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Impacts of Soil Pollution on Human Health and Ecosystem Sustainability

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ABSTRACT: Ecosystem Sustainability is a social goal for people to co-exist on Earth over a long time. Specific definitions of this term are disputed and have varied with literature, context, and time.[2][1] Experts often describe sustainability as having three dimensions (or pillars): environmental, economic, and social,[1] and many publications emphasize the environmental dimension.[3][4] In everyday use, sustainability often focuses on countering major environmental problems, including climate change, loss of biodiversity, loss of ecosystem services, land degradation, and air and water pollution. The idea of sustainability can guide decisions at the global, national, and individual levels (e.g. sustainable living).[5] A related concept is sustainable development, and the terms are often used to mean the same thing.[6] UNESCO distinguishes the two like this: "Sustainability is often thought of as a long-term goal (i.e. a more sustainable world), while sustainable development refers to the many processes and pathways to achieve it."[7]The economic dimension of sustainability is controversial.[1] Scholars have discussed this under the concept of "weak and strong sustainability"; for example, there will always be tension between the ideas of "welfare and prosperity for all" and environmental conservation,[8][1] so trade-offs are necessary. Approaches that decouple economic growth from environmental deterioration would be desirable. But they are difficult to carry out.[9][10]Measuring sustainability is difficult.[11] Indicators consider environmental, social and economic domains. The metrics are evolving. Currently, they include certification systems, types of corporate accounting, and types of index. Soil contamination, soil pollution, or land pollution as a part of land degradation is caused by the presence of xenobiotic (human-made) chemicals or other alteration in the natural soil environment. It is typically caused by industrial activity, agricultural chemicals or improper disposal of waste. The most common chemicals involved are petroleum hydrocarbons, polynuclear aromatic hydrocarbons (such as naphthalene and benzo(a)pyrene), solvents, pesticides, lead, and other heavy metals. Contamination is correlated with the degree of industrialization and intensity of chemical substance. The concern over soil contamination stems primarily from health risks, from direct contact with the contaminated soil, vapour from the contaminants, or from secondary contamination of water supplies within and underlying the soil.[1] Mapping of contaminated soil sites and the resulting cleanups are time-consuming and expensive tasks, and require expertise in geology, hydrology, chemistry, computer modeling, and GIS in Environmental Contamination, as well as an appreciation of the history of industrial chemistry.[2]

KEYWORDS: soil-pollution, ecosystem, sustainable,health,human,environment

I.INTRODUCTION

It is necessary to address many barriers to sustainability to make a sustainability ecosystem possible.[5]:34[12] Some barriers arise from nature and its complexity. Other barriers are extrinsic to the concept of sustainability. For example they can result from the dominant institutional frameworks in countries.

There are many approaches people can take to transition to environmental sustainability. These include maintaining ecosystem services, reducing food waste, and promoting dietary shifts towards plant-based foods. Another is reducing population growth by cutting fertility rates. Others are promoting new green technologies, and adopting renewable energy sources while phasing out subsidies to fossil fuels.[13] The United Nations agreed the Sustainable Development Goals (SDGs) in 2015.[14] These set a global agenda for sustainable development, with a deadline of 2030.

One option to overcome barriers to sustainable development is to decouple economic growth from environmental conservation.[9] This means using fewer resources per unit of output even while growing the economy.[15] This reduces the environmental impact of economic growth such as pollution. Doing this is difficult. Some experts say there is no evidence that it is happening at the required scale. Global issues are difficult to tackle as they need global solutions. Existing global organizations such as the UN and WTO are inefficient in enforcing current global regulations. One reason for this is the lack of suitable sanctioning mechanisms.[5]:135–145 Governments are not the only sources of action for sustainability. Business groups have tried to integrate ecological concerns with economic activity.[16][17] Religious leaders have stressed the need for caring for nature and environmental stability. Individuals can also live in a more sustainable way.[5]

The concept of sustainability has faced various criticisms. One is that the concept is vague and only a buzzword.[1] Another is that sustainability might be an impossible goal.[18] Some experts have pointed out that "no country is delivering what its citizens need without transgressing the biophysical planetary boundaries

Soil gets polluted by pesticides and herbicides. A pesticide is a substance used to kill a pest. A pesticide may be a chemical substance, biological agent (such as a virus or bacteria), antimicrobial, disinfectant or device used against any pest. Pests include insects, plant pathogens, weeds, mollusks, birds, mammals, fish, nematodes (roundworms) and microbes that compete with humans for food, destroy property, spread or are a vector for disease or cause a nuisance. Although there are benefits to the use of pesticides, there are also drawbacks, such as potential toxicity to humans and other organisms.[5][6]

