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Comparative Study of Certain Metals Leading To Soil Erosion in Asian Countries

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Abstract:
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Soil is a natural resource on the earth that is always a challenge to the mankind for various reasons. in fact, it is a fragile product of thousands of years of formation. Topsoil, which lies closest to the surface of the land, contains essential nutrients for our crops and our wellbeing. this top layer of soil that is more often succumb to wind and water erosion. Ultimately Soil erosion decreases soil fertility, which can negatively affect crop yields. It also sends soil-laden water downstream, and creates heavy layers of sediment that prevent streams and rivers from flowing natural manner and can eventually lead to flooding and etc. .

One of the main reasons of soil erosion in recent times is the pollution of heavy metals in Soil. Although heavy metals are naturally present in the soil, geologic and anthropogenic/human activities increase the concentration of these elements to amounts that are harmful to both plants and animals. The present paper aims to analysis the cause and consequence of presence of heavy metals in soil. it also highlights the effect of Human activities and effect on Soil erosion in various countries of Asia . The Data is collated through websites and reliable reading materials like previous researches done in this field.

I. Introduction:

Heavy metals are elements that exhibit metallic properties such as ductility, malleability, conductivity, cation stability, and ligand specificity. They are characterized by relatively high density and high relative atomic weight with an atomic number greater than 20. Some heavy metals such as Co, Cu, Fe, Mn, Mo, Ni, V, and Zn are required in minute quantities by organisms also. However, excessive amounts of these elements can become harmful to organisms.

Heavy metals like **arsenic (As), cadmium (Cd), chromium (Cr), mercury (Hg), lead (Pb), copper (Cu), zinc (Zn), nickel (Ni)** are the ones polluting the soil across the Globe.

Generally, these metals exist either as single entities or in amalgamation with other soil components. These components may include exchangeable ions absorbed on the surfaces of inorganic solids, non exchangeable ions and insoluble inorganic metal compounds such as carbonates and phosphates, soluble metal compound or free metal ions in the soil solution, metal complex of organic materials, and metals attached to silicate minerals. Metals that exist as separate entities are harmful for the soil. This type of contamination is biologically toxic, widely distributed, and persists long-term in soil environment.

Heavy metal contamination of the environment is one of the main concerns because of their peculiar pollutant characteristics *(Wang and Qin, 2005).* They do not decay with time, unlike many organic and radionuclide contaminants. Although heavy metals can be necessary or beneficial to plants at certain low levels, they are also toxic when exceeding specific thresholds.

Due to human activities such as mining and smelting of metals, burning of fossil fuels over use of fertilizers and pesticides in agriculture, production of batteries and other metal products in industries, sewage sludge, and waste disposal in improper manner the presence of chemicals in Soil increases hence the acidity or alkalinity of soil gets imbalanced .which is root cause for **Soil erosion**.

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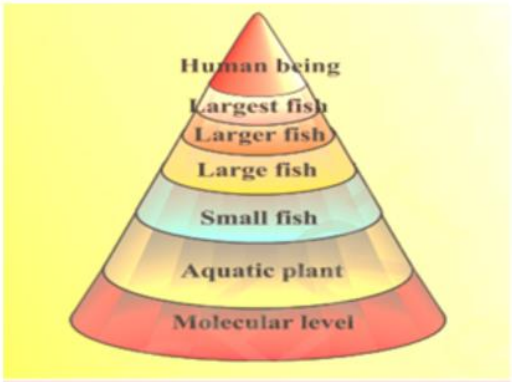

Trophic Level
Concentration of Pollutants Increases 10 Fold at Each Trophic Level

