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Research paper

Water Quality Study at Educational Area in Bandar Seri Alam, Johor, Malaysia

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Abstract

This research study is conducted to provide water quality data of detention pond at UiTM Pasir Gudang Campus (UiTMCJKPG) and to ascertain the suitability of this newly potential water supply source for gardening and landscaping activities in this campus. According to Department of Environment (DoE) Malaysia, 6 water quality parameters must be tested in order to recognize the suitability of the water quality status. These parameters are categorized into physical, chemical and biological characteristics. Based on the intended usage of this new source, the detention pond is classified under Class IIB. As such, the limit for the selected parameters is restricted under this category and must not be exceeded. 16 sampling points have been identified covering along the circumference of detention pond and the inflow point. Several water quality tests such as temperature, pH, turbidity and dissolved oxygen measurement are conducted in-situ while other parameters which mainly subjected to chemical and biological testing are determined in laboratory. The outcome of this research shows that the water quality of retention pond in UiTM Pasir Gudang (UiTMCJKPG) complied with the standard requirement of Class IIB thus making it as an accepted new source of water supply for gardening and landscaping maintenance activities.

Keywords: *sustainable environment; new water source; detention pond; water quality*.

1. Introduction

The Earth is covered by approximately 71% of water. As an essential basic component in life, water exists in the oceans, rivers lakes, icecaps, glaciers as well as underground. Despite the high percentage of water on the Earth, fresh water however is considered as a limited resource [1, 6]. Water is particularly important for human existence and widely being used in various sectors including industrial and agricultural as well as hydroelectric generation [3]. Vigorous urbanization and rapid population growth caused tremendous escalation in fresh water demand [12]. Thus, this inevitably resulted in remarkably alterations to natural processes, natural resource consumption and environmental quality including fresh water.

2. Literature Review

Degradation of water quality is one of the main challenges that societies are facing presently. Natural processes may influence in water quality changes including weathering of rocks, evapotranspiration, depositions due to wind, leaching from soil, run-off due to hydrological factors and biological processes in the aquatic environment [7]. Apart from that, in [9] revealed that anthropogenic pollutants related to land use result in drastic deterioration of aquatic systems in water bodies. 21st century witnessed the continuous economic expansion and uncontrolled development that may increase the production of runoff as one of the largest sources of anthropogenic pollution to receiving waters [11]. In fact, the discharging nutrients such as phosphorus (P) and nitrogen (N) due to the same factor also able to accelerate the eutrophication process [2]. Therefore, rapid development may exacerbate water quality further and give negative impacts on human health and the whole ecosystems.

Ponds are relatively small in size and water volume compared to other water bodies. Due to these factors, ponds may be subtle to environmental changes caused by the land use pressures as well as climate change [4]. Odours, sludge build-up or fish kills can be an early indication that the natural balance and water quality of ponds have been disrupted. In [5] revealed that nutrient concentrations are good predictors of water quality and status conditions of ponds. Therefore, ponds that are affected by urban effluents are predicted to provide higher levels of nutrients in the water compartment than the less impacted water bodies. Ponds tend to be filled in with vegetation and sediment over time. However, the prolong formation of vegetation in deeper parts of the ponds is undesirable [10]. Therefore, water quality monitoring study is required to be conducted as precaution if extended treatment is needed before using for other purposes. Water quality can be measured by assessing its physical, chemical and biological parameters against a set of standards [8]. In Malaysia, Interim National River Water Quality Standard (NRWQS) is used as standard guideline by categorizing the level of pollution into 5 classes; Class 1 to Class V in order to determine the suitability of water to be used for consumption or safe for the environment.