Herbicides are used to kill weeds, especially on pavements and railways. They are similar to auxins and most are biodegradable by soil bacteria. However, one group derived from trinitrotoluene (2:4 D and 2:4:5 T) have the impurity dioxin, which is very toxic and causes fatality even in low concentrations. Another herbicide is Paraquat. It is highly toxic but it rapidly degrades in soil due to the action of bacteria and does not kill soil fauna.[7]

Insecticides are used to rid farms of pests which damage crops. The insects damage not only standing crops but also stored ones and in the tropics it is reckoned that one third of the total production is lost during food storage. As with fungicides, the first insecticides used in the nineteenth century were inorganic e.g. Paris Green and other compounds of arsenic. Nicotine has also been used since 1690.[8]

There are now two main groups of synthetic insecticides –

1. Organochlorines include DDT, Aldrin, Dieldrin and BHC. They are cheap to produce, potent and persistent. DDT was used on a massive scale from the 1930s, with a peak of 72,000 tonnes used 1970. Then usage fell as the harmful environmental effects were realized. It was found worldwide in fish and birds and was even discovered in the snow in the Antarctic. It is only slightly soluble in water but is very soluble in the bloodstream. It affects the nervous and endocrine systems and causes the eggshells of birds to lack calcium causing them to be easily breakable. It is thought to be responsible for the decline of the numbers of birds of prey like ospreys and peregrine falcons in the 1950s – they are now recovering.[9] As well as increased concentration via the food chain, it is known to enter via permeable membranes, so fish get it through their gills. As it has low water solubility, it tends to stay at the water surface, so organisms that live there are most affected. DDT found in fish that formed part of the human food chain caused concern, but the levels found in the liver, kidney and brain tissues was less than 1 ppm and in fat was 10 ppm, which was below the level likely to cause harm. However, DDT was banned in the UK and the United States to stop the further buildup of it in the food chain. U.S. manufacturers continued to sell DDT to developing countries, who could not afford the expensive replacement chemicals and who did not have such stringent regulations governing the use of pesticides.[10]

2. Organophosphates, e.g. parathion, methyl parathion and about 40 other insecticides are available nationally. Parathion is highly toxic, methyl-parathion is less so and Malathion is generally considered safe as it has low toxicity and is rapidly broken down in the mammalian liver. This group works by preventing normal nerve transmission as cholinesterase is prevented from breaking down the transmitter substance acetylcholine, resulting in uncontrolled muscle movements.[11]

The disposal of munitions, and a lack of care in manufacture of munitions caused by the urgency of production, can contaminate soil for extended periods. There is little published evidence on this type of contamination largely because of restrictions placed by governments of many countries on the publication of material related to war effort. However, mustard gas stored during World War II has contaminated some sites for up to 50 years[12] and the testing of Anthrax as a potential biological weapon contaminated the whole island of Gruinard.[13]

Contaminated or polluted soil directly affects human health through direct contact with soil or via inhalation of soil contaminants that have vaporized; potentially greater threats are posed by the infiltration of soil contamination into groundwater aquifers used for human consumption, sometimes in areas apparently far removed from any apparent source of above-ground contamination. Toxic metals can also make their way up the food chain through plants that reside in soils containing high concentrations of heavy metals.[14] This tends to result in the development of pollution-related diseases.

Most exposure is accidental, and exposure can happen through:[15]

- Ingesting dust or soil directly
- Ingesting food or vegetables grown in contaminated soil or with foods in contact with contaminants
- Skin contact with dust or soil

- Vapors from the soil
- Inhaling clouds of dust while working in soils or windy environments

However, some studies estimate that 90% of exposure is through eating contaminated food.[15]

Health consequences from exposure to soil contamination vary greatly depending on pollutant type, the pathway of attack, and the vulnerability of the exposed population. Researchers suggest that pesticides and heavy metals in soil may harm cardiovascular health, including inflammation and change in the body's internal clock.[16]

Chronic exposure to chromium, lead , and other metals, petroleum, solvents, and many pesticide and herbicide formulations can be carcinogenic, can cause congenital disorders, or can cause other chronic health conditions. Industrial or man-made concentrations of naturally occurring substances, such as nitrate and ammonia associated with livestock manure from agricultural operations, have also been identified as health hazards in soil and groundwater.[17]

