

**A REVIEW :**

Soil as an infinitive source to meet the challenges of mankind

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SUMMARY : Soil is a dynamic natural body that is essential to life; Water movement, water quality, land use, and vegetation productivity all have relationships with soil. Soil as a living dynamic system has been compared to human beings which is the basis and the soul of infinite life. Everything begins in the soil and finally ends in it. Soil is a purifier and acts as a scavenger. The importance of soil conservation, the need to conserve and preserve with respect to the soil has been elaborated in this article in relation to human kind on the way to give emphasis to protect soil to create healthy soil for healthy life.

KEY WORDS :

Soil, Soul,
Perspectives,
Dynamic, Inert, Dirt,
Stimulus, System,
Brain, Imprint, Mother
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BACKGROUND AND OBJECTIVES

Soils have great meaning for human kind. Top six inches soils keep mankind away from starvation. From the dawn of agriculture, cultivators recognized good soils being attracted to the fertile soils of river valleys. Most great civilizations have depended on good soils. Continuous replenishment of fertility by natural flooding made possible the stable, organized communities and even cities, in contrast to the nomadic, shifting societies. Mismanagement of fertile soils is the only contributing factor for the down fall of the society. The careful preservation of the soil mantle can be the difference between a prosperous society and poverty. History provides lessons that modern nations have not always heeded.

“The soil locks within its embraces the

beginning of all life and receives at last their discarded forms. It will outlive all the works of man and transcend all human thoughts. It traces the progress of history and shelters its ignoble end it speaks eloquently and dumb. It is the imperishable store house of eternity”. Soil still holds good and will hold good for ever in the future. Soil plays a vital role in sustaining life on the planet. Nearly all of the food that humans consume, except for what is harvested from marine environments, is grown in the soils (Schoonover and Crim, 2015).

As civilization moves to the twenty first century and as World’s population continues to increase, the importance of a continuing increase in food production is obvious. India alone is contributing more than a Billion people. It means that our crop production must be at least doubled by the end of the century. There

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are two options open to us. One way is to increase the area under the plough and the other to increase production per unit area. The scope is limited for the first option. The greater attention will have to be paid to the increasing of the production per unit area, per unit time. The strategy is to maintain soil fertility and proper nutrient management without impairing soil quality. Healthy soil for healthy life is very important concept to protect the soil health by protecting the human health. Now a day's utmost care we are giving to protect human health. As like human health we are having great responsibility to take protection of soil health as well by involving all sectors of people belongs to the entire world.

What is soil? :

To the geologist it is a mute evidence of the past which unravel certain ancient activities. To the engineer it is the basis on which he can put up the vast the road or building. To the physicist, chemist and biologist it is a material with vast amount of unsolved problems involving the greatest skill to solve. But to the agricultural scientist and to the farmer it is the medium in which crops grow to provide food and cloth to the world. An engineer built the world as taking is a base, a doctor can cure the world by getting all most all the medicines from soil by way biological and chemical process. An agriculturist (farmer and agricultural scientist) can feed the world. Soil is the major factor that limits the type of vegetation and crops. Under similar climatic conditions, a loose and porous soil that retains little water will support sparse vegetation when compared to deep, fertile loam or clay. The crop could be grown which in turn sustain the human kind on this earth (Brady and Weil, 2007).

Perspectives of the soil :

Soil is defined as the mantle on earth ranging in thickness from a few inches to several feet in depth consisting of the solid, liquid and gaseous phases in varying proportions. It is a heterogeneous complex with superficial simplicity and deep sealed complexity posing serious challenges to unravel its mysterious nature. In general, forest ecosystems soils can determine species composition, timber productivity, and wildlife habitat, richness, and diversity. In cultivated fields, soil quality plays a significant role in crop productivity since soil nutrients and soil physical properties can directly impact on yields.

Soil is dynamic :

Normally it is considered that soil is static. But in reality soil is very dynamic, ever changing and evolving. It is the continued response of the soil to its environment that determines its state of productivity. Other obvious functions that soils provide humans include fibre for paper, clothing, fuel wood production, foundations for roads and buildings. Soils are performs five essential functions that soils serve as regulating water, sustaining plant and animal life, filtering potential pollutants, cycling nutrients and supporting structures.

Soil is variable and heterogeneous :

Soils are not homogenous. They are variable within themselves and from place to place. They are as variable and different and difficult to define as the people inhabiting the earth, just as the people in different parts of the country and different countries of the world differ in their cultural, social and economical traits and traditions, soils of the worlds also differ in their physical, chemical and biological characteristics and by varying there fertility and productivity.

