ASSESSMENT OF NUTRIENTS (C, N, P) AND HEAVY METAL POLLUTIONS IN SURFACE CANALS SEDIMENTS IN HO CHI MINH CITY

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Abstract

Canals are considered as primary recipients of dissolved and suspended matters that can be locally accumulated and/or transported far away from emission sources into surface sediments or sludges. Nutrients and heavy metals can pose risks to the environment if they exceed the natural processing capacity of ecosystems. The objectives of this study is assess the status of nutrients (C, N, P) and heavy metals pollution in the surface sediments in canals in Ho Chi Minh City. Sediment samples were taken at four canals, including Tau Hu, Vam Thuat, Nhieu Loc - Thi Nghe and 19/05 at the dry and wet season.

The results showed that the contents of nutrients (C, N, P) in the canals were higher in the wet season than in the dry season. However, there is no guideline of the National Technical Regulation (QCVN) regarding the level of nutrient contents in the sediments. Therefore, we only presented the accumulation levels of nutrients in the canals. The results showed that the content Fe > Zn > Cu > Cr > Pb > Ni. The impact and risk assessments showed that the CF of elements was at low, medium and high, Igeo was in the range of no pollution to low and medium pollution. The PLI index > 1 and the RAC risk coefficient within < 30% indicate the pollution and impact of metals on environmental quality.

It could be concluded that the studied rivers/canals in Ho Chi Minh City were accumulating large amounts of nutrients and heavy metals that can affect the life of aquatic animals and microorganisms. So, it is necessary to conduct a requirement to prevent and reduce the emission of organic substances and metals into the rivers/canals as well as canal rehabilitation that provide a better environmental condition for the life of aquatic organisms, animals, and humans living close to the canals

Introduction

Overpopulation and industrialization increase environmental pollution, especially in canals and rivers. Pollutants flow into canals and rivers and accumulate in sediments, causing canal pollution (Li 2020). In sediments, organic pollutants such as nitrogen, phosphorus, organic carbon compounds, etc., causing changes in water quality, they also affect the health of aquatic ecosystems, such as benthic organisms. Pollutants could be existed in many different forms in sediments, causing eutrophication, bioaccumulation in aquatic organisms, oxygen consumption during the decomposition of organic matter, anaerobic conditions creating hydrogen sulfide and methane, both of which adversely affect bottom organisms. High nitrogen and phosphorus content increases organic matter, reduces oxygen, especially in deep layers, affecting the underwater ecosystem, causing outbreaks of aquatic plants (such as algae, seaweed, water hyacinth, duckweed, etc.) causing blooms in water (Yang 2020).

Heavy metals were one of the main sources of significant negative impacts on the ecological quality of sediments and the surrounding environment (Usman, Alkredaa, & Al-Wabel, 2013), especially in river and canal areas where they were considered as an intermediary in the transport of water and substances from land to sea. Influenced by topography and currents, the ability of particles of matter to be deposited under the action of gravity, including metal traces, that are not biologically or chemically degraded, can cause local accumulation (Salomons, Kerdijk, Van Pagee, Klomp, & Schreur, 1988). The transformation of metal traces was very complex; besides, their toxicity affects biodiversity and environment (Cyril Marchand et al., 2006). In general, heavy metal pollution was related to industrial wastewater, agricultural, fisheries, wastewater treatment plants, leaching from domestic landfills, urbanization, chemicals (Bodin et al., 2013). In the environment, they exist in water-soluble, colloidal, suspended and sedimentary phases (Peng, Song, Yuan, Cui, & Qiu, 2009) and are governed by environmental factors such as reduced oxidation (Guo, DeLaune, & Patrick Jr, 1997) and organic composition/content (Mounier, Lacerda, Benaim, & Marins, 2001; Nissenbaum & Swaine, 1976).

Metals were one of the environmental pollutants, depending on the content and duration of exposure, almost any form of metal could harm biological systems, Cr, Ni, Cu, Zn, Pb, Cd, As, and Hg were the most harmful metals in the environment (Ding et al., 2022). In 2009, China proposed Cr, Cd, Pb, As, and Hg as the main pollutants that should be managed in the plan for the prevention and comprehensive control of metal/metalloids pollution. Metals were harmful, kill aquatic organisms, cause hypoxia and were toxic to the ecosystem. Some metals such as Hg, Pb, and As were highly toxic to most organisms even at low concentrations. Many studies have reported heavy metal pollution in the river basin, which confirms that the high rate of human-caused discharge in the river basin was polluting water as well as sediment (Jain, Gupta, & Chakrapani, 2008; Montuori, Lama, Aurino, Naviglio, & Triassi, 2013; Patel et al., 2016; Shafie, Aris, & Haris, 2014). Various pollution indicators have been developed to assess the source and level of contamination of metals in the water system such as pollution coefficients and enrichment coefficients using local baseline data. Sediment quality guidelines have been constructed and developed to assess ecotoxicological risk to aquatic organisms (MacDonald, Ingersoll, & Berger, 2000).

