

Review Article

Contemporary Soil Health Perspectives

S. F. A. Zaidi^{1*}, Brajendra² and S. P. Giri¹

¹Department of Soil Science and Agril. Chemistry, N. D. University of Agriculture and Technology, Kumarganj Faizabad (U.P.), India

²ICAR-Indian Institute of Rice Research, Hyderabad, India

**Corresponding author*

ABSTRACT

Deterioration in soil health is very much concern for agriculture production system because unhealthy soil not only reduces the fertility and productivity of soil but it also results in poor quality of agricultural product which ultimately affecting the health of animal and human being. Unfortunately we are unable to achieve potential yield of rice and wheat even at over Station trails. The condition worsen at former field where a many arias formers achieve 71% less yield at their field as compared to potential yield that area as reveals with the following table

Keywords

Soil Health,
Perspectives,
Status

Introduction

The stagnation in crop productivity in the past few years has become a matter of concern and posing a serious threat to our National Food Security. Soil health decline has emerged as a major factor responsible for the stagnation in agricultural productivity in India. We all know that problems of land degradation, reduction in soil fertility and productivity are very complex, particularly in the resource hungry developing countries.

The importance of respecting the earth has been narrated in practically all the religious traditions and scriptures. In the Prithvi Sukta in Atharva Veda (1500 BC), the hymns in 63 stanzas are dedicated to Mother Earth. They describe the earth system with its complex inter-linkages between the

atmosphere, the hydrosphere, the biosphere and the ecosphere which provides us with water, land, biodiversity and all the energy resources. The importance of balance in nature is also written in Quran (Sura-Hijra-verses19) that states, “And the earth we have spread it out and made in it mountain standing firm and grown in it everything in balance amount”. But due to blind race of development we have misused the natural resources which disturbed the balance of nature and the result you all are observing in the form of abrupt changes in season in many parts of the world. The importance and duties of human towards maintaining healthy earth/soil is also emphasized in Prithvi Sukta as “Mata Bhumi putroham Prithiviyah” meaning “Earth is my mother, I am her son. Yet in another place in Prithvi

Sukta says ‘Ahambhuminadadamarayaya’, meaning “I have bestowed this earth upon humans with the agreement that they shall secure her against environment trespass and shall never let her subject to degradation”. Are we fulfilling the agreement obviously not.

Everything we get from their mother either from the mother which gave the birth or from the Mother earth i.e. soil but most of the people don't care their mother neither their own mother not Mother earth resulting a disturbed and unbalanced family relations and disturbed and unbalanced environment and ecological system.

The Bible cites that Jesus ordered his disciples, “Listen to soil if you have ears”. He also narrated that, “corn seed shown only in good soil produced hundred grains and seed in bad soil condition doesn't produce any corn”.

The sustainable soil management practices demand a match between land use and land attributes (FAO 1976).

Franklin D. Roosevelt (1937) wrote a letter to all state Governors on uniform policy and stated that “The nation that destroys its soil destroys itself.” Pagamber Mohd Sahib in his Hadees (590 AD) asked faithful to recycle stating that, “one third of what is taken out from soil must be returned to it”. This doctrine shows the importance and necessity of recycling crop residues in sustaining soil quality. These practices are very much being adopted by farmers of China.

They try to fulfill 2/3 of nutrient requirements of plants by recycling of organic wastes, crop residues and even night soil and only remaining 1/3 by chemical fertilizers.

The effort should be made to reduce this gap by improving soil fertility productivity and soil health. Soil health means “Soil fitness to support crop growth without becoming degraded or otherwise harassing the environment”

Soil health has multiple dimensions- chiefly

Physical
Chemical
Biological

Physical Degradation

Soil erosion, loss of soil structure
Pan formation
Compaction
Crust formation

Chemical Degradation

Nutrient depletion
Salinization/soil sodification / acidification
Chemical pollution

Biological Degradation

Loss of O.M
Impairment of nutrient recycle/
mineralization (loss of biotic condition)

Assessment and monitoring of soil health indicators

Physical indicators

Soil texture, depth, B.D., S.W.R.,
Infiltration, soil impedance

Chemical indicators

pH, CEC, Avail. N.P.K. and other essential elements.

Biological indicators

Soil O.M., Microbial biomass, C and N ratio

Potentially mineralized nitrogen

Soil respiration, Microbial biomass, Enzymatic activities of soil

Microbial diversity

Earthworm activity

Though there may be other factor responsible for reduction in soil fertility, productivity and soil health. Some main factor may be enumerated as under

Imbalanced use of chemical fertilizers.

Reduction in organic matter content of soil,

Indiscriminate and adulterated use of agro chemicals,

Consequences of climate change,

Poor orno recycling of organic residues and burning of crop residues,

Long-term rice-wheat cropping system particularly with zero tillage.

