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Soil and Human Health

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Introduction

Soil can have both a positive and negative impact on human health. Healthy soils provide the necessary nutrients and clean water to plants in order to produce nutritious food. Human beings are increasingly aware of the influence of their diet on their general health.Soils are important for human health in a number of ways. Approximately 78% of the average per capita calorie consumption worldwide comes from crops grown directly in the soil, and another nearly 20% comes from terrestrial food sources that rely indirectly on the soil. Soils are also a major source of nutrients, and they act as natural filters to remove contaminants from water. However, soils may contain heavy metals, chemicals, or pathogens that have the potential to negatively impact human health. This article will summarize some of the more important and direct relationships between soils and human health.

Quality Food Production and Food Security

Soils play a major role in quality food production and security. production of sufficient amounts of food, adequate nutrient content in the food products, and the exclusion of potentially toxic compounds from the food products. Soils play a major role in all of these areas of quality food production and security.

Influence of Soils on Crop Yield and Food Security

Food security is achieved when all people have access to sufficient, safe, and nutritious food. Food security is central to humans and the ability to produce nutritious crops in sufficient amounts depends on soil properties and conditions. In particular, soils that have a well-developed structure, sufficient organic matter, and other physical and chemical properties conducive to promoting crop growth lead to strong yields and are thus important for food security. Soil degradation, which includes soil erosion and loss of soil structure and nutrient content, decreases crop production and threatens food security.

Soils that contain substances such as heavy metals, which may be toxic to humans, can pass those substances on to humans through crop uptake, leading to unsafe foods that compromise food security.

Human Nutrient Supply from Soils

11 elements constitute 99.9% of the atoms in the human body. These are typically divided into major and minor elements. The four major elements, H, O, C, and N, make up approximately 99% of the human body, and seven minor elements, Na, K, Ca, Mg, P, S, and Cl, make up another 0.9% of the body. Approximately 18 additional elements — called trace elements — are considered essential in small amounts to maintain human life. However, human health experts do not universally agree on the exact number and identity of these trace elements. Out of the approximately 29 elements considered essential for human life, 18 are either essential or beneficial to plants and are obtained from soil, and most of the other elements can be taken up from the soil by plants. The exceptions include H, O, and C, which plants obtain from air and water. Therefore, soils that provide a healthy, nutrient-rich growth medium for plants will result in plant tissues that contain most of the elements required for human life when the plants are consumed.

Negative Health Effects

Heavy Metals

Exposure to heavy metals through soil contact is a major human health concern. The heavy metals of greatest concern for human health include: As, Pb, Cd, Cr, Cu, Hg, Ni, and Zn. Heavy metals enter soils naturally through the weathering of rocks, but they have also been introduced into soils through human activity. Heavy metals are the by-products of mining ores, and they are present in mine spoils and in the immediate surroundings of metal processing plants. Heavy metals are released into soils from landfills that contain industrial and household wastes and from sewage sludge that comes from wastewater treatment plants. E-wastes, or wastes associated with electronic appliances, are an increasing source of Pb, Sb, Hg, Cd, and Ni in the soil. Urban soils are particularly susceptible to significant accumulations of heavy metals from automobile exhaust, coal burning, erosion of metal structures, and refuse incineration. In agricultural use of fertilizers, manures, and pesticides has also contributed to the accumulation of heavy metals in soils. Arsenic has been used in pesticides, and the build-up of arsenic in orchard soils is problematic since it may persist for decades. heavy metals disrupt enzymatic activities commonly affecting the brain and kidneys.

