of Fe in the study area was (2.72 mg/L ± 2.36) as shown in Fig. 6b.

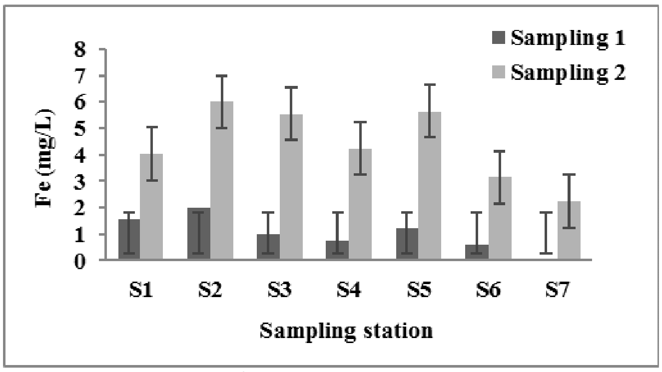

Fig. 6a Distribution of Iron (Fe) values between samplings Fig. 1

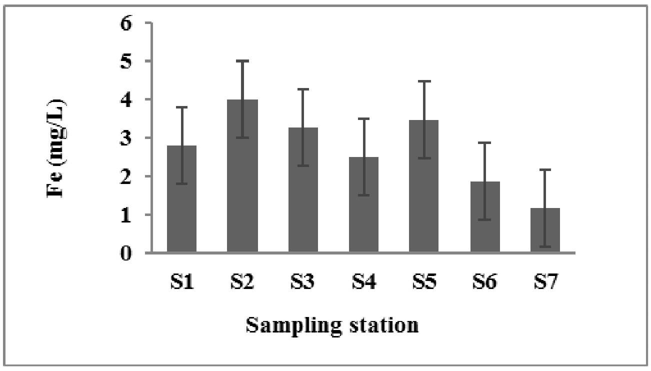

Fig. 6b Mean iron (Fe) values at seven sampling stations

F. Cadmium (Cd)

The range of Cd during the first sampling was from 0.0001 to 0.0004 mg/L with an average of 0.0002 mg/L, where the highest (0.0004 mg/L) was recorded at station 3 and the lowest (0.0001 mg/L) was recorded at station 7. The range of Cd during the second sampling was 0.0001 to 0.0002 mg/L with an average of 0.0001 mg/L, which the highest (0.0002 mg/L) was recorded at station 4 and the lowest (0.0001 mg/L) was recorded at station 7 (Fig. 7a). The average of two samplings of Cd in the study area was (0.0001 mg/L ± 0) as shown in Fig. 7b.

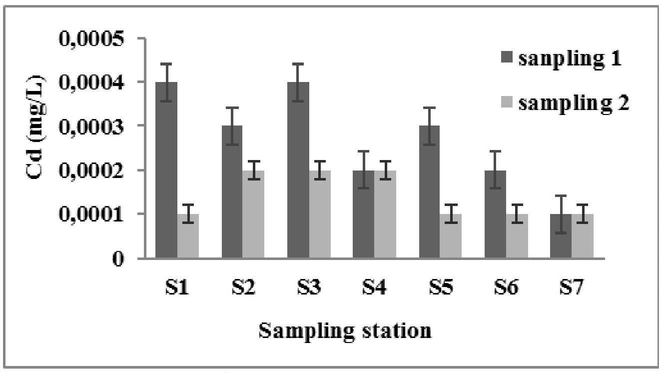

Fig. 7a Distribution of Cadmium (Cd) values between two samplings

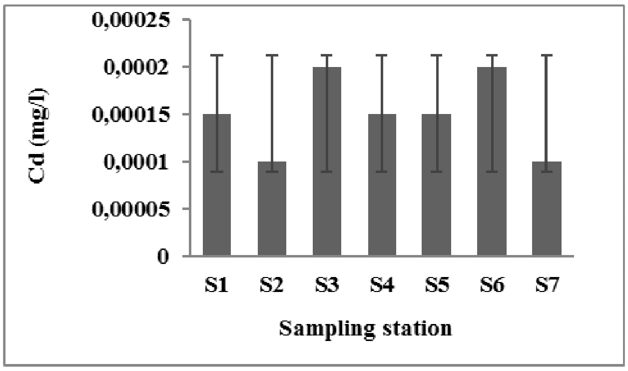

Fig. 7b Mean cadmium (Cd) values at 7 sampling stations

G. Nickel (Ni)

The range of Ni during the first sampling was from 0.0008 to 0.002 mg/L with an average of 0.0013 mg/L, which the highest (0.002 mg/L) was recorded at station 2 and the lowest (0.0008 mg/L) was recorded at station 7. The range of Ni during the second sampling was 0.01 to 0.02 mg/L with an average of 0.014 mg/L, where the highest (0.02 mg/L) was recorded at station 3 and the lowest (0.01 mg/L) was recorded at station 7 (Fig. 8a). The average of two sampling of Ni was (0.007 mg/L ± 0.006) as shown in Fig. 8b.

