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Soil and Water Quality for Healthy Crop: A Review

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ABSTRACT

It is expected that ninety- five present of our food is directly or indirectly made on our soil. Healthy soil is the base of the food system. Soil is the main basis for agriculture and consequently the medium during which nearly all food-producing plants grow. Healthy soils produce healthy crops that successively feed people and animals. Indeed, soil quality is directly connected to food quality and quantity. Soil is that the resource of essential nutrients, water, oxygen and root sustenance that our food-producing plants got to grow and embellishment. They also function a buffer to guard delicate plant roots against drastic fluctuations in temperature. Irrigation water quality may be a critical aspect of crop production. There are several factors that regulate water quality. Among the foremost important are alkalinity, pH and soluble salts. But there are several other factors to think about, like whether water salts like calcium and magnesium or heavy metals which will clog irrigation systems or individual toxic ions are present. so as to work out this, water must be tested at a laboratory that's equipped to check water for agricultural irrigation purposes

KEY WORDS: SOIL QUALITY, WATER QUALITY, RECLAMATION AND CROP PRODUCTION.

INTRODUCTION

Soil, water, air, and plants are vital natural resources that help to supply food and fiber for humans. They additionally maintain the ecosystems there on all life on Earth ultimately depend. Soil may be medium for plant growth; a sink for heat, water, and chemicals; a filter for water; and a biological medium for the breakdown of wastes. Soil interacts intimately with water, air, and plants and acts as a damper to variations inside atmosphere. Soil mediates several of the ecological processes those manage water and air quality that promote plant growth.

Poor quality water usually in change of slow growth, poor aesthetic quality of the crop and, in some cases, could result inside the gradual death of the plants. High soluble salts will directly injure roots, meddling with water and nutrient uptake. Salts will accumulate in plant leaf margins, initiating burning of the sides. Water with high pH will adversely have an impact on the hydrogen ion concentration of the growing medium, meddling with nutrient uptake and inflicting nutrient deficiencies that compromise plant health (Pal et al., 2019).

Reclaimed water, runoff water, or recycled water may need reconditioning before use for irrigation since infection organisms; soluble salts and traces of organic chemicals may even be present. Soil quality is best outlined in reference to the functions that soils perform in natural and agro ecosystems. The slandered of soil resources has traditionally been closely associated to soil productivity

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(Bennett and Chapline, 1928., and Lowdermilk, 1953., Hillel., 1991). Indeed, in several cases the terms soil quality and soil productivity nearly similar (Soil Science Society of America, 1984). Additional recently, however, there's growing recognition that the functions soils perform in natural and agro ecosystems go well on the far side promoting the development of plants. The need to broaden the conception of soil quality on the far side ancient considerations for soil productivity highlighted at a series of recent conferences and symposia.

1. Importance of soil quality: Soils have vital direct and indirect impacts on agricultural productivity, water quality, and global climate (Pal et al., 2020 & Pine et al., 2013). Soils make it potential for plants to grow by mediating the biological, chemical, and physical processes that fund plants with nutrients, water, and other different essentials. Microorganisms in soils convert nutrients into forms that may be utilized by growing plants. Soils are the stores for water and nutrients. Plants draw on these stores as grow roots, stems, leaves, and, eventually, food and fiber for human consumption (Adhikary et al., 2020). In Soils the biological, chemical, and physical processes they make possible an essential resource on that productivities of agricultural and natural ecosystems rely.

The soil interacts with landscape features and plant cover, is a key element in regulating and partitioning water flow through the environment (Jury et al., 1991). The biological, chemical, and physical processes that occur in soils buffer environmental changes in air quality, water quality, and global climate (Lal and Pierce., 1991). The soil matrix is that the major incubation chamber for the decomposition of organic wastes, as an example, pesticides, sewage, and solid wastes. Soil is the important sources which sink of greenhouse gases that contribute greenhouse effect in environment. Soils store, degrade, or immobilize nitrates, phosphorus, pesticides, and different substances that can become air or water pollutants.

Soil degradation through erosion, compaction, loss of biological activity, acidification, salinization, processes reduce soil fertility & quality. These processes decrease soil quality by changing the soil attributes, such as nutrient status, organic carbon content, texture, available water-holding capacity, structure, maximum rooting depth, and. Some changes in these soil attributes may be reversed by external inputs. Nutrient losses, as on example, may be replaced by adding fertilizers (Adhikary et al., 2020 & Adhikary et al., 2016).

