Mathematical and Computer Modelling 54 (2011) 1005–1009

Contents lists available at ScienceDirect

Mathematical and Computer Modelling

journal homepage: www.elsevier.com/locate/mcm

Analysis of relations of heavy metal accumulation with land utilization using the positive and negative association rule method

You Dongmei [a,c], Zhou Jiaogen [b], Wang Jihua [c,*], Ma Zhihong [c], Pan Ligang [c]

[a] College of Resources and Environmental Sciences, China Agricultural University, Beijing 100193, China

[b] Center of Agricultural Engineering and Technology, Shanghai Academy of Agricultural Science, Shanghai 201106, China

[c] National Engineering Research Center for Information Technology in Agriculture, Beijing 100097, China

ARTICLE INFO

Article history:
Received 13 August 2010
Accepted 4 November 2010

Keywords:
Heavy metal accumulation
Land utilization
Positive and negative association rule

ABSTRACT

Tracing of heavy metal pollution sources is a current hot issue of agricultural soil quality management. Land utilization is one of the important factors which affect the heavy metal contents of regional soil. In order to model the relationship between soil heavy metal contamination and land utilization, this paper adopts a novel positive and negative association rule method in order to effectively find the probabilities of different dual events which occur simultaneously and frequently. Given the item set Δd, which are the differences between the values of As, Cd, Cr, Cu, and Hg contents and the corresponding background values, and the set of land use types T, consisting of grain farm, vegetable farm, orchard and forest land, we find the dual association rule $T \Rightarrow \Delta d$. With soil heavy metal data collected in 2006–2008 from Beijing, the experimental results demonstrate that land utilization has made a greater contribution to the accumulation of the concentrations of Hg and Cd than to that of the concentrations of As, Cr and Cu.

1. Introduction

With the intensification of agricultural production development and urbanization, heavy metals from sewage irrigation, atmospheric dust deposition, rubbish landfills and other channels enter into the soil [1–5]. Due to them not being susceptible to microbial degradation or easy to remove, and therefore accumulating unceasingly, the heavy metal ions enter into agricultural products through the food chain, which affects agricultural product quality security, and harms human health. Soil heavy metal pollution has attracted global attention as well as being a hot topic. Tracing pollution sources is essential to the pollution management of soil heavy metals.

A direct and effective method of tracing of heavy metal sources first runs a sampling analysis in the regions affected by pollution sources, and identifies their impact on the heavy metal pollution with reference to certain soil pollution assessment methods, such as using the single pollution index, Nemerow pollution index, geo-accumulation index and ecological risk index, etc. Such research is widely used to study the influence of pollution sources (land utilization, urban industry layouts, transportation roads, waste irrigation, mining areas, landfills, etc.) on soil heavy metal pollution, and has proved massively progressive. For instance, sampling analysis effectively helps to verify the influence of the different land utilization types on the accumulation or pollution of soil heavy metals [6,7]. It is shown that heavy metal contents in mining or metallurgical industry peripheries are higher than those in the suburbs [7–9]. Sampling analysis along transportation roads shows the heavy metal contents in both the soil and the dust along both sides of roads to present varying degrees of accumulation [10–12].

* Corresponding author. Tel.: +86 1051503488; fax: +86 1051503729.
E-mail address: wangjh@nercita.org.cn (J. Wang).

0895-7177/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.mcm.2010.11.028