Chronic exposure to benzene at sufficient concentrations is known to be associated with a higher incidence of leukemia. Mercury and cyclodienes are known to induce higher incidences of kidney damage and some irreversible diseases. PCBs and cyclodienes are linked to liver toxicity. Organophosphates and carbonates can cause a chain of responses leading to neuromuscular blockage. Many chlorinated solvents induce liver changes, kidney changes, and depression of the central nervous system. There is an entire spectrum of further health effects such as headache, nausea, fatigue, eye irritation and skin rash for the above cited and other chemicals. At sufficient dosages a large number of soil contaminants can cause death by exposure via direct contact, inhalation or ingestion of contaminants in groundwater contaminated through soil.[18]

The Scottish Government has commissioned the Institute of Occupational Medicine to undertake a review of methods to assess risk to human health from contaminated land. The overall aim of the project is to work up guidance that should be useful to Scottish Local Authorities in assessing whether sites represent a significant possibility of significant harm (SPOSH) to human health. It is envisaged that the output of the project will be a short document providing high level guidance on health risk assessment with reference to existing published guidance and methodologies that have been identified as being particularly relevant and helpful. The project will examine how policy guidelines have been developed for determining the acceptability of risks to human health and propose an approach for assessing what constitutes unacceptable risk in line with the criteria for SPOSH as defined in the legislation and the Scottish Statutory Guidance.

II.DISCUSSION

Sustainability is regarded as a "normative concept".[5][20][21][2] This means it is based on what people value or find desirable: "The quest for sustainability involves connecting what is known through scientific study to applications in pursuit of what people want for the future."[21]

The 1983 UN Commission on Environment and Development (Brundtland Commission) had a big influence on how we use the term sustainability today. The commission's 1987 Brundtland Report provided a definition of sustainable development. The report, Our Common Future, defines it as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs".[22][23] The report helped bring sustainability into the mainstream of policy discussions. It also popularized the concept of sustainable development.[1]

Some other key concepts to illustrate the meaning of sustainability include:[21]

- It may be a fuzzy concept but in a positive sense: the goals are more important than the approaches or means applied;
- It connects with other essential concepts such as resilience, adaptive capacity, and vulnerability.
- Choices matter: "it is not possible to sustain everything, everywhere, forever";
- Scale matters in both space and time, and place matters;
- Limits exist (see planetary boundaries).

In everyday usage, sustainability often focuses on the environmental dimension.

Scholars say that a single specific definition of sustainability may never be possible. But the concept is still useful.[2][21] There have been attempts to define it, for example:

- "Sustainability can be defined as the capacity to maintain or improve the state and availability of desirable materials or conditions over the long term."[21]

- "Environmental sustainability [is defined as] meeting the resource and services needs of current and future generations without compromising the health of the ecosystems that provide them."[24]
- "Sustainability [is] the long-term viability of a community, set of social institutions, or societal practice. In general, sustainability is understood as a form of intergenerational ethics in which the environmental and economic actions taken by present persons do not diminish the opportunities of future persons to enjoy similar levels of wealth, utility, or welfare."[6]
- "Sustainability means meeting our own needs without compromising the ability of future generations to meet their own needs. In addition to natural resources, we also need social and economic resources. Sustainability is not just environmentalism. Embedded in most definitions of sustainability we also find concerns for social equity and economic development."[25]

Some definitions focus on the environmental dimension. The Oxford Dictionary of English defines sustainability as: "the property of being environmentally sustainable; the degree to which a process or enterprise is able to be maintained or continued while avoiding the long-term depletion of natural resources".[26]

Not unexpectedly, soil contaminants can have significant deleterious consequences for ecosystems.[19] There are radical soil chemistry changes which can arise from the presence of many hazardous chemicals even at low concentration of the contaminant species. These changes can manifest in the alteration of metabolism of endemic microorganisms and arthropods resident in a given soil environment. The result can be virtual eradication of some of the primary food chain, which in turn could have major consequences for predator or consumer species. Even if the chemical effect on lower life forms is small, the lower pyramid levels of the food chain may ingest alien chemicals, which normally become more concentrated for each consuming rung of the food chain. Many of these effects are now well known, such as the concentration of persistent DDT materials for avian consumers, leading to weakening of egg shells, increased chick mortality and potential extinction of species.[20]

Effects occur to agricultural lands which have certain types of soil contamination. Contaminants typically alter plant metabolism, often causing a reduction in crop yields. This has a secondary effect upon soil conservation, since the languishing crops cannot shield the Earth's soil from erosion. Some of these chemical contaminants have long half-lives and in other cases derivative chemicals are formed from decay of primary soil contaminants.[21]

Heavy metals and other soil contaminants can adversely affect the activity, species composition and abundance of soil microorganisms, thereby threatening soil functions such as biochemical cycling of carbon and nitrogen.[22] However, soil contaminants can also become less bioavailable by time, and microorganisms and ecosystems can adapt to altered conditions. Soil properties such as pH, organic matter content and texture are very important and modify mobility, bioavailability and toxicity of pollutants in contaminated soils.[23] The same amount of contaminant can be toxic in one soil but totally harmless in another soil. This stresses the need for soil-specific risks assessment and measures.