The soil profile :

The vertical section of soil that shows the presence of distinct horizontal layers is known as the soil profile. The term horizon refers to the individual or distinct layers within the soil profile. Most soils are composed of several horizons. Typically, horizons of a soil profile will follow the topography of a landscape. Designation of horizon boundaries are also comes from measurements of soil color, texture, structure, consistence, root distribution, effervescence, rock fragments, and reactivity. The uppermost layer, the O horizon, consists primarily of organic material. The A horizon is a mineral horizon that is formed at or just below the soil surface. The B horizon, known as the "zone of accumulation", occurs below the O, A, and/or E horizons, if present. The C horizon is the soil layer that generally sees little influence from pedogenic weathering processes and is therefore comprised of partially weathered parent material. Under the C horizon comes the R horizon, or bedrock.

Soil is not inert :

Rocks crushed to the fineness of earth would not possess the intangible factor called life since soils inhibit millions and billions of micro-organisms and there species

of living beings like earth worms, which are inherent part of the soil and without which there is no soil. The soil serves not only as a medium for plant growth and for microbiological activity *per se* but also as a sink and recycling factory for numerous waste products which might otherwise accumulate to poison our environment.

Soil is not dirt :

Generally soil is considered as dirt. The correct meaning of dirt is matter out of place. If for that matter, we consider soil as matter out of place, well, everything in the world will become out of place including human beings. Hence soil is not dirt. “Without life, there is no soil and without soil, there is no life on the earth planet”. “Soil is the interface of the organic and inorganic chemistry of the terrestrial world, combining nitrogen and carbon from the atmosphere with the various elements of mineral lithosphere via the organisms anchored in the soil, intercepting energy of the sun and moisture from the hydrosphere and atmosphere.”

Soil responds to stimulus :

There most important difference between the living and the non living is the response to the stimulus by the living and non response to the stimulus by the non living. Soil actually responds to the stimulus. We speak of the response of soil to the nutrients applied to the soil. Soils which is cared for and managed well, responds well for good yield, where was a soil which is not cared for and not managed well does not respond well and yields poorly. Moreover, the soil supports our buildings and provides material for the construction of earthen structures such as dams and road beds.

Soil is a living dynamic system :

The study of the plant as a living system is known as botany. The study of animals and birds as living systems are known as zoology and ornithology. Similarly, the study of soil as a living system is known edaphology or soil science. It is a universally known truism that micro-organisms, plants, and many higher animals affect and influence the properties of soil.

Any living systems such as plants, animals or human beings have certain attributes and characteristics like color, structure and the various metabolic systems. Soil features related to biotic (plant and animal) activity such as burrows, mounds, root channels, and worm castings

contribute to soil profile development because each of these processes change the porosity of the soil. The burrowing of animals, much like old root channels, creates large pores for rapid movement of water, gases, and solutes through the soil. The structure of some surface horizons is formed entirely by animal activity (earthworms, ants, termites, and other organisms). Earthworms are capable of consuming their own body weight in food daily (Minnich, 1977). They are also responsible for the ‘sinking’ of objects through the soil profile over time (Darwin, 1897). Charles Darwin devoted his last book, “The Formation of Vegetable Mould Through the Action of Worms” to the process of bioturbation, the process in which plants and animals facilitate the mixing, or rearrangement, of the soil profile. Much like animals, plants can have a strong influence on soil properties.

Colour :

Color shows the adaptability of the animal or human being to a particular climatic condition. In temperate regions people are lighter in color complexion which helps in withstanding coldness. In tropical regions, the color complexity of the human being is darker; because only that can withstand and protects form the heat. Soil color varies with topography, climatic factors and soil depth etc. Drainage characteristics of a soil can have a large impact on soil colour. The soil color can reveal insights into the local hydrologic regime. Soils that are well-drained tend to be brighter than poorly-drained soils. Poorly-drained soils create anaerobic conditions in which the Fe in the soil is reduced, resulting in very dull colors. Soils with extremely reduced conditions and a chroma <2 are referred to as “gleyed” soils. In semitropical regions, the yellowish brown or yellowish red adapt to this kind of climate. Likewise, soils have different colors such as black, red, yellow etc., which indicate the adaptability of the soil to support the particular crop and certain properties and specific characteristics. For example, black soil is said to plough itself and is highly suitable for the cultivation of cotton. The acidic, lateritic and hill soils are suitable for the cultivation of plantation of such as tea, coffee, cardamom rubber and cole vegetables.