Faulty agronomical management practices

Faulty moisture management practices.

The problem of deficiency of essential nutrient increasing day by day because we are not adding nutrient in proportion to its removal by crop. So the gap between nutrient addition and their removed is increasing every year. The quantity and kind of nutrient removed by various crop differ from crop to crop and between variety to verity within the same crop. The avenge

removal of various nutrients by different crops are being given as fallows.

Reduction in organic matter content of soil

The stagnation in crops productivity and poor yield are largely due to serious soil quality decline which necessitates to maintain SOM for soil sustainability. The future sustainability of crop production will greatly depend upon improvement in soil resource base through its effective management.

Soil organic carbon is known to serve as soil conditioner, nutrient resource, substrate for microbial activity, preserver of environment and major determinant of sustaining agriculture productivity (Yadav and Kumar 2009). The percentage of OC of our soil reducing drastically. A survey study reveals that most of the soil samples were recorded low to very low OC percentage in all the three zones of Eastern Uttar Pradesh (Anand Sen & Zaidi, 2014). The reduction in OM content obviously reduced the soil fertility, productivity and deterioration.

Indiscriminate and adulterated use of agro chemicals

There are many reports that fictitious fertilizers and agrochemicals are being sold to the formers and because of this fictitious agrochemicals some times, scenes of whole crop failure encountered resulting in formers committee suicide. One of the recent example of adulterated agrochemicals published in Dainik Jagran on 20th January 2016 that Mr. Ajab Singh of Saharanpur purchased zinc sulphate for curing Khaira disease of paddy for his field. He applied ZnSO₄ twice but whole crop was destroyed by Khaira disease. He is informed the administration no action has been taken and

after much hue and cry the registration of shop keeper has been cancelled and the same person in this same shop is selling fictitious agrochemical with other registration name.

The agrochemical not only increasing cost of production but also pollutes our soil, ground water as well as produce. The polluted soil and water also harming the activities of soil microorganisms which play important role in availability of nutrient to the plant. The contamination of agrochemical in our produce largely affecting human and animals health causing many disease in human and animals. Many studies has shown that even mother milk has been contaminated by agrochemicals.

Consequences of climate change

There is ecological balance for every part of the world and any changes in climatic condition disturbs this balance and ultimately affecting every creature and natural entity of that environment. You all have seen heavy hail storms and creation of river in dispart of Saudi Arabia, heavy rain storms in America and other parts of world, low precipitation in Eastern Uttar Pradesh and high rain fall in dispart of Rajasthan, Tsunami and earth quake in many parts of the world. These all are harmful for every creature of area and obviously reduction in soil fertility, productivity and soil health.

Poor or no recycling of organic residues and burning of crop residues

Burning of rice straw, a common practice followed by the farmers in many states of the country for early clearance of land which result in enormous loss of plant nutrients and also is a source of pollution. The air pollution in Delhi people due to straw burning by farmers of NCR in recent season

have been observed and after that verdict to stop the burning of straw has been passed by Govt. There is a need to implement the resolution.

Long-term rice-wheat cropping system particularly with zero tillage

The decline in soil fertility and productivity of rice-wheat cropping system are being reported by most of the south Asian countries. After 23 year of experiment in Rice-wheat cropping system, it has been concluded that sole chemical fertilizer application treatment improved the yield upto 15 years of experimentation after that there was stagnation in yield and lasts even year showed decreasing trend in yield of Rice – Wheat cropping system. The addition of 5 t FYM ha⁻¹ with recommended dose recorded the highest yield and improvements in soil health in rice- wheat cropping system indicated the need of organic manure in spite of recommended dose of N.P.K and Zn. (Rao *et al.*, 2013).

Zero-Tillage technique is fruitful for the areas where water stagnates for a long period and time not spare for tillage operation. The Zero Tillage is harmful in Rice-Wheat cropping system because we destroyed the soil structure while puddling of field for paddy transplantation.

The pleaty structure of soil due to puddling restrict the water to go down and it stagnate for requirement of paddy crop but for the next crop:

It disturbs the air water ratio in the soil, reducing air circulation in lower soil horizon, thus reducing the activities of beneficial aerobic microorganisms of soil.

The nutrients from only upper horizon of soil could be utilized by crop.

Reduction in organic carbon and other nutrients of upper horizon of soil.

Increase in weed infestation.

Increase in plant disease and insect infestation.

It is good that farmers have been rejecting this technique but it has already harmed our agriculture production system. The weed, disease and insect infestation are affecting so high that no agriculture production could be achieved without application of Agrochemicals.