3. Methodology

3.1. Study Area

UiTM Pasir Gudang Campus (UiTMCJKPG) is the second campus for UiTM Cawangan Johor, located at Bandar Seri Alam, Masai, Pasir Gudang, Johor. Located in southern Malaysia, Bandar Seri Alam has gone through tremendous development in recent years and houses various educational facilities from local and international schools to campuses and universities. Being acknowledged as City of Knowledge, Bandar Seri Alam is booming with many on-going and future developments of facilities and amenities. UiTMCJKPG is mostly surrounded by nature including plantations, lake and water reservoir. However, the previous, current and future developments of other institutions and facilities nearby may contribute to water pollution and lead to deterioration of water quality especially neighbouring this area. Furthermore, part of campus area is surrounded by the oil palm plantation site. As such, pollutant mainly originated from pesticide and fertilizer can be transported into the pond from excess runoff. This research study aims to provide water quality status based on physico-chemical characteristics and assessment on detention pond water at UiTMCJKPG and to ascertain the suitability of this newly potential water supply source for gardening and landscaping activities in this campus.

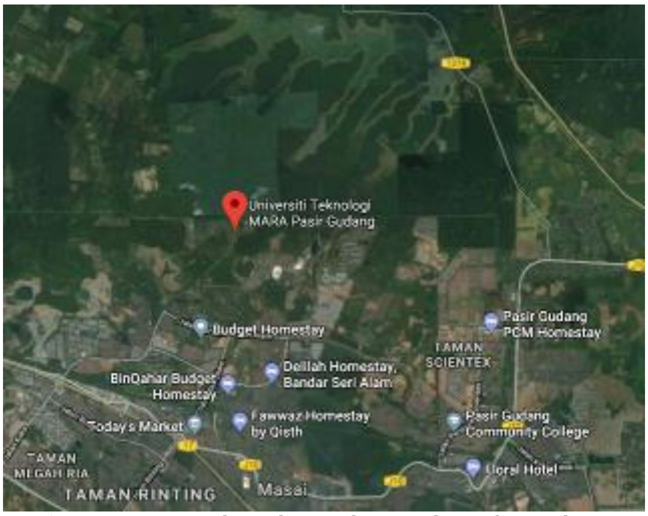

Fig. 1: UiTMCJKPG located in Bandar Seri Alam, Johor, Malaysia

3.2. Methods

The methodology of study is mainly revolved around laboratory and in-situ testing. Water samples are taken at retention pond UiTMCJKPG (see Fig. 2) and kept in Environmental Laboratory at Faculty of Civil Engineering. 16 sampling points are selected for this study and each sampling point consist of 1 water sample. The water samples are taken 15 cm to 30 cm below water surface. In-situ testing which covers pH, turbidity and concentration of dissolved oxygen. These parameters need to be tested immediately after the samples are extracted to avoid intolerable error due to chemical reactions. All water samples are ensured to be well preserved under room temperature without direct expose to sunlight thus reducing acid formation in samples. The samples can be stored up to 28 days prior to testing date. The procedure of experimental testing is based on the Water and Wastewater Testing Handbook 20th Edition. The equipment/apparatus used for this study include, Spectrophotometer, Mineral Stabilizer, Polyvinyl Alcohol Dispersing Agent, Nessler Reagent, COD Low Range Digestion Reagent vials, DRB200 Reactor, BOD Bottle, Dissolved Oxygen Meter, pH Meter, filter paper, Suspended Solid Apparatus, Oven, Incubator, Turbidity meter, dilution water, deionized water, sample cell and graduated mixing cylinder.

The water quality index (WQI) which was proposed by the Department of Environment (DOE) in 2005 is calculated to determine the class of water quality in study area and the status of the water cleanliness level for the intended usage. The sub index formula (SI) for each parameter is shown in Table 1. Ultimately these values are computed in WQI formula which is stated in 1. The limit value of each parameter and classification of water quality classes and status are presented in Table 2.