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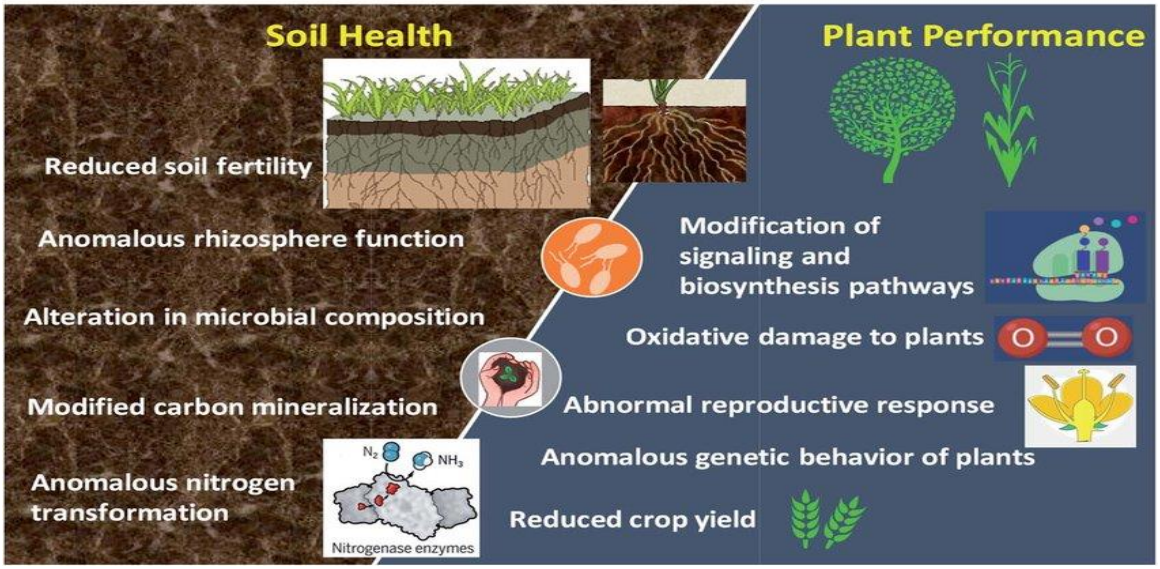
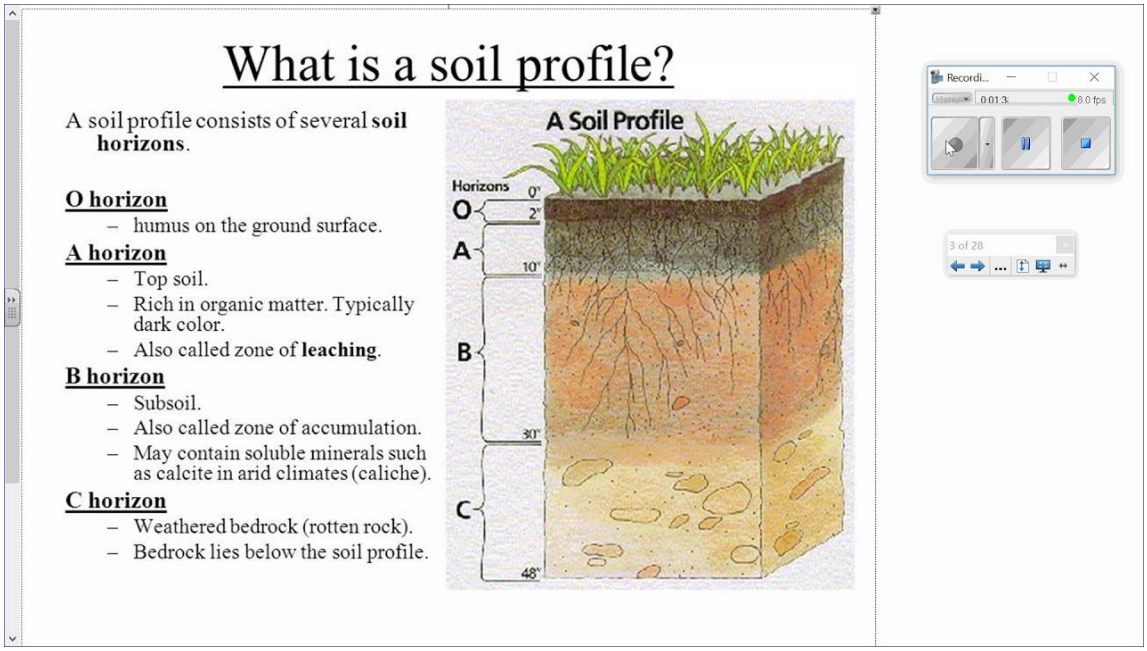
Agro-ecological consequences of heavy metal release





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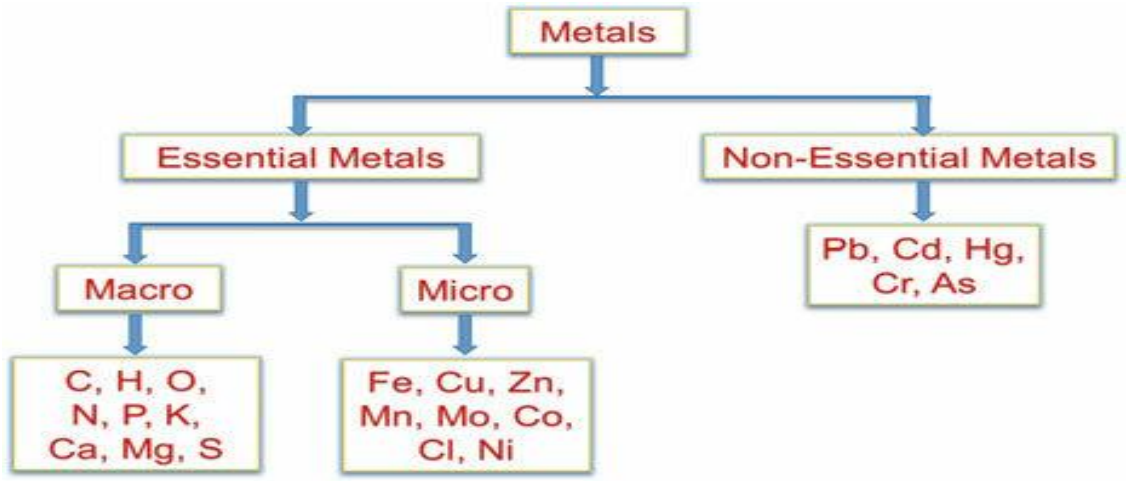