1.1 Soil quality and agricultural productivity: Damage to agricultural productivity has traditionally been the key concern concerning soil degradation. Agricultural technology has, in some cases, improved the standard of soils. In different cases, improved technology has covered considerable of the yield loss that might be attributed to declining soil quality, except on those soils that are liable to quick and irreversible degradation. A healthy soil is a living, dynamic eco-system, swarming with microscopic and higher organisms that perform several important functions as well as transforming dead and decaying matter likewise as minerals to plant nutrients (nutrient cycling); monitoring plant disease, insect and weed pests; improving soil structure with positive effects for soil water and nutrient holding capacity, and ultimately improving crop production. A healthy soil also contributes to mitigating global climate change by maintaining or increasing its carbon content (Pal et al 2020 & Pal et al 2019).

1.2 Soil degradation on productivity: The result come from different experiment, yield losses resulting from soil erosion would be less than 10 percent over the next 100 years (Crosson and Stout., 1983; Hagen and Dyke., 1980; Pierce et al., 1984; Putnam et al., 1988). Such projections of low-yield losses, in addition to increasing concern over off-site water quality damages from agricultural production, have begun to shift the emphasis of federal policy to the off-site damages caused by erosion. More vital, estimates of productivity losses ensuring from erosion haven't accounted for damages caused by gully and ephemeral erosion, sedimentation (Pierce 1991), or reduced water accessibility attributable to belittled infiltration of precipitation. The cultivated land also being damaged by compaction, salinization, acidification. These damages will reduce yield losses resulting from erosion. Erosion accelerates the processes of compaction, salinization, and acidification. Yield losses are larger than those projected within the past if all degradation processes and their interactions are considered.

2. Improve Soil Quality: Given the multiple processes of soil degradation and therefore the probable underestimation of the full cost of erosion on the cost of production, it can be determined that soil degradation may have major effects on the ability of the India to bear a productive agricultural system. The costs of reversing multiple causes of soil degradation to keep up yields may be large sufficient to affect the costs of production, even if total yields are not affected. To date, enhancements in agricultural technologies kept the costs of return for losses in soil quality low enough or will increases the yields large enough to offset the price of soil degradation on most croplands.

2.1 Soil Management: Finally, though attention has clearly been targeted on soil degradation, soil management to enhance soil quality holds the promise of producing gains in productivity. Soil management to enhance soil quality is a chance to concurrently improve profit and environmental performance.

Soil quality change by the following steps: Identification of the soil attributes that can serve as indicators of change in soil quality, Standard field and laboratory methodologies that can be used to measure changes in indicators of soil quality, A coordinated monitoring program that can quantify changes in soil quality indicators, and A coordinated research program designed to support, test, and confirm models that can be used to predict the impact of management practices on soil quality.

2.2 Soil Nutrient Availability: Nutrient availability is an essential soil aspect for plant productivity and water quality and is expressively altered by soil management practices. Nutrient availableness is often calculated by extracting nutrients from the various components in the soil with chemicals and measurement of nutrient content within the extract. Nitrogen, phosphorus, and potassium are the major nutrients in the soil that are dignified by extraction.

2.3 Soil Organic Carbon: Soil organic carbon or soil organic matter is the most important indicator of soil quality and productivity. Depletion of soil organic carbon is followed by depletion of plant nutrients, deterioration of soil structure, diminished soil workability (Frye, 1987), and lower water-holding capacity of the soil. The availability of organic carbon in the soil affects soil permeability, water retention, and hydraulic conductivity, which all define the way rainfall is portioned and potential pollutants transported. It changes the efficacies and fates of applied pesticides

2.4 Soil Texture: The soil texture in the surface soil layer may be changed as a result of removal fine particles during the erosion, as a result of mixing subsoil into the surface layer during tillage and as a result of deposition of eroded sediments on the soil surface. Changing the surface soil texture can have important effects on crop productivity (Frye, 1987 and Lal, 1987), for example, by reducing the amount of nutrients or water holding capacity or by restricting the growth of plant roots. Texture also effects the segregating of rainfall in surface and the movement of water and potential pollutants through the soil.

2.5 Structure: The term soil structure, as broadly defined by Kay (1989), has three components. The first is structural form, which refers to the geometry of the soil pore space (porosity, pore size distribution, and pore continuity). The second is aggregate stability, which refers to the size distribution and resistance of aggregates to degradation. The third is structural resiliency, which refers to the ability of the soil structure to re-form once it has been degraded.