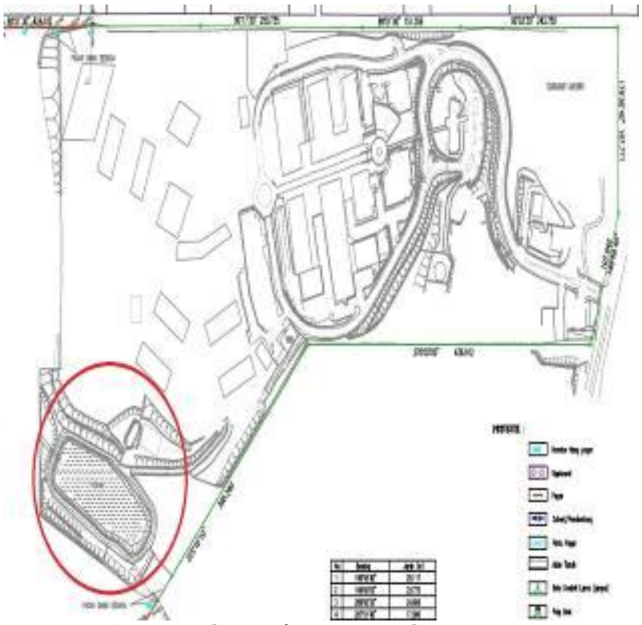

Fig. 2: Aerial view of retention pond UiTMCJKPG

Table 1: Sub Index (SI) equation for WQI in Malaysia as proposed by DoE 2005

WQVs	Value[a]	Sub Index
DO (% saturation)	$X \le 8$ $8 < X < 92$ $X \ge 92$	$SI_{DO} = 0$ $SI_{DO} = -0.395 + 0.03X^2 - 0.0002X^3$ $SI_{DO} = 100$
BOD	$X \le 5$ $X > 5$	$SI_{BOD} = 100.4 - 4.23X$ $SI_{BOD} = (108e^{-0.055X}) - 0.1X$
COD	$X \le 20$ $X > 20$	$SI_{COD} = 99.1 - 1.33X$ $SI_{COD} = (103e^{-0.0157X}) - 0.04X$
AN	$X \le 0.3$ $0.3 < X < 4$ $X \ge 4$	$SI_{AN} = 100.5 - 105X$ $SI_{AN} = (94e^{-0.573X}) - 5\|X - 2\|$ $SI_{AN} = 0$
SS	$X \le 100$ $100 < X \le 1000$ $X \ge 1000$	$SI_{SS} = (97.5e^{-0.00676X}) + 0.05X$ $SI_{SS} = (71e^{-0.0016X}) + 0.015$ $SI_{SS} = 0$
pH	$X < 5.5$ $5.5 \le X < 7$ $7 \le X < 8.75$ $X \ge 8.75$	$SI_{pH} = 17.2 - 17.2X + 5.02X^2$ $SI_{pH} = -242 + 95.5X - 6.67X^2$ $SI_{pH} = -181 + 82.4X - 6.05X^2$ $SI_{pH} = 536 - 77X + 2.76X^2$

[a] X is the concentration parameter in terms of mg/L, except for pH and DO. For DO, X refers to DO percentage saturation. Meanwhile, for pH, X refers to the pH value

Table 2: Water quality classes (I-V), WQI and water status as proposed by DoE 2005

Parameters	Unit	Classes				
		I	II	III	IV	V
AN	mg/L	<0.1	0.1–0.3	0.3–0.9	0.9–2.7	>2.7
BOD	mg/L	<1	1–3	3–6	6–12	>12
COD	mg/L	<10	10–25	25–50	50–100	>100
DO	mg/L	>7	5–7	3–5	1–3	<1
pH	-	>7	6–7	5–6	<5	>5
SS	mg/L	<25	25–50	50–150	150-300	>300
Water quality index	-	>92.7	76.5–92.7	51.9–76.5	31.0–51.9	<31.0
Water Status	-	Very good	Good	Average	Polluted	Very polluted

4. Results and Discussion

Table 3 shows the result of water quality analysis and the WQI standard requirement for class IIB respectively. By observing the gap values, it indicates that all the parameters are in the acceptable range and comply with the requirement of WQI Class IIB. Another important indication to strengthen the finding of this study is the water quality index (WQI). This value together with the sub index (SI) value for each critical parameter is demonstrated in Table 4.