Structure :

Structure is possessed by animal or human and is

constituted by the skeletal system enclosed by flesh and skin. Soils also possess different structures called platy, columnar etc., and this is constituted by the various soil particles (sand, silt, and clay) are arranged into soil aggregates (also called peds) and reflects both physical and chemical weathering. The mucous colloidal membrane spread throughout the body in the human or animal system helps in the absorption and assimilation of food. Similarly, the clay colloid present throughout the soil helps in the absorption of nutrients to the plants and acts similarly as the mucous membrane. Several factors influence soil structure, including soil texture, soil moisture, organic matter content, compaction, the activity of soil organisms, and management practices. Aggregate size is typically described as very fine, fine, medium, coarse, or very coarse and the size limits of these classes depend on the aggregate shape. Grade describes the distinctness of the peds and is classified as weak, moderate, or strong. More information on size and grade can be found in the Soil Survey Manual (Soil Survey Division Staff, 1993). A soil structure description is written as “grade, size, shape”, such as “moderate medium subangular blocky structure.”

Organic matter :

It is the heart of soil. It comprises an accumulation of partially or completely decomposed plant, animal residues and other organic compounds synthesized by soil microbes as the decay occurs. Organic matter content has a profound influence on both soil processes and soil quality. In the field, high organic content may be recognized by a dark soil color in the surface horizons. Organic matter in soils promotes biotic growth since it serves as a food source for earthworms and other organisms. Organic matter has a high water infiltration capacity and contains many plant essential nutrients. The increased water holding capacity aiding in the retention of soil moisture, organic matter protects the soil against the kinetic energy of raindrops and also acts as an insulation layer for the soil surface. Without organic matter, bare mineral soil is much more susceptible to accelerated erosion processes. Since billions of tons of soil in the world are displaced every year, it is important the soil organic matter should remain intact. Additionally, organic matter acts as a binding agent for nutrients. Depending on environmental conditions, organic matter can be stored in the soil for long periods of time. Warm,

humid conditions promote breakdown of organic matter by micro-organisms, whereas cooler, drier climates limit decomposition and soils act as a carbon reservoir.

Digestive system :

The human or other living beings are able to digest the food like the complex proteins, carbohydrates and fat and convert them by the digestive juices, enzymes etc., to simpler materials like ammonia, nitrate, glucose, carbon, hydrogen etc. In the same manner any material like compost, fertilizers and organics etc., added to the soil are digested and decomposed to the simpler units like nitrogen, phosphorus which are absorbed by the plant roots and innumerable number of organisms inhabiting the soil. Thus there exists a digestive system in the soil. It is a transitory soil constituent as it is continuously broken down by soil organisms and lasts from few hours to several hundred years. It requires maintenance by regular addition to the soil of plant and/or animal residues. Organic matter content varies from 1.0 to 6.0 % by weight in top soil and very less in sub soil. In respect of soil productivity organic matter plays an indispensable role.

Circulatory system :

Just a blood and lymph circulation constitute the circulatory system in the biological entities of human and animal, in the case of soil the circulatory system is constituted by the “soil solution” and “soil water” which is constantly moving throughout the soil particles. In the same way blood carries the nutrients and oxygen to various parts and cells of the human being, in the soil, the soil water carries the plant nutrients to the soil particles and to the roots of the plants. Soil water is held in soil pores with varying degrees of tenacity depending on the amount of water present and size of the pores. Soil water with its soluble constituents (nutrients) makes up soil solution, which is the critical medium for supplying nutrients to growing plants. Soil water plays significant role in controlling energy balance of the soil and regulates the gaseous exchange in the upper layer of the soil. The presence of water in different amounts in soil governs its thermal, mechanical, physical, chemical and biological properties.

Respiratory system :

Respiration in the case of human beings and

organisms constitutes the exchange of gases, *i.e.*, oxygen is taken in and carbon-dioxide is given out. Similarly in the soil also continuous gas exchange takes place which is comparable to the respiratory system. The innumerable roots and soil organisms which inhabit the soil do respire which constitutes the respiratory system in the soil. The content and composition of soil air are determined largely by the water content of the soil, since the air occupies those soil pores not filled with water. Soil air always differs from atmosphere air in composition because of moisture content, root and microbial activities. Relative humidity may approach 100% at optimum soil moisture, CO₂ content is often several hundred times higher than 0.033% and oxygen content usually <20%, in extreme cases only 5-10%. In cases of low soil air, the diffusion rate of air in to and out of the soil would be slow and this leads to unsatisfactory conditions for optimum plant growth.