2.6 Acidity and Alkalinity: Soil pH is a measure from which many general interpretations about the chemical properties of a soil can be made. The acidity, neutrality, or alkalinity of a soil suggests the solubility of various compounds in the soil, the relative bonding of ions to exchange sites, and the activities of microorganisms (McLean, 1982 and Pal et al 2020). pH value is less than 4 indicates the presence of free acids in soil and from oxidation of sulphides; pH of less than 5.5 indicates that presence of exchangeable aluminium; and a pH from 7.8 to 8.2 indicates the presence of calcium carbonate (Thomas, 1967). Acidity and alkalinity in soil can be managed, by management of proper agricultural practices, fertilizer and lime applications.

2.7 Erosion: Soil erosion is a natural marvel that has happened since Earth was formed. Erosion by water and wind has helped shape the landscapes that people know today. Quantitative studies of the amount of erosion that occurred during periods of geologic and historic time show that the rate is highly variable in space and time. This variability can be caused by external factors, such as changes in climate and vegetation, or by internal factors that result in episodic erosion. The rates of erosion under current farming systems are much higher than before farming began and are greater than those in uncultivated areas.

2.8 Water-Holding Capacity: An important attribute of a soil is its ability to store and release available water to plants. The importance of water available to plants and its measurement were discussed by Ritchie (1981). Plant-available water is required to absorbed nutrients from soil of all crop simulation models. The plant-available water capacities should be determined to the depth of rooting, and temporal changes in plant-available water capacities those that are either natural or induced by management or erosion should be determined in the surface layers.

3. Irrigation Water: Irrigation water is used to grow fresh produce and sustain livestock. It is using of makes it possible to produce fruits and vegetables and raise livestock, which are consumed in everyday our diet. Agricultural water is used for irrigation, pesticide and fertilizer application, crop cooling etc. When irrigation water is used efficiently and manages properly, production and crop yield is affected. Reducing of water can cause reduce production and yield. Management practices is the main important way to improve the irrigation water use and maintain optimal production and yield.

3.1 Concerned about the agricultural water quality: Water quality can be pretentious by poor planning of industrial sites, animal farms, and barnyards and feedlots. Water source are continue indicative and potential risks of contamination due to improper management. Poor water quality will have an effect on the standard quality of food crops and cause to illness in people who consume them. Groundwater is one of the safest sources of water but depending on field location and field size, it may not be possible to use water from these sources for irrigation. Water quality should be tested to ensure it is acceptable for plant growth and to minimize the risk of discharging pollutants to surface or ground water.

3.1.1 Salinity Hazard: The most important water quality guideline on crop productivity is that the water salinity hazard as restrained by electrical conductivity (EC). The key effect of high EC water on crop productivity is that the inability of the plant to vie with ions within the soil solution for water (physiological drought). The greater the EC, the less water is accessible to plants, although though the soil might seem wet. As a result of plants will solely transpire “pure” water, usable plant water within the soil solution decreases dramatically as EC increases (Adhikary et al 2020). Actual yield reductions from irrigating with high EC water varies considerably. Factors influencing yield reductions embody soil type, drainage, salt type, irrigation system and management. On the far side effects on the immediate crop is that the long period impact of salt loading through the irrigation water.

3.1.2 Sodium Hazard: Water infiltrations will reduce when irrigation water contains high sodium as well as present of calcium and magnesium contents. It is called “sodicity,” results from excessive soil accumulation of sodium. Sodic water is not the similar as saline water. Sodicity reasons swelling and dispersion of soil clays, surface crusting and pore plugging. This degraded soil structure condition blocks infiltration and may rise runoff. Sodicity causes a decrease in the downward movement of water through the soil, and plants roots may not get adequate water, in spite of pooling of water on the soil surface after irrigation. The most common measure to measure sodicity in water and soil is called the Sodium Adsorption Ratio (SAR).

3.1.3 pH and Alkalinity: The acidity or alkalinity of irrigation water is expressed as pH. In normal range of pH in irrigation water is varies from 6.5 to 8.4. Abnormally low pH’s are not suitable, but may cause accelerated irrigation system corrosion where they occur. High pH’s above 8.5 are often caused by high bicarbonate and carbonate concentrations, known as alkalinity. Extreme bicarbonate concentrates can also be difficult for drip or micro-spray irrigation systems when calcite or scale formed, causes reduced flow rates through holes or emitters. In this stage to control the situations, injecting sulphuric or other acidic materials into the system is required.