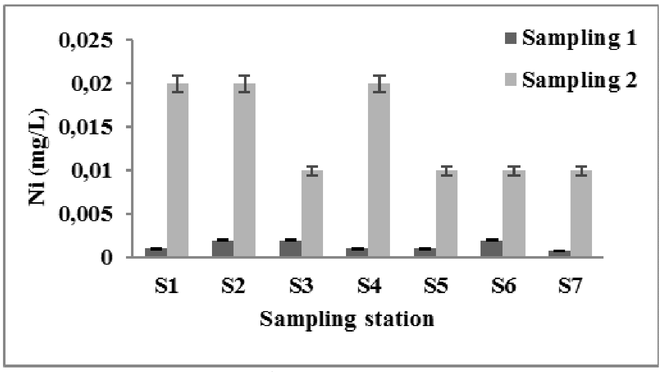

Fig. 8a Distribution of (Ni) values between two samplings

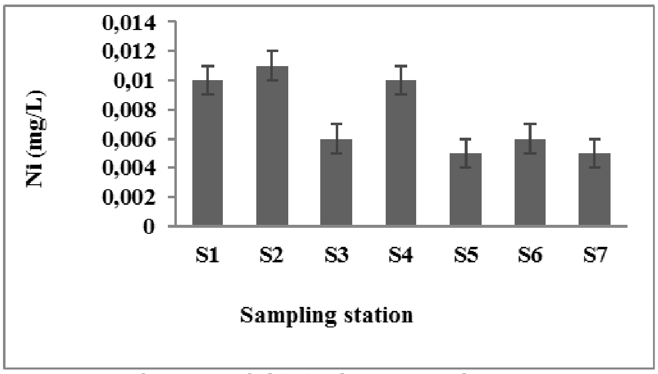

Fig. 8b Mean Nickel (Ni) values at 7 sampling stations

The explanation of statistical analysis of the seven of heavy metals will be explain as follows.

A. Copper

Statistical analysis showed there were no significant differences between sampling stations and between sampling times ($p > 0.05$; $p < 0.05$). Based on the NWQS, the level of Cu is classified as Class I. Cu contributed to the environment through vehicles. Oil is another pathway by which metal enters the environment via the road surface and the metal becomes bound to the surfaces of road dust or other particles.

B. Manganese

Statistical analysis showed that there were no significant differences between stations and between sampling times ($p > 0.05$; $p > 0.05$). Based on the NWQS, the level of Mn is classified as Class II. With respect to the Mn metal, the study reveals that there are expected additions of quantities of industrial effluents and anthropogenic wastes that are particularly associated with the water streams in the lake.

C. Lead

Statistical analysis showed that there were no significant differences of Pb between stations and sampling times ($p > 0.05$; $p > 0.05$). Based on the NWQS, the level of Pb in the study area is classified as Class I. Pb deposited in parking lots and roads can be carried by surface runoff that flows into the lakes. The presence of Pb can be observed not only in the area density of vehicles, but also the atmosphere that falls with rain water and transported to aquatic sediments [21] effectively than the surface area. There is an increasing problem of heavy metal contamination during a surface runoff in the area city. However, the Pb values in this study are not high different compared to the value obtained by [20] based on their study in Tasik Chini (0.0016 to 0.0034 mg/L).

D. Zinc

Statistical analysis showed that there were significant difference between sampling stations and between sampling times (ANOVA, $p < 0.05$; $p < 0.05$). Based on the NWQS, the level of Zn in the study area is classified as Class I. High concentration of Zn indicates an increase of pollution load due to the movement of agricultural ashes, industrial effluents and anthropogenic wastes [9] or from vehicle exhausts, oil lubricants, automobile parts and the corrosion of building materials. However, the Zn values of the lake in this study are slightly higher compared to [20] based on their study in Tasik Chini (0.005 to 0.006 mg/L).