Excretory system :

Just as the undigested food and unwanted materials are sent out by the human beings or animals, the excretory system of the soil excretes the excessively present and unwanted materials such as salts which are manifested as white or black encrustations on the surface of the soil. In many regions, we find once-thriving agricultural fields reduced to desolation by man-induced erosion or salinization resulting from injudicious management of the soil-water system. Add to that, the shortsighted depletion of non-replenished water resources as well as the dumping of poisonous wastes is indeed a consistent pattern of mismanagement. Despite the known degradation of resource, we still continue squandering and abusing such precious resource, for the sake of population-environment-food crisis being faced by the world.

Clay and brain :

Clay and brain usually when one scolds the other person, the question being asked is “is there clay inside your head?”. As a soil scientist this stuck me very much and I wanted to know why of all the other things clay is chosen. After thorough analysis and research I found the answer. It is astonishing to know that the clay in the soil and the brain in the human head are very similar in the structure and functioning. Brain does the function of the reception, retention and recompilation (remembering)

or retrieval. In the same way clay also receives the nutrients, retains them and releases (exchange) them exactly like the brain. A man without brain is infertile and useless. So also, a soil without clay is infertile and useless. Hence, if one says that there is clay in your head, we should not get hurt, but only feel proud that we have good brain. The most important part of the soil with respect to plant nutrition like human left side and right side brain is the colloidal fraction which consists of inorganic colloids (clay) and organic colloids (humic substances). Most of soil colloids possess electronegative adsorption sites available for attracting cations including calcium, magnesium, potassium, ammonium etc. as well as H⁺ arising from the biological activity. Organic matter on decomposition releases nutrients. The cations adsorbed on the surface of the colloids are capable of exchanging rapidly and reversibly with those in soil solution. The principal immediate source of mineral nutrients to plant roots is ions in the soil solution. This nutrient supply is gradually depleted by absorption of nutrient ions by plant roots and continuously replenished by desorption of exchangeable ions on the clay-humus complex and break down of readily decomposable organic debris.

Individuality and imprint :

Though we are human beings, yet one does not resemble the other. For example, taking the face, though each of us have different characters like hair, ears, forehead, eyes, nose, lips, mouth etc., yet one does not have the similar face as the other and it is really wonderful to know how the people differ from each other. Even in the case of identical twins, the idiosyncrasies' would vary. Besides this, each one has a unique and distinct type of fingerprint, characteristic of only that particular individual which does not match with anybody else. Similarly the voice of individual is characteristic to the particular individual though one can artificially mimicry as the other. In the same manner each soil has its own individuality and imprint just as human beings.

Soil is the symbol of mother earth and good lady:

In all our ancient literature like Vedas, Puranas, Ethikasa, Upanishads, Religious and Scriptural treatises mother and earth are considered as one of the earth and soil is called “Mother Earth” or “Bhooma Devi”. Saint Thiruvallular, even thousand years ago has written in two

couplets comparing soil or land to a good lady. The couplets are: 1. "If the land owner doesn't visit the land and doesn't care for her, she would defect as that of wife is not cared and nurtured by her husband". 2. "If a person(land owner) is lazy sitting idle without doing any work in the soil/land the good land lady would yell and laugh at him". This amply personifies the soil/ land as the Mother and Good Lady.

Soil as a scavenger and purifier :

In the human life, utmost love and intense affection are showered between couples (husband and wife), parents and children and friends as long as they are alive. Once the life is out, the person is dead; nobody wants to have the "dead body" or "corpse". It becomes a horror and has to be disposed as immediately as possible. But the only one who receives even the corpse with open hand of welcome is the soil. Any dead organism even like a rat, left on the soil purifies and emanates bad smell. But once it finds a place inside the soil *i.e.*, buried even within a few inches down from the surface there is no foul smell or obnoxious odor.

Capacity of man and capacity of soil :

A man takes in the early night "elixir" (Amirtham) in a golden cup with platinum spoon. What happens to it after a few hours? In the morning he has already converted the elixir into the obnoxious smelling stool which he has to excrete. Once this excreta (fascies) is added to the soil, it is converted into "elixir" by the soil in the sense that the obnoxious and awful smelling material is degraded, decomposed and deodorized and split into simple components like the important plant nutrients as nitrogen, potassium, hormones, vitamins, enzymes etc. we are aware of the fact that many life saving drugs like antibiotics are isolated only from micro-organisms inhabiting the soil.

All life beings in the soil and ends in the soil :

Whatever so on the earth will perish. It is very interesting to know by analysis and backward integration that even the human being has the origin in the soil. One may say that life of man begins in the womb of the mother. It is partially true. If we think very deep, we realize that the origin of the child is foetus which is formed by the fusion of sperm from the man and egg from the women. The sperm and the egg were produced by the blood.