Faulty agronomical management practices

Another important reason for decreasing soil fertility, increase in cost of production and decrease in fertilizer use efficiency is faulty methods of agronomical practice are being used by most of the farmers. It is showing of seeds and fertilizers (NPK) by broadcasting on the tilled soil surface behind tractor. It resulted most of the seed destroyed being in very lower position and taken up by birds because of laying on surface of soil. This increase cost of seed applied. Similarly fertilizer (P&K) also fixed on upper soil surface and nitrogenous fertilizer destroyed by De-nitrification, evaporation and leaching. Thus very less amount spare for proper root zone which plant may utilize. This also resulted in decrease of fertilizer use efficiency and thus increases in cost of production unnecessarily.

Faulty moisture management practices

Most of the canal irrigated area are being affected by salinization because high water table salts goes upward and remain on the surface. The farmers when get water for irrigation they submerged their field

regularly which destroys the fertility and health of their soil.

In conclusion, it could be stated that Integrated Plant Nutrient Supply System (IPNS) is the only prudent way to save our soils of their deteriorating fertility, productivity and over-all health and ultimately assuring us food security and the desired quantity and quality of produce. Simply blanket inclusion of FYM/ compost/ green manure with inorganic fertilizers alone will not fulfill our aim. The routine suggestion of adding the blanket dose of 150:70:70 kg per hectare of N, P₂O₅ and K₂O respectively for rice will not sufficient without addition of organic manures. The climatic zone, crop variety, soil tests and agronomic practices followed must also be considered for intended returns and sustaining soil fertility, productivity and health. All the components of IPNS/ INM have to be considered which may include following practices.

Adopt the soil-test based nutrient management practices (all macro and micronutrients must be considered). The amount and kind of manure and fertilizers, their application practices and timing should be based on soil, crop and their varieties, irrigation facilities, climatic conditions and yield target.

Recycling of organic residues should be popularized among farmers.

Substitution of NPK fertilizer upto 25-50% through organic manure (FYM, Compost, Vermicompost or Green Manure) should be adopted for improvement in yield and quality of produce and soil health.

Strict verdict to stop burning of plant residues should be passed by the U.P. Government and implemented strictly.

Fertile soil should not be utilize for urbanization and other projects.

Use of bio-fertilizers where ever applicable.

Generally avoid rice -wheat cropping system for longer periods, but if necessary, use the Green manuring.

Legumes should be included in crop rotation.

Avoid zero- tillage in rice-wheat cropping system.

Lesser use of agrochemicals, preferring bio agents and cultural practices for control of weeds, diseases, nematodes and insects etc.

Use of sulphur coated or neem coated urea to improve fertilizer use efficiency.

Practicing the summer plowing.

Improving fertilizer use efficiency by using advanced agronomic and water management techniques.

Leveling of fields, proper moisture management and drainage system should be adopted.

References

Amar Singh, SudhirKumar, Y.V. Singhand Arti Bhatia(2014)Organic carbon Dynamics In soilsamendedwith DifferentorganicManureandTillagepractices in Rice-Wheatcropping system. Journal of theIndianSociety ofSoil Science62(4) 344-350
Himadra Panda andDharamvir Hota (2001). Bio fertilizers and Organic farmingGene-Tech Book, New Delhi.

Kharche, V.K., S.R. Patil, A.A. Kukarni, V.S. Patil andR.N. Katkar (2013). Term Integrated Nutrient Managementfor enhancingSoil Quality and crop Productivity UnderIntersiveCroppingsystem on vertisols. Journal ofthe Indian Societyof Soil Science.61(4)323-332.

Mahendra Singh (2010) Soil Management in relation to sustainable food production. Journal of IndiaSociety ofSoil Science, 60 (4) 251-260.

Rajkhowa, D.J., (2012). Effect of Rice strawmanagementpracticeson yieldof Kharif Rice and soilfertility under Rice-Ricecropping system. Journal ofthe Indian Societyof Soil Science. 60(3) 208-212.

Rao, K.V., K Surekha, P.C. Latha,M.B.B. Prasad, Babu, Brajendra, T.I. GhoseD.Srinivas, B.R. Jagdeesh, S.F.A. Zaidi and B.C.Viraktmath (2013) Sustainable Rice productionExperiences from long term fertilizer experiment. Book.Published by Directorate of Rice Research(ICAR) Hyderabad.

Singh, S.S. (2004).Soil fertility andNutrientManagement Kalyani Publishers, New Delhi 10).

Upindra Sharmaand S.K. Subetia (2014).Effect oflong – termIntegratedNutrient on rice(*Oryza sativa* L.)wheat(*Triticum aestivum* L.) Productivityand SoilPropertiesin North –Western HimalayaJournal of the Indian Societyof Soil Science,62 (3) 248-254.

Zaidi, S.F.A., Tripathi, H.P.and Singh, B (2007)Effect ofN applicationtimingonNitrogenuse efficiency ofrice. *Oryza*. 44 (2) 181-183.