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## Potentially toxic elements in agricultural soils from the Lombardia region of northern Italy

Gian Maria Beone<sup>a\*</sup>, Franca Carini<sup>a</sup>, Laura Guidotti<sup>a</sup>, Riccardo Rossi<sup>b</sup>, Marina Gatti<sup>a</sup>, Maria Chiara Fontanella<sup>a</sup>, Roberto M. Cenci<sup>c</sup>

<sup>a</sup>Department for Sustainable food process, Faculty of Agriculture, Food and Environmental Sciences, Università Cattolica del Sacro Cuore, Via Emilia Parmense 84, 29122 Piacenza, Italy

<sup>b</sup>AEIFORIA Srl Spin-off of Università Cattolica del Sacro Cuore, Piacenza, Italy

<sup>c</sup>BIO-BIO, Via Collina 13, 21023 Besozzo, Varese, Italy

\*Corresponding author

E-mail address: gian.beone@unicatt.it (G.M. Beone)

### Abstract

The aim of this survey was to assess the concentration range of potentially toxic elements (PTE) in agricultural soils of the Lombardia plain and to consider their spatial variability across the catchments of the Ticino, Adda, Oglio, Mincio and Po rivers. Agricultural soils were sampled at depths of 0-30 cm based on the LUCAS (Land Use/Cover Area frame statistical Survey) using a pre-existing network of geo-referenced points. The samples from each catchment were analysed to determine their main properties and their concentrations of As, Be, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Tl, V and Zn. The spatial distribution of PTEs reflected the predominant lithology on which the soils developed and the sediment deposition along the river catchments. The highest concentrations of As and Sb in the Adda basin and of Co, Cr and Ni in the Po basin were due to their geological origin. The elevated concentrations of Hg and Pb in the Adda basin probably arose from old mining operations. Italian legislation includes two legislative levels: A for residential/recreational areas and B for commercial/industrial areas. The A levels were exceeded only for As, Be, Co, Cr, Cu, Ni and Zn. The percentage of soils exceeding this threshold was low and consistently below 15% of the measured samples for all elements.

**Keywords:** Potentially toxic elements (PTE), agricultural soils, hydrographic basins, Lombardia region.

### 1. Introduction

The assessment and monitoring of soil quality represents a key issue for agricultural policy and the management of environmental resources. Soil quality, amongst many other functions, is highly relevant to our ability to provide ecosystem services essential to human beings, such as the conservation of plant and animal productivity and the provision of healthy food and feed. This is an important topic for policy makers who have the responsibility to preserve soil quality and to implement measures to remediate polluted soils. Potentially toxic elements (PTE), whether of geogenic or anthropogenic origin, can constitute a risk to human health and ecosystems. The routine monitoring of the concentrations of PTEs over time provides information about the changes in soil quality due to human activities, including alterations in land use and climate change.

Recently, we conducted a survey in the Lombardia region in which the concentrations of PTEs in soils were measured as part of the “Soil Project” (European Commission, 2015). This study was part of a wider project, commissioned by “Regione Lombardia” to the Università Cattolica del Sacro Cuore (UCSC) in Piacenza and to the Joint Research Centre - Institute for Environment and Sustainability (JRC-IES) in Ispra in 2011, to assess the quality of agricultural soils in Lombardia through a three-year environmental monitoring program. Our study was conducted on soils sampled using the LUCAS (Land Use/Cover Area frame statistical Survey) pre-existing network of geo-referenced points (EUROSTAT, 2000). Initially, sampled soil was analysed to determine the soil characteristics and concentrations of PTEs, organic pollutants and gamma-emitting radionuclides (Guidotti et al., 2015). Thereafter, further analyses were carried out to quantify the various biological features of the soils. This survey represents the first effort in Lombardia to construct a database of topsoil properties based on standard sampling and analytical procedures (JRC, 2014).

Two monitoring studies of the concentrations of Cd, Cu, Mn, Ni, Pb and Zn in agricultural soils of the Lombardia region have previously been carried out by Sacchi et al. (Ap and C horizons) under the RAMET

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