E. Iron

Statistical analysis showed that there were significant differences in the mean Fe levels between stations and between sampling times ($p < 0.05$; $p < 0.05$). Based on the NWQS, the level of Fe in the study area is classified as Class IV. The highest concentration of Fe may be due to the discharge of industrial wastes into the water body [1]. However, the Fe values of the lake in this study are higher compared to the value obtained by [20] based on their study in Tasik Chini (0.32 to 1.02 mg/L).

F. Cadmium

The statistical analysis showed that there were no significant differences between the seven sampling stations, but significant differences between the sampling times (ANOVA, $p > 0.05$; $p < 0.05$) respectively. Based on the NWQS, the level of Cd in the study area is classified as Class I. The results of Cd are low during the second sampling, but high during the first sampling, this may be due to the presence of Cd in the dust and deposited in the lake. The presence of Cd the atmosphere is usually caused by burning of fossil fuels in vehicles, industrial activities and construction activities very rapidly in the vicinity of the basin. However, the Cd values of the lake in this study are about the same to the value obtained by [20] based on their study in Tasik Chini (0.0003 to 0.0004 mg/L).

G. Nickel

Statistical analysis showed that were no significant differences in the mean contents of Ni in the seven sampling stations, but significant differences between sampling times (ANOVA, $p > 0.05$; $p < 0.05$) respectively. Based on the NWQS, the level of Ni in the study area is classified as Class I. However, the Ni values of the lake in this study are lower compared to the value obtained by [1] in the study of Ganga river of India which was between 0.012 to 0.37mg/L.

IV. Conclusion

The results of the analysis of the seven heavy metals in the seven sampling stations found that the concentration of heavy metals is relatively low. Only Fe has high content and in class IV, followed by Mn in class II. Despite the relative distribution of heavy metals present in general are in Class I, but likely their concentration will be increased in the future in line with an increase in human activity.

Based on the statistical analyses show that Zn, Fe were significantly different between sampling stations and sampling times, Cd and Ni have significantly different only during sampling times. But three heavy metals namely Pb, Mn and Cu have no significant during sampling times and stations.

Monitoring should be carried out from time to time of the waste waters that enter into Lake Cempaka, to trace and control new contamination as well to identify the sources, especially those that can have a direct impact on existing aquatic life in the lake.

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References

[1] D. Kar, P. Sur, S. K. Mandal, T. Saha, and R. K. Kole, “Assessment of heavy metal pollution in surface water,” *International Journal of Environmental Science and Technology*, vol. 5, pp. 119-124, Dec. 2008.

[2] M. W. Akhtar, M. Paramasivam, M. Ganguly, S. Purkait, and D. Sengupta, “Assessment and occurrence of various heavy metals in surface water of Ganga river around Kolkata: A study for toxicity and ecological impact,” *Environmental Monitoring and Assessment*, vol. 160, pp. 207-213, Jan. 2010.

[3] W. Z. Tang, B. Q. Shan, H. Zhang, and Z. P. Mao, “Heavy metal sources and associated risk in response to agricultural intensification in the estuarine sediments of Chaohu Lake Valley, East China,” *Journal of Hazardous Materials*, vol. 176, pp. 945-951, Apr. 2010.

[4] R. Reza and G. Singh, “Heavy metal contamination and its indexing approach for river water,” *International Journal of Environment Science and Technology*, vol. 7, pp. 785-792, Sep. 2010.

[5] N. Ahmad, M. S. Jaafar, and M. S. Alsaffar, “Study of radon concentration and toxic elements in drinking and irrigated water and its implications in Sungai Petani, Kedah, Malaysia,” *Journal of*

Radiation Research and Applied Sciences, vol. 8, pp. 294-299, Jul. 2015.

[6] S. Whitmee, A. Haines, C. Beyrer, F. Boltz, A. G. Capon, B. F. D. S. Dias, A. Ezeh, H. Frumkin, P. Gong, P. Head, R. Horton, G. M. Mace, R. Marten, S. S. Myers, S. Nishtar, S. A. Osofsky, S. K. Pattanayak, M. J. Pongsiri, C. Romanelli, A. Soucat, J. Vega, and D. Yach, “Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation-Lancet Commission on planetary health,” *The Lancet*, vol. 15, pp. 1973-2028, Nov. 2015.

[7] M. K. Ahmad, S. Islam, S. Rahman, M. R. Haque, and M. M. Islam, “Heavy metals in water, sediment and some fishes of Buriganga River, Bangladesh,” *International Journal of Environmental Research*, vol. 4, pp. 321-332, Apr. 2010.