The blood is produced from the chime of the food consumed. The food comes from the various sources like cereals pulses fruits and vegetables which have their origin in the respective crops. The crops are grown in the soil; following is the sequence in the cycle: Soil-nutrients-crop-food-blood-sperm egg-foetus-child-man-soil.

Man is ultimately made of five elements (earth) soil, water, fire, air and space. On death, the body is decomposed and again spilt into the same five elements. Thus life begins in the soil and ends in the soil. Whether one is buried or burnt after death, ultimately the end place is the soil only.

Soil has the responsibility of anything and everything we think of :

All the industries have their origin in soil, since all the raw materials needed for the various industries emanate only from the soil. Right from the diamond, gold, copper, zinc, aluminium, lignite, coal-all are obtained from the soil. The raw material of the cotton fiord the textile industry, wood pulp for the rare and paper industries, sugar cane and beet for the sugar industry, calcium and rock for the cement industry et., have the origin of their raw materials from the soil only. The soil supports everything and soil supports all.

Tolerance and forbearance of the soil :

Even when we dig the soil, trample and do all kinds of possible abuses soil forbears and tolerates everything just as a mother is able to appreciate and enjoy the mischiefs of her child. We have to learn from the soil several lessons: the most important of which is that one should have patience and tolerance one should be productive and anything undesirable and not needy should be converted into desirable needy.

Good and bad karma in relation to soil :

It has been said in the Vedas that one earns is a bad karma if he bequeaths his land to his successors (heir) with less fertility level than how he got it from his predecessor. Whereas, if one is able to hand over the land or soil with added (enhanced) fertility he earns good karma. Hence it is imperative that we have to either maintain the fertility of the soil or to enhance it: we cannot afford to reduce it at any cost at anytime

Soil conservation and preservation :

It takes millions of years for the formation of an inch of soil on the earth's mantle. but it is easy to destroy it, degrade it and abuse it in no time. Soil erosion is a major concern around the globe. In order to properly prevent and manage erosion, it is important to understand erosion concepts. Soil erosion is both naturally-occurring (geologic erosion) and influenced by humans (accelerated erosion). Globally, around 15 % of total land area is eroded, of which over half is severely eroded (Blanco-Canqui and Lal, 2008). Soil erosion rates are greater than soil formation rates, posing a threat to sustainable agriculture (David, 2006). Productive land is < 11 % of earth's total land area (Eswaran *et al.*, 2001), yet it must supply food to the world's population (>7 billion people). David (2006) suggested that soil is being lost at a rate that is 10 to 40 times faster than soil formation and around 10 million ha of cropland is lost yearly to erosion. Agriculture accounts for nearly 75 % of soil erosion worldwide (David, 2006). Essentially, erosion occurs in a three-step process of detachment, transport, and deposition. The first step, detachment, is the removal of soil material from the soil mass by raindrops, running water, wind, or human/animal activities. The detached soil materials are then transported downhill by method of splashing, floating, dragging, or rolling. Sand particles are heavier than silt or clay, and therefore cannot be transported as far or at the same velocity.

Man as a soil-forming factor :

Man is considered as the sixth factor of soil formation (Dudal, 2004). Human interventions were either direct – through plowing, liming, manuring, fertilizing, Cultivating fields, removing hills, filling in low places, reducing /increasing fertility of soil, accelerating or reducing erosion and deposition through surface water manipulation; indirect through changing the natural soil forming factors; changing the vegetation by deforestation, relief by leveling and terracing, moisture regime through irrigation and drainage, parent material through transport, dumping or the exploitation of peat and rocks, through erosion and sedimentation. Even when populations were small these effects might cumulatively, through time, be considerable (Proudfoot, 1972). In his agricultural endeavors, he modifies effectively the soil-forming factors, notably the vegetational environment. By means of irrigation; he may change completely the climate of

the soil. Man also influences directly the properties of the soil; Cultivation and fertilization of soils and the removal of crops are widely practiced activities that stamp man as an outstanding biological soil-forming factor; Effect of Cropping on Soils; Today, crop yield and nitrogen are still declining, but at an exceedingly small rate; Increase in soil acidity; Loss in total Nitrogen; change in carbon-nitrogen ratio and removal of mineral constituents.

Conclusion :

Soil once lost is lost once and for all. While soil is eroded and taken away ultimately to the sea through the rivers and watercourses and wind, millions of tons of valuable plant nutrients are lost, worth several cores of rupees which are not recoverable. Therefore, it is the imperative, foremost and bounden duty of everyone of us to bestow our best respect and attention and care to conserve and preserve the valuable soul of life, the soil, lest we are committing a sin on this score.

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