UNIVERSITI TEKNOLOGI MARA

GEOSPATIAL AND MULTIVARIATE STATISTICAL ANALYSIS OF HEAVY METAL CONCENTRATION IN SOILS OF PERLIS

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged or referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Urbanisation and industrialization have elicited continuous emission of metals which pose a great threat on human health. Soil samples from 19 station (include control) in Perlis obtained in triplicates and at depths of 0 to 15, 15 to 30, 30 to 45, 45 to 60, 60 to 75 and 75 to 90cm. 7 metals (Pb, Cu, Zn, Cr, Co, Ni and As) was analysed using microwave digestion to determine the concentration and distribution of heavy metals in soil of Perlis. The results with Pb (12.6), Cu (13.8), Zn (157.9), Cr (94.9), Co (3.4), Ni (197.7) and As (19.6) mg/kg exceed the control values. As compared with allowable limit set for soils from the Department of Environment and World Average Soil Value, Pb, Zn, Cr, Ni, As relatively higher. This indicates that the anthropogenic activities and reaction between soil properties and metal affected the soils in the study area greatly. Most soil samples high in surface soil (0-15cm) and decrease from first depth to third and increase from third depth to sixth depth. The mobility of heavy metals largely depended on the role of soil properties such as organic matter, clay content, nodules formulation of Fe and Mn oxides, metal properties and concentration. Implementation of geostatistical and multivariate analysis successfully grouped metals according to their anthropogenic or natural origin and illustrate the spatial distribution trends confirming the clear contribution of anthropogenic inputs. The results demonstrate that groups Pb, Zn and Co probably deposited by vehicular emission. Meanwhile, Cr, Cu, Ni and As were impacted by mixed sources (anthropic and natural origin). Geo-accumulation index and enrichment factor results moderate contaminated to extreme contaminated for Zn, Cr and Ni, while pollution load index has resulted a moderate pollution in station 3, 5, 6, 7, 12, 13 and 18. Findings of this study will create awareness and offer undertaking appropriate action to protect soil quality.

TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Soil was a very specific component of the biosphere because it is not only a geochemical sink for contaminants but also acts as natural buffer controlling the transport of chemical elements (i.e heavy metal) and substances to the atmosphere, hydrosphere and biota [1]. With rapid industrialization and urbanization that have occurred in most part of the world, the soil compartment is receiving a substantial amount of pollutants from different sources including heavy metals [2]. These heavy metals are the most dangerous group of anthropogenic environmental pollutants due to their toxicity, persistency in the environment [3], bioaccumulative, and resistant to biochemical degradation and can pose a potential threat to human health [4].

In the last decades, great interest has been focused on heavy metals in soil and factors controlling their distribution within the soil profiles. Heavy metals in soils have been considered to be powerful tracers for monitoring the impact of human activities [5] and have attracted a great deal of attention worldwide due to their non-biodegradable nature and long biological half-lives [6]. The specific physic-chemical features of the metals strongly determine their mobility and availability in soil [7]. The accumulation of heavy metals and migration into soil profiles can cause a potential risk to plants, animals and human health due to the transfer of these elements in soil, groundwater, and their uptake by plants and their introduction into the food chain.

Heavy metals can be subjected to soil through several sources such as anthropogenic activity, atmospheric deposition and natural sources. Natural concentrations of heavy metals in soils depend primarily on composition of geological parent materials [8]. Meanwhile, anthropogenic sources can be discharged in many ways, mainly through direct or indirect emissions of trace elements from human activities, such as the burning of fossil fuels, industrial activity, production and extensive use of chemical fertilizers and pesticide, daily activities and vehicle emission [9, 10]. Continuous emission of anthropogenic activity has left the metal pollution of