[8] A. Stéphane, S. Jörg, B. Gérard, and J. M. Jouanneau, “Fifty-year sedimentary record of heavy metal pollution (Cd, Zn, Cu, Pb) the Lot River reservoirs (France),” *Environmental Pollution*, vol. 132, pp. 413-426, Dec. 2004.

[9] Škrbic, B. and N. Đuriśić-Mladenović, “Chemometric Interpretation of Heavy Metal Patterns in Soils Worldwide”. Chemosphere, 80, 1360-1369. http://dx.doi.org/10.1016/j.chemosphere.2010.06.010

[10] K. Sekabira, O. H. Origa, T. A. Basamba, G. Mutumba, and E. Kakudidi, “Assessment of heavy metal pollution in the urban stream sediments and its tributaries,” *International Journal of Environment Science and Technology*, vol. 7, pp. 435-446, Jun. 2010.

[11] C. Copat, F. Bella, M. Castaing, R. Fallico, S. Sciacca, and M. Ferrante, “Heavy metals concentrations in fish from Sicily (Mediterranean Sea) and evaluation of possible health risks to consumers,” *Bulletin of Environmental Contamination and Toxicology*, vol. 88, pp. 78-83, Jan. 2012.

[12] M. G. Abdullahi, M. K. A. Kamarudin, M. E. Toriman, M. B. Gasim, A. Endut, and I. Garba, “Assessment of natural groundwater recharge in Terengganu, Malaysia,” *International Journal on Advanced Science, Engineering and Information Technology*, vol. 6, pp. 781-786, Oct. 2016.

[13] M. R. Mahananda, B. P. Mohanty, and N. R. Behera, “Physico-chemical analysis of surface and ground water of Bargarh district, Orissa, India,” *International Journal of Research and Reviews in Applied Sciences*, vol. 2, pp. 284-295, 2010.

[14] H. Zeng and J. Wu, “Heavy metal pollution of lakes along the mid-lower reaches of the Yangtze River in China: Intensity, sources and spatial patterns,” *International Journal of Environmental Research Public Health*, vol. 10, pp. 793-807, Feb. 2013.

[15] X. Jiang, W. W. Wang, S. H. Wang, B. Zhang, and J. C. Hu, “Initial identification of heavy metals contamination in Taihu Lake, a eutrophic lake in China,” *Journal of Environmental Sciences*, vol. 24, pp. 1539-1548, Sep. 2012.

[16] M. K. A. Kamarudin, M. E. Toriman, M. H. Rosli, H. Juahir, A. Azid, S. F. Mohamed Zainuddin, N. A. Abdul Aziz, and W. N. A. Sulaiman, “Analysis of meander evolution studies on effect from land use and climate change at upstream reach of Pahang River, Malaysia,” *Mitigation and Adaptation Strategies for Global Change*, vol. 20, pp. 1319-1334, Dec. 2015.

[17] M. K. A. Kamarudin, M. Idris, and M. E. Toriman, “Analysis of Leptobarbus hoevenii in control environment at natural lakes,” *American Journal of Agricultural and Biological Science*, vol. 8, pp. 142-148, 2013.

[18] A. A. Mohamed, S. A. Rahim, D. A. Aitman, and M. K. A. Kamarudin. “Analysis of seasonal soil organic carbon content at Bukit Jeriau Forest, Fraser Hill, Pahang,” *Malaysian Journal of Analytical Sciences*, vol.20, pp. 452-460, 2016.

[19] Q. Sui, X. Cao, S. Lu, W. Zhao, Z. Qiu, and G. Yu, “Occurrence, sources and fate of pharmaceuticals and personal care products in the groundwater: A review,” *Emerging Contaminants*, vol. 1, pp. 14-24, Nov. 2015.

[20] I. Mushrifah, M. Shuhaimi-Othman, A. Ahmad, and E. C. Lim, “Seasonal influence on water quality and heavy metals concentration in Tasik Chini, Peninsular Malaysia,” in *Proc. TAAL’07*, 2007, p. 300.

[21] N. A. Wahab, M. K. A. Kamarudin, M. B. Gasim, R. Umar, F. M. Ata, and N. H. Sulaiman, "Assessment of total suspended sediment and bed sediment grains in upstream areas of Lata Berangin, Terengganu," *International Journal on Advanced Science, Engineering and Information Technology*, vol. 6, pp. 757-763, Oct. 2016