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Assessment of Heavy Metal Concentrations Along an Urban Gradient Using Spanish Moss (*Tillandsia usneoides*) as a Biomonitoring Tool in Kandy, Sri Lanka

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Background: Kandy is known as one of the highly polluted cities in Sri Lanka due to its geographic location, high vehicular traffic, and dense population. *Tillandsia usneoides* (Spanish moss) is an air plant which absorbs their nutrition directly from the atmosphere and acts as a biomonitor for the airborne heavy metals.

Objective: The objective of the study is to assess the heavy metal concentration along the urban gradient using Spanish moss as a biomonitoring tool.

Methods: Spanish moss plants were obtained from the Royal Botanical Garden, Peradeniya, and transplanted at selected locations along the urban gradient considering the Kandy Clock Tower as the urban center. Samples were collected at 4-week intervals over a three-month period and analyzed using ICP-MS (NexION 2000B, PerkinElmer, USA) following microwave-assisted digestion. The distance from the urban center to each location was measured using Google Earth Engine. Analysis was done using Ggplot2, vegan, dplyr and tidyr packages of R Software (version 4.3.1).

Results: Arsenic shows highest concentration within 0-5km (833.0ppb) and it declines with distance (803.0 ppb). The median of as decreases with distance and indicates less variability. In Cd highest median and interquartile range (IQR) showed in the 10-15km (23.0 ppb) range and almost all the distance categories show higher variability reflecting spatial heterogeneity. The highest median Hg concentration was observed in the 15 - 20 km category (8672.00 ppb) and decrease was observed in the overall Hg concentration with urban gradient. When compared with other metals, Hg shows a less variability in most distance categories indicating a uniform distribution. Median Pb concentration steadily increased with distance (596.0 ppb - 769.0 ppb) and IQR is comparatively high which indicates a greater variation. Outliers suggest possible local pollution in all metals.

Conclusion: This study indicates that the pollution levels along the urban gradient is not only affected by the distance but also affected by the localized sources as well.

Keywords: Air pollution, Spanish moss, Urban Gradient