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"Watch your step": dangers of soil contamination*

"De olho no que pisa": os perigos da contaminação do solo

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It is indisputable that, considering the amount of water on our planet, this could be called Planet Water. However, we cannot close our eyes to the nearly 30% of the earth's surface that gives its name to the planet, which is home to the more than 7.5 billion human beings and an important portion of our biodiversity. It is on our ground, on our soil, that our buildings, highways, railways are built; it is in our planet that most of the food is cultivated or created for our consumption; and where we spend most of our lives.

The soil compartments depend on different processes that can reduce its quality, such as erosion, desertification, flooding, presence of pathogens and parasites and contamination by chemical substances. All these processes seem to have a close connection with anthropogenic activities; but, on the other hand, they are also able to affect the quality of life of the human beings in a negative way. The chemical contamination of the soil stands out among these processes, not because it is the most aggressive or the one that causes the greatest damage to the soil, but because it is the quietest and invisible one. Certainly, a mother would prevent her child from playing in the sand in order not to catch germs, parasites, bacteria, chigoe fleas; never to avoid lead poisoning, selenosis or intoxication by any other chemical element, which may be present in high concentrations in the soil.

Although soil is the source and/or deposit of many chemical contaminants, the number of studies investigating the degree of soil contamination and its ecological effects and in human health, this contamination is still much lower than pollution of the aquatic environment, for example. Anyone can come to the same conclusion by searching for some database of scientific articles using the indexing terms corresponding to this subject.

From the point of view of the legal protection of environmental compartments and based on the resolutions of the National Environment Council (CONAMA), although Resolution No. 420/2009[1] on the protection of soil and groundwater quality, is more recent than Resolution No. 003/1990[2], which provides on air quality (it is necessary to update this last Resolution), it has some feasibility problems. Perhaps the main one is to establish quality reference values (VRQs) by the state environmental agencies and the Federal District.

In CONAMA Resolution No. 420/2009[1] suggests what kind of soils will follow the guidelines for the management of contaminated areas, its suggestion occurs through the categorization of soils in different soil quality classes, based on the concentration of chemical substances, establishing four classes in increasing order of contamination: Class 1, Class 2, Class 3 and Class 4. This framework is based on guiding values: VRQs; prevention (PV); and research (VI). VI is the concentration of a particular substance in the soil which, at high levels, presents potential risks to human health. VP is the limit value of a specific substance, so that it is able to sustain its main functions and has been established based on phytotoxicity analysis and ecological risk assessment. VRQ is the concentration of a specific substance that defines the natural quality of the soil. The first two values were determined in that Resolution; but the VRQs would be established by the competent state and environmental agencies of Federal District within a four-year term after that Resolution was published; a new deadline was subsequently set, December 2014. Until 2016, of all state and Federal District environmental agencies, only five had established their own VRQs[3]. Even for these States, the number of chemicals contemplated was reduced.

Legal sphere aside, it is important to mention other aspects about exposure to soils and their chemical contaminants, as well as their adverse effects on living organisms. The first relevant data to be mentioned, and that few people know, is that the United States Environmental Protection Agency estimates the rate of involuntary ingestion of soil (soil + dust) in the order

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of: 100 mg/day, for children from 0 to 6 months of age; 200 mg/day for children from 6 months to 12 years of age; and 100 mg/day for individuals from 12 years of age[4]. In a quick account, considering a life expectancy of approximately 80 years, we calculate that each human being involuntarily eats almost 3.5 kg of soil during his lifetime. This means that, hypothetically, a person who spends his whole life in a soil with a concentration of 300 mg/kg of lead (permitted by CONAMA Resolution for residential soils) involuntarily ingests, just by living and breathing in that environment, more than 1 g of lead throughout life. Does it sound irrelevant? This is equivalent, on average, to 34.3 μg/day of lead. Here it is important to mention that the Food and Drug Administration, the U.S. food safety control agency, sets the maximum level of lead exposure caused by food at 6 μg/day[5].

In 2014, we published a study that related soil intake from areas impacted by coal activities with the mutagenic risk obtained through the established by Ames test[6]. The amount of soil required to double the rate of spontaneous mutation and the time required for this rate to be reached was calculated (using the value of 200 mg/day of involuntary intake of soil in children). The results revealed that exposure to soils, for a period between 0.6–3 days, was already sufficient to double the rate of spontaneous mutation, since these rates were obtained with values ranging between 129.3 and 600 mg of soil. Among the soil collection areas of this study, there were public parks, which warns us about the mutagenic risk to children may be exposed, by the simple and innocent fact of playing in a park or in a place near their home.

Another study investigated the impacts of exposure to soils in public squares contaminated by mercury. During 120 days, Wistar rats were exposed to soil leaching and, after this period, hematological, physiological and mainly behavioral alterations were observed. After this chronic exposure, some rats began to lose mobility of the posterior trunk, compromising their locomotion. Obviously, this result cannot be overtaking to a scenario of human exposure to these soils, but it is warning to the danger of chronic exposure to urban soils contaminated by mercury[7].

A number of other experimental studies have revealed adverse effects resulting from exposure to contaminated urban soils, causing genetic damage[8], physiological[9] and reproductive problems[10]. As mentioned earlier, we must be careful in going beyond these scenarios, but such studies reveal the dangers of exposure to soil contaminated by chemical substances and to be more careful where we step on.

Our close relationship with the soil highlights the need to be careful with this environmental compartment, and the studies alert us to the progressive decrease in soil quality and the potential invisible risks to which we are vulnerable to. The environmental agencies need to ensure compliance with the legal duties of polluters and improve, day by day, the mechanisms we have for the maintenance of environmental quality. The society also needs to be aware about it, because "what is pollutant is invisible to the eye".

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