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Environmental distribution and associated human health risk due to trace elements and organic compounds in soil in Jiangxi province, China

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ABSTRACT

The government of China launched its first national soil quality and pollution survey (NSQPS) during April 2006 to December 2013. Data gathered in several earlier soil surveys were rarely used to understand the status of pollution. In this study, the dataset collected at the provincial level was analyzed for the first time. Concentrations, distribution, diversity, and human health risks of trace elements (As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Se, V and Zn) and organic pollutants (benzene hexachloride (BHCs), dichlorodiphenyltrichloroethanes (DDTs), phthalic acid esters (PAEs), polycyclic aromatic hydrocarbon (PAHs), polychlorinated biphenyls (PCBs), and petroleum hydrocarbons (PHCs)) in surface soil samples collected across Jiangxi province,China were presented. The results showed that, the proportion of contaminants with concentrations higher than their corresponding regulatory reference value ranged from 0.12% to 17%. It is worth note that, the local residents are exposed to moderate non-carcinogenic and carcinogenic risks at some sites. The comprehensive analysis of soil pollutants provide baseline information for establishing a long-term soil environmental monitoring program in Jiangxi province, China.

1. Introduction

Potential soil quality issues include loss of organic matter, reduction in soil fertility, biodiversity, contamination, sealing, compaction, salinization, and landslides (Commission of the European Communities [EC], 2002). Of these issues, soil fertility and contamination are directly related to food safety, and minimizing the transfer of contaminants from soil to the food chain is a top priority in China (Zhao et al., 2015; Y.L. Liu et al., 2013, X.M. Liu et al., 2013). Soil pollution is a complex issue, and a combination of pollutants and an increasing food safety risk have affected a large part of the population (Lu et al., 2015). Heavy metals, organochlorine pesticides (OCPs), persistent organic pollutants, and some emerging organic pollutants are considered to be the most important factors impacting on human health and ecological security (Chen et al., 2015; Niu et al., 2014; Cai et al., 2008). According to the Ministry of Environmental Protection of China (CMEP), 16.1% of soil in China exceeds the environmental quality standard set by the CMEP: approximately 26 million ha of agricultural soil were contaminated. Contamination by trace elements accounts for the majority (82.4%) of the soils classified as contaminated, with organic contaminants accounting for the rest (CMEP, 2014). Thus, a comprehensive study of the distribution and associated human health risks from these pollutants in soil is urgently required for regional soil environment management and pollution control.

Over the past few decades, various soil survey programs have been carried out in China to meet increasing demands from land-use management departments, environmental regulatory agencies, and the public health sector (Liu and Diamond, 2005; M. Li et al., 2014; Z.Y. Li et al., 2014; Teng et al., 2014). Releasing information from these surveys will help to raise public awareness of soil contamination and facilitate future research into pollution control (Y.L. Liu et al., 2013, X.M. Liu et al., 2013). In this study, the current soil environmental status of Jiangxi Province, based on national soil quality and pollution survey data, was used as a regional example. The target pollutants in this study were 12 trace elements (As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Se, V, and Zn), benzene hexachlorides (BHCs), dichlorodiphenyltrichloroethanes (DDTs), phthalic acid esters (PAE), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and petroleum hydrocarbons (PHCs). The levels and distribution of these pollutants are

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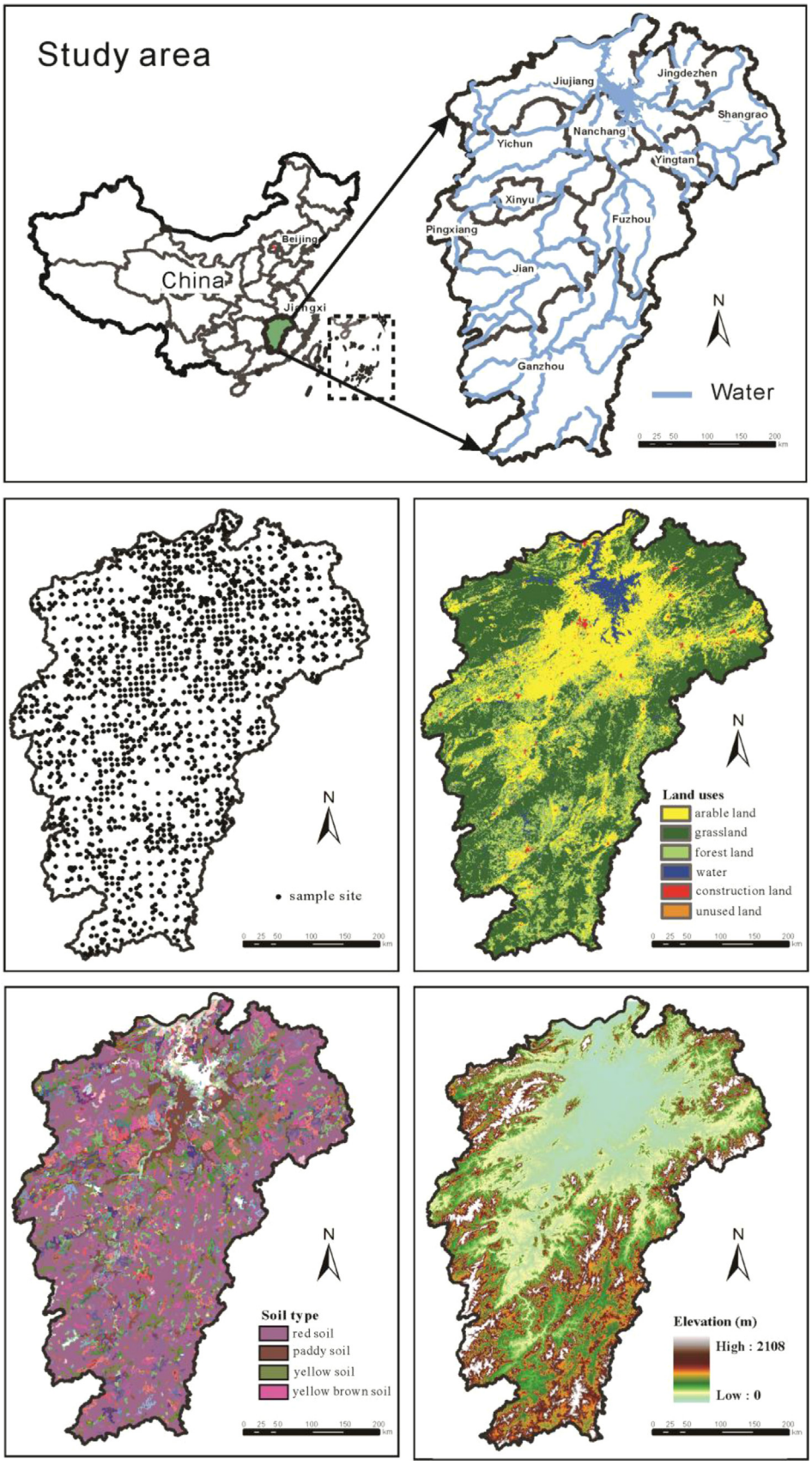

Fig. 1. Overview of the study area and location of sampling site.