3.1.4 Chloride: Chloride is a common in irrigation waters. It is essential to plants in very low quantities; because of it can cause toxicity to sensitive crops when it is high concentrations. Similarly sodium, with high chloride concentrations causes creates more problems, when applied through sprinkler irrigation. Leaf burn symptoms with sprinkler irrigation from presence of both sodium and chloride which reduced by night time irrigation or application on cool, cloudy days.

3.1.5 Boron: Boron is an element that is essential in low amounts, but toxic at higher concentrations. Toxicity may occur on sensitive crops at concentrations less than 1.0 ppm. Indian soils and irrigation waters contain enough boron that additional of boron fertilizer is not required in most of the situations. Boron toxicity can occur at low concentrations; in irrigation water examination is recommended for ground water before applying any additional boron to irrigated crops.

3.1.6 Sulphate: The sulphate ion is a major contributor to salinity in irrigation waters. As with boron, sulphate in irrigation water has fertility benefits, and irrigation water in India often has enough sulphate for maximum production for most crops. Exceptions are sandy fields with <1 percent organic matter and <10 ppm SO4-S in irrigation water.

3.1.7 Nitrogen: Nitrogen in irrigation water (N) is largely a fertility issue, and nitrate-nitrogen (NO3-N) can be a significant N source in different part of India. The nitrate ion often occurs at higher concentrations than ammonium in irrigation water (Pal et al 2020). Waters high in N can cause quality problems in crops such as barley and sugar beets and excessive vegetative growth in some vegetables. However, these problems can usually be overcome by good fertilizer and irrigation management. Regardless of the crop, nitrate should be credited toward the fertilizer rate especially when the concentration exceeds 10 ppm NO3-N (45 ppm NO_3^-).

CONCLUSION

The global population that can predicate to exceed 9 billion by 2050, compounded by the struggle for land and water resources and the effect of climate change continue coming to our current and future food security pivots the ability to increase the yields and food quality. Complete production management systems that encourage and improve agro-ecosystem health that is socially, ecologically, and economically sustainable are essential in order to protect our soils where preserving high production capacities. Farmers play an essential role in this aspect. Numerous and diverse farming methods encourage the sustainable management of soils with the goal of improving productivity, for example, agro ecology, conservation agriculture, organic farming, zero tillage farming, and agroforestry. A better understanding in between soil life and ecosystem function and the influence of human interferences will enable the reduction of negative influences and allow to capture the benefits of soil biological activity more effectively for a more sustainable.

REFERENCES

Adhikary R and Pal A (2020). Clay Pot Irrigation- A Review Study. Asian Plant Research Journal. 5(1): 37-42.

Adhikary R and Pal A (2019). Geotextile and its Importance in Agriculture: A Review Study. International Journal of Bioresource Science. 6(2): 61-63.

Adhikary R, Bera M, De SK and Pal A (2020). Pitcher irrigation in salinity management for production of brinjal crop in coastal soil of West Bengal, India. Ecology, Environment and Conservation. 26: 179-183.

Adhikary N, Disha A, Mahata AP, Pal A, Adhikary R, Sardar M, Saha A, Bauri SK, Tarafdar PK and De SK (2016). Efficient use of jute agro textiles as soil conditioner to increase chilli productivity on Inceptisol of West Bengal. Journal of Soil and Water Conservation. 15(3): 242-245.

Allmaras RR, Langdale GW, Unger PW, Dowdy RH, and VanDoren DM. (1991). Adoption of conservation tillage and associated planting systems. Pp. 53-84 in Soil Management for Sustainability, R. Lal and F. J. Pierce, eds. Ankeny, Iowa: Soil and Water Conservation Society.

Bennett HH, and Chapline WR. (1928). Soil Erosion a National Menace. U.S. Department of Agriculture, Circular No. 33. Washington, D.C.: U.S. Government Printing Office.

Crosson P R., and Stout AJ. (1983). Productivity Effects of Cropland Erosion in the United States. Washington, D.C.: Resources for the Future.

California Department of Water Resources. Agricultural Use Program: California's Irrigated Agriculture. Available at http://www.owue.water.ca.gov/agdev/ External

Environmental Protection Agency. Protecting Water Quality from Agricultural Runoff: Clean Water is Everybody's Business. Nonpoint Source Control Branch, 2005.

