determines station 1, station 3 and station 5 is class 2 while others are class 3; and pH parameter shows only station 5, station 6 and station 7 is class 1 while others are class 2.

Figure 3: Water quality status of UTM River.



(DO means Dissolved Oxygen; BOD means Biological Oxygen Demand; COD means Chemical Oxygen Demand; SS means Suspended Solid; pH means Acidic or Basic water; NH_3N means Ammoniacal Nitrogen)

According to the result shows that UTM River has possibility and probability to cause water pollution until class 3 and class 4 due to excessive and extreme land used development for human activities within the UTM River. Several land use activities are detected that carried out along UTM River, namely residential activity, agricultural activity (small scale), road and bridges construction

activity, building construction activity, and sedimentation activity.

Residential Activity

The activities that carry out along UTM River are food court, faculties, and laboratories. The main issues and problems that could contribute to river water pollution through domestic waste like oil waste, wash water waste, food waste, and chemical waste from the activities that directly dump into the river (Figure 4). There are also settlements activities within UTM River, which can cause water pollution towards the river through failure of septic tanks system.

Figure 4: Domestic waste that dumps into UTM River.

Agricultural Activity (Small Scale)

Several research activities carried out in concentrated on agriculture perspective, which involve with the organic chemical such as fertilizers and biocides (herbicides and pesticides) in determinant the growth of plants. On the other hands, chemical and organic substances that used in fertilizer could easy to spill into nearby river due to water runoff and led to seepage into ground. Generally, biocide consists of axoxystrobin, thionhanate-methyl, chlorothalonil and carbendazim that can cause negative consequences for aquatic environment through carcinogenic substances that are very harmful and toxic to human life [9].

Road and Bridges Construction Activity

Road and bridges plays an important role to increase the meeting point, reduce travel time and cost, which will benefits on improving the job opportunities, educations and health services. Eventually, water surface runoff during rainy season had cause negative impact on the environment through motor oil, gasoline, heavy metals, trash, and other pollutants (Figure 5). Normally, road surface runoff in rapid urban development are experience on major source of pollution like nickel, copper, zinc, cadmium, lead, and polycyclic aromatic hydrocarbons (PAHs) that created by combustion of gasoline and other fossil fuels [2].

Figure 5: Road through water surface runoff cause river pollution in sedimentation.

Building Construction Activity

Building construction adjacent to river could impact the river especially through land clearing soil erosion and river bank erosion (Figure 6). For example, site clearance and earthworks are often involves in land clearing using heavy machinery. So, the process causing the land to become unstable and loose, and this could make it easier to erode and led to high sedimentation in river. The high deposition of muddy in river will cause turbidity pollution that reduce light level in water and cause interference respiration process and food source to aquatic life [10]. It also changes the originality of habitat in upstream river.

Figure 6: Building construction activity.

Sedimentation Activity

As discuss in building, road and bridges construction activity, other activities like residential, agricultural and animal husbandry are having high possibilities to cause river pollution through sedimentation. Any changes in original of specific area for land clearing development will cause interruption to the soil structure, which contribute towards the erosion and led to sedimentation in river. Majority sedimentation activity are resulted the nonpoint source pollution.

4. Conclusion

As conclusion, water quality of UTM River is majority in class 1 and class 2. However, uncontrolled and unmanageable of rapid development in land used activities will possibility and probability to cause river water pollution to increase into class 3 and class 4. Therefore, investigation towards possibilities of pollutant sources that contribute contamination into UTM River through land used activity are detected namely residential activity, agricultural activity (small scale), road and bridges construction activity, building construction activity, and sedimentation activity. Hence, human should respect, protect and responsible towards river water quality from being destructed through pollution that may destroy the environmental-nature as a whole.

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