Table 3: The results of water quality testing

Parameters (Unit)	Laboratory Result	WQI Class IIB
AN (mg/l)	0.24	0.1 – 0.3
BOD_5 (mg/l)	2.87	1 – 3
COD (mg/l)	22.10	10 – 25
DO (mg/l)	7.51	5 – 7
pH	7.63	6 – 9
Total SS (mg/l)	21.10	25 – 50

Table 4: Sub Index (SI) value for each respective parameter and Water Quality Index (WQI) value

Sub Index (SI) and Water Quality Index (WQI)	Index Value
SI BOD	87.75
SI COD	71.92
SI AN	75.30
SI SS	85.59
SI pH	95.50
SI DO	97.41
WQI	86.06

From Table 4, the water quality index (WQI) value is located in the range of 76.5 – 92.7 thus allowing it to be classified under Class IIB with satisfactory cleanliness level. Therefore, the water has been experimentally proven to be safe and acceptable for the intended use.

5. Conclusion

In conclusion, the water quality index value shows that the water can be classified under Class IIB, thus making it suitable for the usage on landscaping and gardening activities. By having this promising result, it is hope that this valuable source can be utilized effectively and efficiently to reduce the dependency on tap water for such activities.

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References

[1] Bartram J & Ballance R (1996), Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes, Vol. 2, *Military Operations Research* 348.

[2] Carey RO, Hochmuth GJ, Martinez CJ, Boyer TH, Dukes MD, Toor CS & Cisar JL (2013), Evaluating nutrient impacts in urban watersheds: Challenges and research opportunities, *Environmental Pollution* 173, 138–149.

[3] Das J & Acharya BC (2003), Hydrology and assessment of lotic water quality in Cuttack City, India, *Water, Air, and Soil Pollution* 150, 163–175.

[4] Declerck S, De Bie T, Ercken D, Hampel H, Schrijvers S, Van Wichelen J, Gillard V, Mandiki R, Losson B, Bauwens D, Keijers S, Vyverman W, Goddeeris B, De meester L, Brendonck L & Martens K (2006), Ecological characteristics of small farmland ponds: Associations with land use practices at multiple spatial scales, *Biological Conservation* 131, 523–532.

[5] Epele LB & Miserendino ML (2015), Environmental quality and aquatic invertebrate metrics relationships at patagonian wetlands subjected to livestock grazing pressures, *Plos One* 10, 1-19.

[6] Khalil B & Ouarda TBMJ (2009), Statistical approaches used to assess and redesign surface water-quality-monitoring networks, *Journal of Environmental Monitoring* 11, 1915-1929.

[7] Khatri N & Tyagi S (2015), Influences of natural and anthropogenic factors on surface and groundwater quality in rural and urban areas, *Frontiers in Life Science* 8, 23–39.

[8] Loukas A (2010), Surface water quantity and quality assessment in Pinios River, Thessaly, Greece, *Desalination* 250, 266–273.

[9] Massoud MA, El-Fadel M, Scrimshaw MD & Lester JN (2006), Factors influencing development of management strategies for the Abou Ali River in Lebanon. I: Spatial variation and land use, *Science of the Total Environment* 362, 15–30.

[10] Mitsch WJ & Sven EJ (2004), Ecological engineering and ecosystem restoration. *John Wiley and Sons Inc.*, Hoboken, New Jersey.

[11] Novotny V (2003), Water Quality: Diffuse Pollution and Watershed Management. *John Wiley and Sons Inc.*, Hoboken, New Jersey.

[12] Ramakrishnaiah CR, Sadashivaiah C & Ranganna G (2009), Assessment of water quality index for the groundwater in Tumkur taluk, Karnataka state, India, *E-Journal of Chemistry* 6, 523–530.