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Short Communication

Revisiting Soil Testing for Soil Health and Food Safety: An Indian Perspective

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Abstract
Soil plays an important role in food safety as it determines the composition of plant produce through soil-plant continuum. To ensure food safety, it is important to monitor the quality of agricultural soil especially with respect to pollution. With the launching of soil health card scheme at a national scale, the real meaning of soil health can be realized if the indicators of soil health along with soil nutrient status are evaluated during routine soil testing. The site and soils which shows accumulation of pollutants should be monitored regularly and proper remediation measures should be adopted to avoid build-up of pollutants in soil. A geo- spatial database should be maintained and updated as and when the routine soil testing is conducted so that any change whether related to nutrient status of the soil or pollution can be detected and proper remedial measures can be adopted. This will ensure sustainability of soil and food safety and security in the long run.

***Key words**: Soil Pollution, Heavy Metal Contamination, Food Safety, Soil Health, Plant Nutrition.*

Soil plays an important role in food safety as it determines the composition of food (plant produce) through the soil- plant continuum. There are 18 essential nutrients required by plants to complete their life cycle, of which, some are required in large quantities (Nitrogen, Phosphorus, Potassium, Sulphur, Calcium and Magnesium), while others are required in trace amount (Zinc, Boron, Copper, Manganese, Chlorine, Nickel, Molybdenum). However, plants also absorb elements such as Arsenic (As), Cadmium (Cd), Chromium (Cr), Mercury (Hg), and Lead (Pb) which are not essential (Rattan et al, 2002, 2005; Singh and Kumar, 2006; Bhatia et al, 2015).The toxic concentration of these heavy metals ultimately reaches to human body through food chain. Although there are studies on heavy metal accumulation in soil and plants, but, not much attention has been given from the perspective of quality of soil and their potential impact on human health by transfer of heavy metals through the soil- plant continuum. Rarely, attention is being given to evaluate the heavy metal contamination of soil in soil testing. Routine soil testing is mainly done to evaluate the fertility status of the soil in connection to the crop production.

Recently, Govt. of India in Feb. 2015 launched Soil Health Card Scheme at national level (http://www.soilhealth.dac.gov.in/). The launching of Soil Health Card coincided with the international year of soils, *'Healthy soil for Healthy life'*. This scheme aims at promoting soil test based balanced use of fertilizers to enable farmers realize higher yields at lower cost. The soil health cards contain information on crop-wise recommendations of nutrients and fertilizers required for the individual farms to help farmers to improve productivity through judicious use of inputs (fertilizers and manures). The soil samples are tested in various soil testing labs across the country. Thereafter, the experts analyze the soil test results and provide recommendation. Currently, there are 540 govt. soil testing lab (static) in India. Altogether, there are 1574 number of soil testing labs which include static as well as mobile labs funded by State Govt., Indian Council of Agricultural Research, National Project on Management of Soil Health and Fertility, Krishi Vigyan Kendra etc. (http://farmer.gov.in/). According to the Dept. of agriculture, Cooperation and farmers welfare 4, 72, 77,794 number of soil health card has been distributed to farmers till Jan. 2017 (*http://www.soilhealth.dac.gov.in*). The soil health card has the following information as shown in the Table 1. The focus of the soil health card scheme is soil fertility management with respect to crop production to optimize the yield and improve farm income. These soil tests based recommendation of fertilizers and manure helps in increasing farm income by increasing crop yields and reducing input costs. However, to ensure food quality and safety, the soil health status with respect to pollution and transfer of pollutants to plant body need to be considered. This is particularly important in peri-urban areas which need to be monitored for accumulation of heavy metals that often leads to degradation of soil health and contamination of food chain (Jackson and Alloway, 1992; Rattan et al., 2002; Singh and Kumar; 2006). Most of these peri-urban areas are contaminated with pollutants including heavy metals such as Pb, Cd, Ni, and Hg. These metals are contributed mainly through industrial effluents, sewage and sludge, vehicular emission, pesticide application and other such sources (Bhatia et al, 2015). Crops raised on the metal-contaminated soils accumulate metals in quantities excessive enough to cause health problems both to animals and human beings consuming these metal rich plants (Tiller, 1986). For example, consumption of As-contaminated rice can cause (or promote) cancer of the bladder; Cadmium can attack kidney, liver, bone, and affects the female reproduction system; Chromium can cause cancer, and humans can be exposed through eating Cr-laden vegetables and Lead and Mercury are well known neurotoxins (Peralta-Videaa et al, 2009). To ensure food quality and safety, it is important to monitor the quality of agricultural soils. If growing in contaminated soil is unavoidable, crops which do not accumulate the metal pollutants in the edible parts should be grown. For example, Singh et al, (2012) conducted a detailed study to examine the crop species differences in heavy metal accumulation and distribution in various edible and non-edible plant parts. They found that vegetables like spinach, fenugreek, mustard and soybean are not suitable for their cultivation on Cu and Zn contaminated soils whereas carrot, tomato, brinjal, clusterbean, cabbage, cauliflower, potato and onion could be safely grown on Zn and Cu contaminated soils. Thus, selection of suitable crop species is critical for cultivation on metal contaminated soils.

Table 1. A template of soil health card scheme (adapted from http://www.soilhealth.dac.gov.in/)

SOIL HEALTH CARD	**Name of Lab**				
Farmers Details	**SOIL TEST RESULTS**				
Address	**S. No**	**Parameter**	**Test Value**	**Unit**	**Rating**
	1	pH			
	2	EC			
	3	Organic Carbon			
	4	Available Nitrogen			
	5	Available Phosphorus			
Soil Sample Details	6	Available Potassium			
Soil Sample No.	7	Available Sulphur			
Sample collection Date	8	Available Zinc			
Survey No.	9	Available Boron			
Khasra No.:	10	Available Iron			
Farm Size	11	Available Manganese			
GPS lat long	12	Available Copper			
Irrigated/rainfed					

Secondary and Micro Nutrients Recommendations		
Sl. No	**Parameter**	**Recommendations for soil Applications**
1	Sulphur	
2	Zinc	
	Boron	
4	Iron	
5	Manganese	
6	Copper	

Fertilizer Recommendations for Reference Yield (With Organic Manure)				
Sl. No	**Crop & Variety**	**Reference Yield**	**Fertilizer Combination -1 for N P K**	**Fertilizer Combination - 2 for N P K**
	Paddy			

General Recommendations	
1	Organic Manure
2	Bio fertilizer
3	Lime/Gypsum

The source of pollution in agricultural soil could be through use of poor quality irrigation water, industry effluents, sewage and sludge, pesticide application, and non-point source or in some case it may be geogenic. Therefore, to ensure soil health and food quality, a more holistic approach is needed for evaluation of soil health status. With the launching of soil health card scheme at a national scale, the real meaning of soil health can be realized if the indicators of soil health along with soil nutrient status are evaluated during soil testing. For this, assessment of combination of soil chemical, biological and physical properties along with irrigation water quality are needed. The site and soils which shows accumulation of pollutants should be monitored regularly and proper remediation measures should be adopted to avoid build-up of pollutants in soil. A geo- spatial database should be maintained and updated as and when the routine soil testing is conducted so that any change whether related to nutrient status of the soil or pollution can be detected and proper remedial measures can be adopted. This will ensure soil health, food quality, safety, security and overall sustainability of the agricultural system

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