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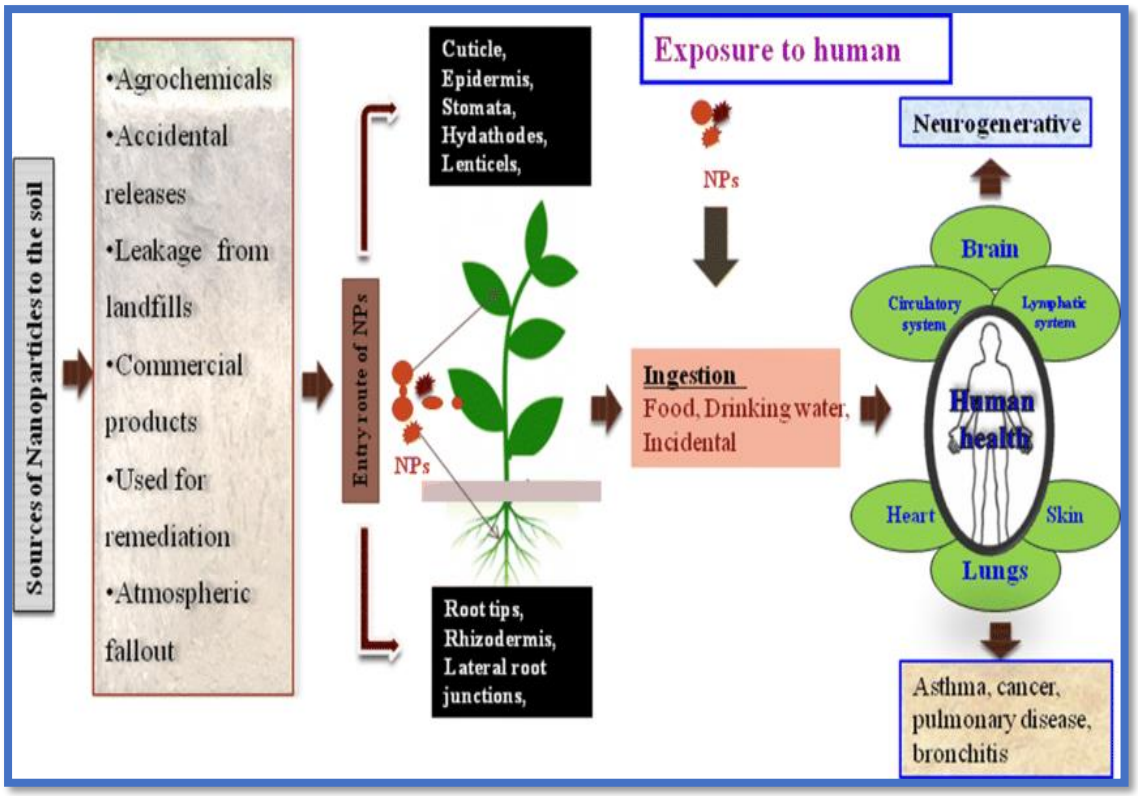

Organic Chemicals

Soil contamination with organic chemicals is a serious problem in all nations. A large amount of these organic chemicals come from the agricultural application of herbicides, insecticides, and nematicides. These organic chemicals are highly diluted in the upper layers of the soil, and they form chemical mixtures used in reactions involving microorganisms. We have very little toxicological information about the health effects of these chemical mixtures. Due to the very long half-lives of many organic chemicals, they are referred to as "persistent organic pollutants." These persistent organic pollutants are organic chemicals that resist decomposition in the environment and bioaccumulate as they move up the food chain. An example of this is 1,1,1-trichloro-2,2-bis(p-chlorophenyl) ethane (DDT), which was shown to disrupt the hormonal systems of raptors

Airborne Dust

Airborne dust can impact human health, especially when the particles are less than 10 microns in size. The main direct health effect of inhaled dust is irritation of the respiratory passages and diseases, such as lung cancer. Humans can breathe airborne dust containing toxicants into the lungs, where the toxicants may enter the bloodstream. Cultivation for agricultural production and deflation (wind

erosion) from the unpaved road and work sites and denuded fields can introduce dust into the atmosphere. Airborne dust from Africa is a significant health concern for North American soils. Clouds of dust from the Sahara and Sahel deserts follow the trade winds across the Atlantic Ocean, and African dust has been linked to elevated levels of Hg, Se, and Pb in North American soils. The number of asthma cases in the United States more than doubled between 1980 and 2000, and asthma rates have also increased in the Caribbean. Airborne dust from Africa has been tentatively linked to increased asthma in North America.

Soil Pathogens

Although most organisms found in soil are not harmful to humans, the soil does serve as a home for many pathogenic organisms. Bacteria are the most abundant type of organism in soil, and they are found in every soil on Earth. Most fungi are saprophytes that absorb nutrients by aiding in the decomposition of dead organisms, but approximately 300 soil fungi species out of the more than 100,000 total fungi species are known to cause disease in humans. For example, the soil fungus *Exserohilium rostratum* was responsible for the 2012 fungal meningitis outbreak in the United States. Most protozoa found in the soil feed on bacteria and algae, but some cause human parasitic diseases such as diarrhea and amoebic dysentery. Helminths are parasites that may inhabit the human intestines, lymph system, or other tissues. Diseases caused by helminths require a non-animal development site or reservoir for transmission, and the soil is a common development site. The soil is not a natural reservoir for viruses, but viruses are known to survive in soil. Pathogenic viruses are usually introduced into the soil through human septic or sewage waste. Viruses that cause conjunctivitis, gastroenteritis, hepatitis, polio, aseptic meningitis, or smallpox have all been found in soil.

Water Quality and Soil

Improper sewage sanitation is a problem for approximately 40% of the world's population, and millions of people die each year from water-borne diseases. Humans can take advantage of the purifying abilities of soil to address wastewater issues. Well-designed, properly maintained, and functioning on-site sewage treatment systems are highly effective at reducing the risk of water-borne diseases in areas with low population densities. Twenty-five percent of the households in the United States use on-site sewage disposal systems, such as septic systems, to deal with their wastewater.