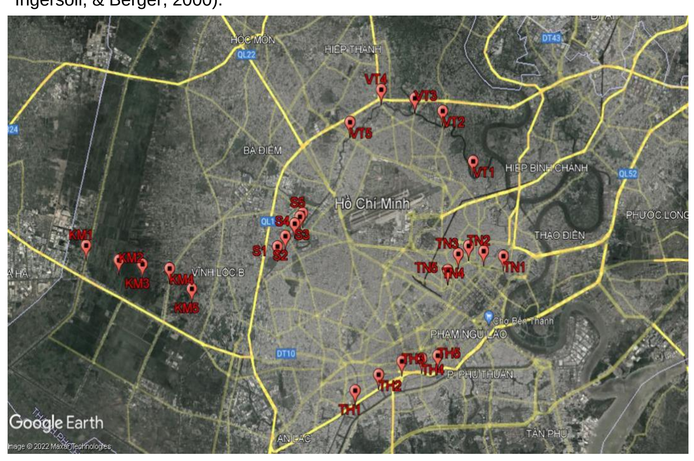
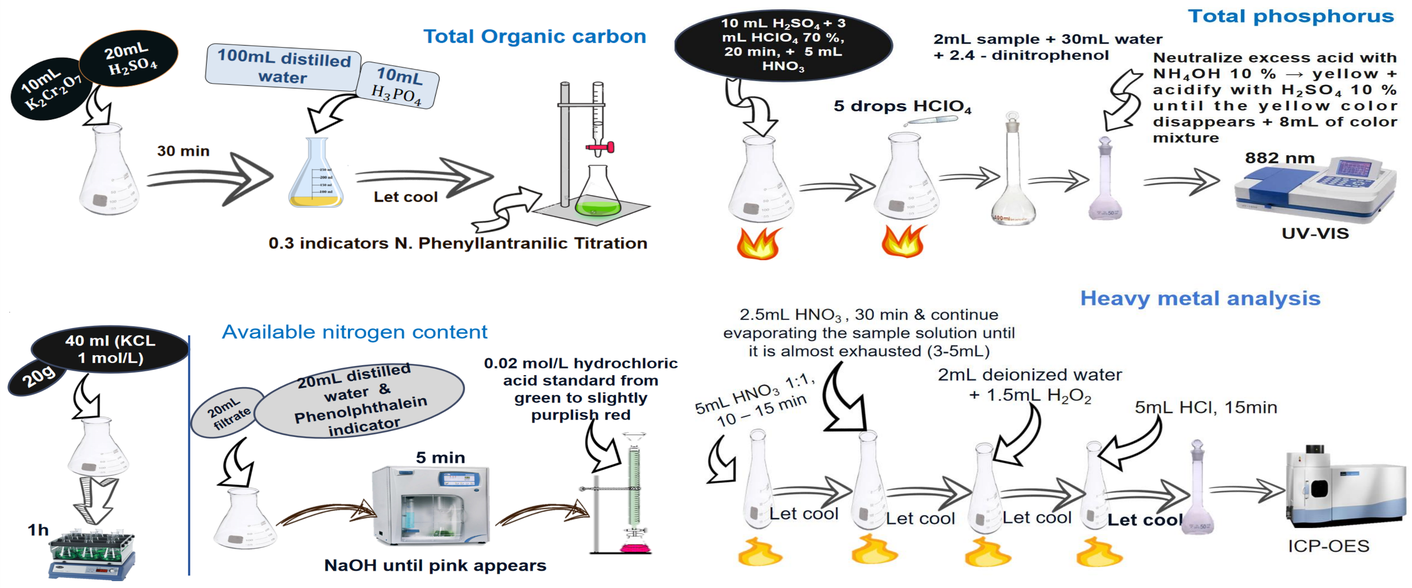
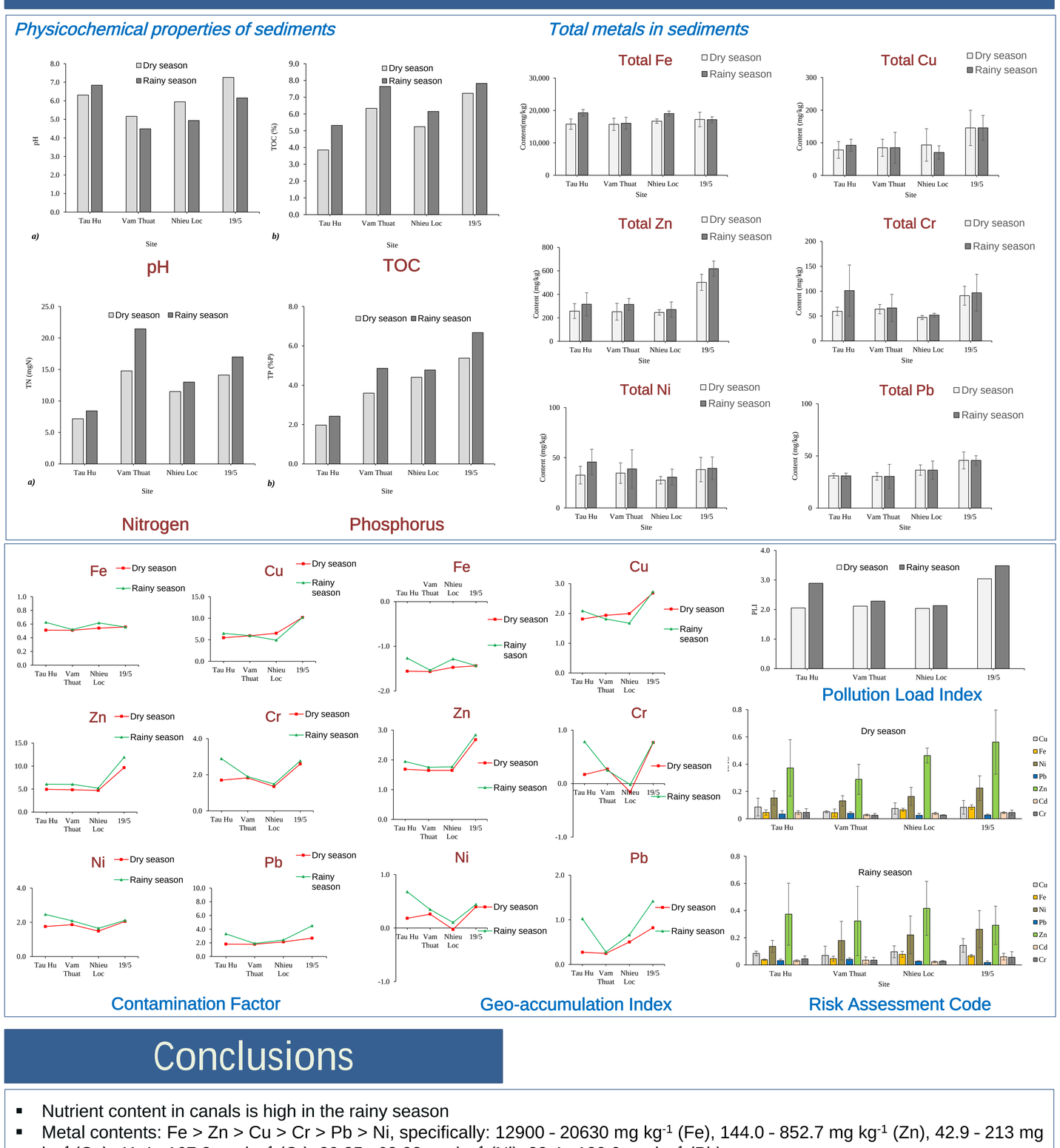