Types of Soil Pollutants

- Heavy metals (such as lead and mercury, at excessively high amounts) in the soil can make it very poisonous to humans.
- PAHs (polycyclic aromatic hydrocarbons) are a class of organic chemicals where only carbon and hydrogen atoms are present.
- Coke (coal) production, automobile emissions, cigarette smoke, and shale oil extraction are all sources of PAHs in the soil.
- Industrial Waste Soil contamination can come from the dumping of industrial waste into soils.
- Pesticides are chemicals (or chemical mixes) that are used to kill or prevent pests from reproducing.

Soil structure and composition

The composition, moisture, and compaction of soil are all major factors in determining the erosivity of rainfall (Rainfall erosivity is an index that describes the power of rainfall to cause soil erosion). Sediments containing more clay tend to be more resistant to erosion than those with sand or silt, because the clay helps bind soil particles together. Soil containing high levels of organic materials are often more resistant to erosion, because the organic materials coagulate soil colloids and create a stronger, more stable soil structure

Soil erosion secondary data collection and analysis:

Asia is the largest continent in this world. The total area of the Asia Region is about 44 million km2, accounting for 29.4% of the total land area in the world. Its population density is high – averaging 1.87 people per hectare – compared to the world average of 0.54 people per hectare.

Guided by the provisions of the UNCCD, The Asian Regional Thematic Programme Network on Desertification Monitoring and Assessment, abbreviated as TPN1, was launched in July 1999 in Beijing, China. The Asian region is working on six TPNs:

- TPN for desertification monitoring and assessment;
- agro-forestry and soil conservation;
- pasture management and sand dune fixation;
- Water resources management for agriculture in arid, semi-arid and dry sub-humid areas**;** etc

Based on the report by Oldeman (1991), the GLASOD project estimated that human-induced soil degradation in Asia region (including non-ASP west Asian countries) accounted for 31 percent of the inhabited land area, the highest share of any of the global regions.

Soils in Asia were found to have been degraded by several factors:

- water erosion (59 percent),
- wind erosion (30 percent),
- chemical degradation (10 percent)
- physical degradation (2 percent).

This so-called first generation of environmental problems is leading not only to negative nutrient balances but also to habitat destruction and loss of biodiversity (Oldeman , 2000)

The highest rate of erosion were recorded in Indian subcontinent (> 90 mil ha), Philippines (10 mil ha) and Indonesia (22.5 mil ha).

According to the data from UNEP in 1997, of the 1.96 billion ha of soil resources in the world that have been degraded, **Asia has the highest rate of approximately 38%**.
Sources of contamination of **cultivable** land in most Asian countries include

- Parent rock Material
- Mining
- Smelting,
- Agrochemicals
- Sewage Sludge Applications,
- Livestock Manure Uses

Soil Erosion Data studied from Asian Countries:

- Study indicates rise in concentrations of Cd, As, Pb, Cu and Zn, especially in paddy soil. In many regions of Southeast Asia (Bangladesh, India, China, Vietnam, Taiwan - Province of China, Thailand and Nepal), arsenic is naturally present in groundwater which contaminate soil when harvested in paddy fields (Smedley, 2003; Brammer and Ravenscroft, 2009).

- The agricultural rice soils of the Guandu Plain in Taiwan, Province of China are seriously contaminated with As and Pb (Zhuang et al., 2009; Chang et al., 1999, 2007). Cadmium pollution of paddy fields has been found downstream of a Zinc mineralized area in Thailand (Simmons et al., 2005)
- China contributes around 28 percent of global mercury (Hg) emissions, with India, Japan and the Korea Democratic Republic also among the ten countries that contribute the most to global Hg emissions (Li et al., 2009).

- With rapid industrialization, urbanization and intensive use of farmland, China is now facing serious soil pollution (Ministry of Environmental Protection, the People's Republic of China, 2014). About 19.4 percent of farmland has high levels of Cd, Ni and As pollution. (Wei and Chen, 2001).

- In 2006-2010, China's Ministry of Environmental Protection and Ministry of Land and Resources jointly launched a nationwide investigation of soil pollution status, covering an area of 6.3 million square kilometers.