Frye WW. (1987). The effects of soil erosion on crop productivity. Pp. 151-172 in Agricultural Soil Loss: Processes, Policies, and Prospects, J. M. Harlin and G. M. Berardi, eds. Boulder, Colo.: Westview Press.

Hillel DJ. (1991). Out of the Earth: Civilization and the Life of the Soil. New York: The Free Press.

Hagen LJ, and Dyke PT. 1980. Merging data from disparate sources. Agricultural Economics Research. 32(4):45-49.

Jury W.A, Gardner WR, and. Gardner WH. (1991). Soil Physics, 5th Ed. New York: Wiley.

Kay BD. (1989). Rates of change of soil structure under different cropping systems. Advances in Soil Science 12: 1-52.

Lal R. (1987). Effects of soil erosion on crop production. CRC Critiques and Reviews in Plant Science 5:303-367.

Lowdermilk WC. (1953). Conquest of the Land Through 7,000 Years. Bulletin 99. Washington, D.C.: U.S. Department of Agriculture, Soil Conservation Service.

Lal R and Pierce FJ. (1991). The vanishing resource. Pp. 1-5 in Soil Management for Sustainability, R. Lal and F. J. Pierce, eds. Ankeny, Iowa: Soil and Water Conservation Society of America.

McLean EO. (1982). Soil pH and lime requirement. II. Methods of soil analysis. Agronomy 9:199-224.

Pine D, De SK, Tarafadar PK, Pal Arunabha, Mahata AP, Adhikary R and Bauri SK (2013). Efficient use of geotextiles as soil conditioner to increase potato productivity on inceptisol of West Bengal. Journal of Soil and Water Conservation. 12(2):104-107.

Pal Arunabha, Adhikary R, Bear M, De SK and Sardar M (2020). Application of Different Geotextile in Soil to Improve the Soil Health in Humid and Hot Sub Humid Region of West Bengal, India. International Journal of Current Microbiology and Applied Sciences. 9(6): 2812-2818.

Pal Arunabha, Adhikary R, De SK and Sardar M (2020). Effect of different geotextile treatments in soil to increase the yield and yield attribute of capsicum (Capsicum annuum). International Journal of Chemical Studies. 8(3): 2620-2622.

Pal Arunabha, Adhikary R, Barman S and Maitra S (2020). Nitrogen transformation and losses in soil: A costeffective review study for farmer. International Journal of Chemical Studies. 8(3): 2623-2626.

Pal Arunabha and Adhikary R, (2020). Improving of Phosphorus use Efficiency in Acid & Alkaline Soil: a Critical Review Study. Indian Journal of Natural Sciences. 10(59):18558-18562.

Pal Arunabha, Adhikary R, Bear M, and Garanayak R (2020). Pitcher irrigation: a water saving technique in arid region. International Journal of Engineering, Science and Mathematics. 9(2): 52-57.

Pal Arunabha, Adhikary R, Bear M, and Garanayak R (2019). To Study About Yield and Yield Attribute Parameter on Tube Rose by Application of Different Irrigation Treatments in West Bengal. International Journal of Bioresource Science. 6(2): 51-55.

Pal Arunabha, Adhikary R, Bera M, Garanayak R and Roy R (2019). Growing of tube rose with different irrigation treatment under alluvial soil of West Bengal. Journal of Pharmacognosy and Phytochemistry. 98(3): 4534-4538.

Pierce FJ, Dowdy RH, Larson WE and Graham WAP. (1984). Soil productivity in the cornbelt: An assessment of erosion's long-term effects. Journal of Soil and Water Conservation. 39:131-138.

Putnam J, Williams J, and Sawyer D. (1988). Using the erosion-productivity impact calculator (EPIC) model to estimate the impact of soil erosion for the 1985 RCA appraisal. Journal of Soil and Water Conservation. 43:321-326.

Ritchie JT. (1981). Soil water availability Plant and Soil 58:327-338.

Thomas GW. (1967). Problems encountered in soil testing methods. Pp. 37-54 in Soil Testing and Plant Analysis. Part I. Soil Science Society of America Special Publication No. 2. Madison, Wis.: Soil Science Society of America

U.S. Geological Survey. Estimated Use of Water in the US in 2000. Available at http://pubs.usgs.gov/circ/2004/circ1268/htdocs/text-ir.htmlExternal.