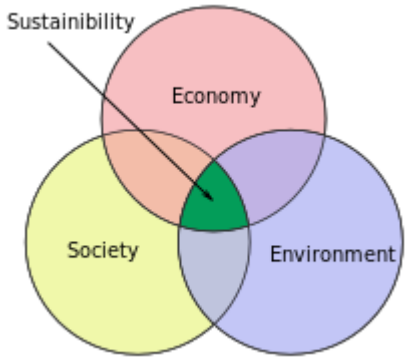
III.RESULTS

Cleanup or environmental remediation is analyzed by environmental scientists who utilize field measurement of soil chemicals and also apply computer models (GIS in Environmental Contamination) for analyzing transport[24] and fate of soil chemicals. Various technologies have been developed for remediation of oil-contaminated soil and sediments [25] There are several principal strategies for remediation:

- Excavate soil and take it to a disposal site away from ready pathways for human or sensitive ecosystem contact. This technique also applies to dredging of bay muds containing toxins.
- Aeration of soils at the contaminated site (with attendant risk of creating air pollution)
- Thermal remediation by introduction of heat to raise subsurface temperatures sufficiently high to volatilize chemical contaminants out of the soil for vapor extraction. Technologies include ISTD, electrical resistance heating (ERH), and ET-DSP.
- Bioremediation, involving microbial digestion of certain organic chemicals. Techniques used in bioremediation include landfarming, biostimulation and bioaugmentating soil biota with commercially available microflora.
- Extraction of groundwater or soil vapor with an active electromechanical system, with subsequent stripping of the contaminants from the extract.
- Containment of the soil contaminants (such as by capping or paving over in place).
- Phytoremediation, or using plants (such as willow) to extract heavy metals.
- Mycoremediation, or using fungus to metabolize contaminants and accumulate heavy metals.
- Remediation of oil contaminated sediments with self-collapsing air microbubbles.[26]
- Surfactant leaching

- Interfacial solar evaporation to extract heavy metal ions from moist soil[27]

In March 2009, the issue of uranium poisoning in Punjab attracted press coverage. It was alleged to be caused by fly ash ponds of thermal power stations, which reportedly lead to severe birth defects in children in the Faridkot and Bhatinda districts of Punjab. The news reports claimed the uranium levels were more than 60 times the maximum safe limit.[36][37] In 2012, the Government of India confirmed[38] that the ground water in Malwa belt of Punjab has uranium metal that is 50% above the trace limits set by the United Nations' World Health Organization (WHO). Scientific studies, based on over 1000 samples from various sampling points, could not trace the source to fly ash and any sources from thermal power plants or industry as originally alleged. The study also revealed that the uranium concentration in ground water of Malwa district is not 60 times the WHO limits, but only 50% above the WHO limit in 3 locations. This highest concentration found in samples was less than those found naturally in ground waters currently used for human purposes elsewhere, such as Finland.[39] Research is underway to identify natural or other sources for the uranium. Scholars usually distinguish three different areas of sustainability. These are the environmental, the social, and the economic. Several terms are in use for this concept. Authors may speak of three pillars, dimensions, components, aspects,[36] perspectives, factors, or goals. All mean the same thing in this context.[1] The three dimensions paradigm has few theoretical foundations. It emerged without a single point of origin.[1][37] Scholars rarely question the distinction itself. The idea of sustainability with three dimensions is a dominant interpretation in the literature.[1]



Sustainable ecosystem

IV.CONCLUSION

Scholars have criticized the concepts of sustainability and sustainable development from different angles. One was Dennis Meadows, one of the authors of the first report to the Club of Rome, called "The Limits to Growth". He argued many people deceive themselves by using the Brundtland definition of sustainability.[49] This is because the needs of the present generation are actually not met today. Instead, economic activities to meet present needs will shrink the options of future generations.[110][5]:27 Another criticism is that the paradigm of sustainability is no longer suitable as a guide for transformation. This is because our societies are "socially and ecologically self-destructive consumer societies".[111]

Some scholars have even proclaimed the end of the concept of sustainability. This is because humans now have a significant impact on Earth's climate system and ecosystems.[18] It might become impossible to pursue sustainability because of these complex, radical, and dynamic issues.[18] Others have called sustainability a utopian ideal: "We need to keep sustainability as an ideal; an ideal which we might never reach, which might be utopian, but still a necessary one.

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