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# Soil health: Importance, options and challenges in Mizoram

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## Abstract

Soil health plays as an important role for food security and sustainable agriculture. Besides, soil organic carbon which acts as a store house for plant nutrients, balancing of nutrients and proper soil physical condition is needed to maintain a healthy soil. With the launched of soil health card scheme, many farmers will be benefited by understanding the soil condition and the amount of nutrients to be applied which will increase food productivity. However, to meet the food requirement of the state and realizing the role played by soil for sustainable production. Several challenges lie ahead where more research and developments have to be emphasized. This includes site specific nutrient management, proper integration of nutrient including organic and inorganic, better utilization of nitrogen fixers and re structuring soil testing laboratories.

**Key words**: Soil health, food productivity, site specific, nutrients, soil test.

## Introduction

The term soil quality and soil health are often used interchangeably and simply can be defined as "the capacity of soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality and promote plant and animal health".[1] Soil fertility was once an indicator of a productive or good soil as viewed by a soil scientist, implying to the inherent nutrient content and supplying capacity of soil to crops for better yield. However, the term soil health or quality encompassing soil chemical, physical and most importantly biological status of soil has been widely used. The 68$^{th}$ UN general assembly realizing the crucial role of soils for food security, mitigation of climate change, ecosystem service and sustainable development declared 2015 as the international year of soils for imparting awareness of soil health.

Soil organic carbon (SOC) is the key indicator of soil health which acts as a store house for the nutrients, maintaining physical condition of soil and supports soil biota communities. The technological options which have been found to be efficient for soil C sequestration include green manuring/manuring, mulching, conservation tillage and agroforestry. It is generally perceived

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that organic matter/SOC per se increase the activity of microbes. However, in order to maintain the C:N ratio, microbes required nutrients. For example, if the organic substrate is of low quality or high C:N ratio, limitation of soil microbes may also be due to limited supply of N in the soil.[2] Soil aggregation regulates organic matter dynamics and soil fertility, thereby affecting the change in microbial community.[3] Therefore, soil health maintenance requires chemical, physical and biological aspects.

## Soil Health and Crop Production

In Mizoram agriculture occupied a very important place permeating in all major spheres of the society. Rice is the staple food of Mizoram and yet the production of rice is only 58994 MT year$^{-1}$ meeting only 32% of the state requirement[4]. Though agriculture contribution may be less, its importance cannot be understated as about >60 per cent of the population is engaged in it. This reality puts a question mark on the credibility of our agriculture system and the need to find technological ways to boost agriculture production. Various socio-economic and environmental issues that stand in the way of agricultural development also need to be addressed such as "shifting cultivation".

With the launch of "Soil Health Card Scheme" from February 2015, soil health cards were issued to farmers for judicious use of chemical fertilizer based on soil test results. In Mizoram, thousands of soil samples had been collected, tested in different soil testing laboratories by agriculture and allies such as Directorate of Agriculture, KVK, ICAR covering the whole state. This is an important step towards agriculture production where soil health status will be identified and the required amount of chemical fertilizer can be applied. In the past, major nutrient such as N, P and K in the form of Urea, SSP or DAP and MOP were given priority. However, presently preliminary reports showed the deficiency of secondary nutrients like Ca and Mg and micronutrient *viz.* Zn, B and Mo. Subsequently, the soil health card scheme also integrates micronutrients. Although the success story of this scheme may yet be too early to justify. It will in fact be beneficial for farmers who have properly managed the farms based on interpretation of the card by an expert. However, the real success for agriculture in Mizoram in relation to soil health may also have to engulf some key component. In fact, these points have to be emphasized for present and future:

### *Site specific nutrient management (SSNM) and dose of chemical fertilizer*

Needless to say the role played by fertilizers in the success of India's Green Revolution was tremendous. Yet, it may also be wise to consider the effect of unbalance and excess application to soil health and even to human health. Normally the recommendation followed for rice in Mizoram is 60:40:40 N, P and K kg ha$^{-1}$. Recently, Kumar[5] has observed the P requirement for range of soils having pH 5 may be as high as 130 kg ha$^{-1}$ in Meghalaya which was much more than the normal perceived dose. Available results show that soils of Mizoram are normal low in P which was due to high rainfall associated with the persistence of oxides of iron and aluminum fixation. However, soil test results for soil health card from a case study of Phaipheng village, Bilkhawthlir, Kolasib district revealed that majority of the soils were high in P, low in N and medium in K. These results further revealed that blanket application or recommendation of fertilizers for a whole region may not respond towards better productivity. Because, crop requirement of nutrients for a particular region may differ with sites, within the same field, different seasons and year. SSNM has been practice successfully with high yield targets in intensive cropping systems of India. SSNM aims to increase nutrient use efficiency by considering the nutrient supplying capacity of the soil, the optimum amount and time of nutrient required for higher yield target. In SSNM system, the required amount of the plant nutrient is fixed based on the yield of the previous crop, estimating yield target, soil testing, nutrient omission

plots (N,P,K), determination of leaf nutrient content etc.

### *Balance and Integrated Nutrient Management (INM)*

It is well known that Mizoram soils are acidic in nature, with average pH ranging between 5.5 to 6. The available option for increasing soil pH is the use of agriculture lime. Three types of limes are used in India namely-calcium oxide (CaO) or burnt lime, calcium hydroxide [$Ca(OH)_2$] or slaked lime and dolomite [$CaMg(CO_3)$]. Burnt lime and hydrate lime has high $CaCO_3$ equivalence (CCE) approximately 179 and 135 while dolomite have approximately 109. Although dolomite has a lower CCE, its market availability and Ca and Mg content (25-28% CaO and 17-19% MgO) may be preferable in Ca and Mg deficient soils of Mizoram. Dolomite may serve a dual purpose in improving the soil health status. With the increasing concern of organic production, organic agriculture may not be always meeting the nutrient requirement of important food crops because of slow releasing nutrient capacity. INM aims at efficient and judicious use of all the major sources of plant nutrients e.g. organic and inorganic sources so as to attain maximum economic yield integration of at least 25% plant nutrients through organic sources (FYM, green manure, cakes, vermicompost, crop residues) with 75% through fertilizers to improve soil health. Burning crop residues not only leads to loss of N, P, K and S nutrients but also contributes to global $NO_2$ and $CO_2$ budget, destruction of microbial biota and losses of water from soil.

### *Utilization of N fixers*

Although research on the benefit of leguminous to soil health is limited in Mizoram, the advantages of N fixers had been recognized worldwide. In Mizoram, the main cropping patterns available are rice mono-cropping in lowlands, upland rice as a sole or intercropped with vegetables followed by soyabean etc. Legumes such as pegion pea, french bean, cow pea and soy bean are the widely gown legumes in Mizoram. This crops should be included in any possible combination as a catch crop, intercrop and fallow crop e.g. after the harvest of lowland rice. It should be noted that legumes are efficient in N fixation and improves soil health through a symbiotic association with *Rhizobium* besides its advantages as a green manure. The use of azolla, an aquatic fern is gaining importance, because of its symbiotic relationship with anabaena to fix nitrogen. It has been widely use in China and Philippines along lowland rice. Thus its inclusion to lowland rice may be promising. Pegion peas and other legumes can also be planted after the harvest of upland *jhum* rice and thus second year fallow may be utilized.

### *Strengthening soil testing laboratories*

There are only few laboratories able to conduct soil analysis in Mizoram and the existing laboratories have limited capacity to analyzed important soil health parameters. The primary parameters for soil testing laboratories in India involves analysis of pH, electrical conductivity (EC), available N, P, K, and OC. Micronutrient and soil biological parameters (microbial biomass carbon and soil enzymes) have to be incorporated for complete soil health assessment. Microbes and their activity play a key role in organic matter decomposition, nutrient cycling and are used as soil health indicator. Thus nutrient supplying capacity and change in soil functioning due to agricultural management can be ascertained. For example phosphatase enzyme is involved in P cycle and if P availability is less in soil, the enzyme release increases from microbes and plant roots for P solubilization to cop up with P stress.

## CONCLUSION

With the ever-increasing population, the need for self sufficiency in food production becomes a greater challenge. There is great need to pay attention for the existing soil management system, and technological options to increase

soil health for agricultural sustainability. Soil health is one of the key sources to fill up the food basket of the state. The above suggestions made towards improvement of soil health will surely play a significant role in meeting the food security of the state.

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