- Trace elements are pollutants of major concern, especially in the southern area of China. Currently, the evaluation of soil pollution in China is primarily based on the Environmental Quality Standard for Soils which was promulgated and implemented in 1995. At present, China's Ministry of Agriculture is working on an Implementation Plan on Prevention and Control of Heavy Metal Pollution in Agricultural Product.

- Historic and current rates of intensive pesticide and fertilizer use in agricultural land and also industrial development have caused the accumulation of organic pollutants and heavy metals in soils of Indonesia. (Dibiyantoro, 1998).

- The tapioca industry in Java is now recognized as a contributor to cyanide levels which have risen above background levels in river water (Indrayatie et al., 2013).

- Mining plays an important role in the Indonesian economy but small- scale mining (ASGM), can have a major impact on the environment (Limbong et al., 2003; Prasetyo et al., 2010). During ASGM, Hg is used to recover Au from the ore during grinding. The process is inefficient and releases a significant amount of Hg to soil, water and the atmosphere (Limbong et al., 2003; Edinger et al., 2008). Tailings from Hg amalgamation are then leached with cyanide. Ultimately, the final waste, contaminated with metals and cyanide, is released into the environment (Veiga et al., 2009). Many ASGM operations also release As and Sb to the environment, although this depends on the composition of the host ore (Edinger et al., 2008). These operations are unlicensed and illegal. Indonesia has now signed the Minamata Convention on Hg and has decentralized control of ASGM operations to provincial governments
- There is large area of acid soils distributed across the tropical and subtropical regions of Asia, mainly in Southeast Asia, parts of East Asia and parts of South Asia. Acid sulphate soils are widely distributed in the coastal plains of Southeast Asia and southern China. The total area of acid sulphate soils in Southeast Asia is 7.5 million ha and there are about 112 thousand ha of these soils in China (Shamshuddin et al., 2014).
- In Vietnam, ferralitic, basaltic, and grey degraded soils, which cover about one third of the country, have strong potential for acidification and degradation because of their nature (NISF, 2012)
- Tea is cultivated extensively in subtropical regions of China, Japan, Southeast Asia and parts of South Asia. There is serious acidification of soils in tea gardens (Wang et al., 2010). Excess application of ammonium-based fertilizers and lack of leaching were responsible for acidification and salinization of soils

In some countries in Asia, removal of nutrients from the soil in crop harvest appears substantially to exceed inputs through natural replacement or fertilizer application. For example, negative soil nutrient balances have been reported for each of the 15 agro-climatic regions of India (Biswas and Tewatia, 1991; Tandon, 1992). Long-term experiments in India show depletion of soil P and K is higher for plots with N fertilizer, and depletion of K is higher still with N+P fertilizer (Tandon, 1992)

An increasing incidence of sulphur and zinc deficiency is occurring in the region. Sulphur deficiency has been reported for India, Pakistan and Sri Lanka, and zinc deficiency for India and Pakistan (FAO/RAPA, 1992).

Mechanization of cultivation and harvest in Asian countries has increased, resulting in soil erosion and soil compaction due to tractor loading (Zhang et al., 2006). Some studies of soils in rice/wheat cropping areas of India showed increases in compactness of subsurface soils as indicated by increased bulk density as high as 1.80 g cm-3. This was due to the use of heavy machinery in conjunction with puddling activities (Sidhu et al.,2014; Singh, Jalota and Sharma, 2009; Aggarwal et al., 1995; Kukal and Aggarwal, 2003).

II. Conclusion and suggestion

Contamination of soils by heavy metals is an important challenge facing many countries around the world,

Many studies have confirmed that the rates of soil contamination in many parts of Asia are above recommended standards.

Agricultural soil erosion accounting for huge depreciation in grain production, and is affected by heavy metals, mainly Cd, Hg, Cu, and Ni.

The major sources of heavy metal pollution in Asian countries are anthropogenic activities along with rapid urbanization and industrialization processes apart from natural and human factors.

Few more factors contributing are deforestation, the overuse of agricultural chemicals, Heavy metal sediments and mining activities.

The probable solutions to reduce the soil pollution and there by the erosion

- Use of correct farming techniques
- Recycling of Waste before disposal, Recycle and Reuse Products
- Use of organic fertilizers instead of chemical fertilizers
- Use of naturally available pesticides
- Involvement of Locals experts in the relevant fields.
- Community education and awareness by Soil Scientists
- Proper maintenance of sewage system, Proper disposal method of household and industrial waste
- Reforestation and Afforestation Should be Promoted
- Plantation of trees useful for preparation pesticides.

Finally, the Life on earth is a dependent species on the earth and its soil. Unless we adopt the synchronization with nature and its preservation in its innate form. the LIFE on the planet earth slowly perishes. All living things on the earth will also die. Thus, we all should take every possible step to retain, create, adopt, and implement all wholistic approaches to preserve the planet earth with utmost care.

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