Figure 1. Map showing the canals of Ho Chi Minh with sampling points.

Methods and Materials



Results



Conclusions

- Nutrient content in canals is high in the rainy season
- Metal contents: Fe > Zn > Cu > Cr > Pb > Ni, specifically: 12900 - 20630 mg kg^{-1} (Fe), 144.0 - 852.7 mg kg^{-1} (Zn), 42.9 - 213 mg kg^{-1} (Cu), 41.4 - 167.2 mg kg^{-1} (Cr), 20.85 - 63.98 mg kg^{-1} (Ni), 22.4 - 139.9 mg kg^{-1} (Pb)
- The impact and risk assessments showed that the CF of elements was at low, medium and high, I_{geo} was in the range of no pollution to low and medium pollution.
- The PLI index > 1 and the RAC risk coefficient within < 30% indicate the pollution and impact of metals on environmental quality.
- All sources of metal waste are efected by human.

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References

1. C. W. Chen, Kao, C.M., Chen, C.F., Dong, C.D. 2007. 'Distribution and accumulation of heavy metals in the sediments of Kaohsiung Harbor, Taiwan', Chemosphere, 66: 1431-40.
2. Cheng, Frederick Y, and Nandita B Basu. 2017. 'Biogeochemical hotspots: Role of small water bodies in landscape nutrient processing', Water Resources Research, 53: 5038-56.
3. Dodds, Walter K, and Val H Smith. 2016. 'Nitrogen, phosphorus, and eutrophication in streams', Inland Waters, 6: 155-164