The Case of Micronutrient Usage in Indian Agriculture

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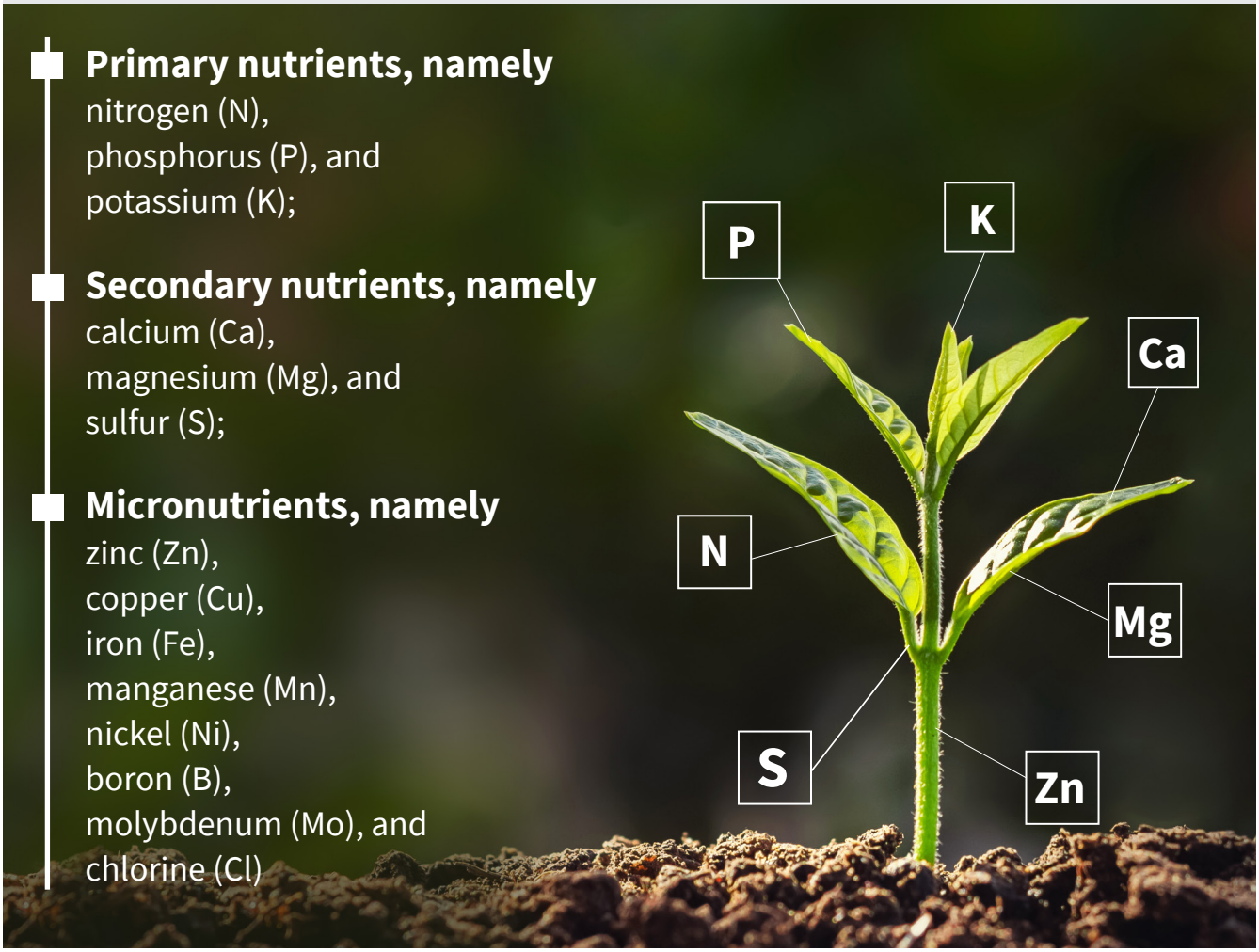
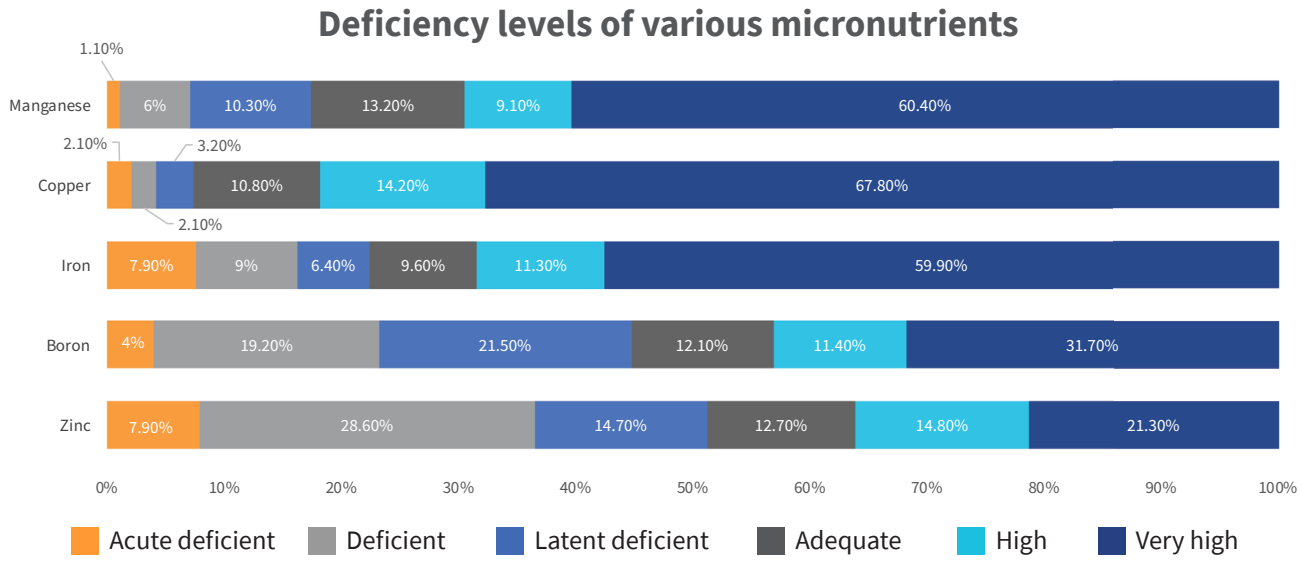
India is among the top crop-producing countries across the globe, with an annual production of 98.38 million metric ton (MMT) of wheat, 110.15 MMT of rice, and 22.95 MMT of pulses. However, crop yields are lower in India as compared to other top producing countries, such as China, Brazil, and the United States. Systemic issues are a major reason behind the low agricultural yield in India. These include small and fragmented landholdings—with 86% of farmers classified as small and marginal who operate on less than two hectares of land, lack of credit facilities and training for farmers, and inadequate market linkages. This leads to the use of traditional farming methods and improper use of soil nutrients, which act as barriers to investment in high yielding methods of production, such as farm mechanization and irrigation facilities.

India's population is expected to reach 1.70 billion by 2050. To ensure food security for this growing population, the country must increase its agriculture production significantly. With limited scope to expand the cultivable area, India must focus on increasing its agricultural yield. This note highlights the importance of soil nutrients, particularly micronutrients, and the factors that affect the availability of these micronutrients in Indian soils. It also explores the reasons for the low use of micronutrients and provides recommendations to optimize their use to increase yields.

Soil health is dependent on 17 nutrient elements essential for plant growth. In addition to carbon (C), hydrogen (H), and oxygen (O), which the crops absorb through water and air, some other nutrients are categorized as follows:



Crops absorb these nutrients from the soil or through fertilizers applied to the soil. An analysis of soil samples in India revealed a deficiency of five key nutrients, as illustrated in the graph below.



Source: Guidelines for using micronutrients, National Food Security Mission

Factors that affect the availability of micronutrients in Indian soil

Both natural and human-induced factors are responsible for the low incidence of micronutrients in Indian soils.

Natural factors

1. **Soil pH:** The availability of micronutrients decreases as soil pH increases, expect for molybdenum. Hence, micronutrients are naturally available in more acidic soils than alkaline soils. The ideal soil pH level for micronutrient availability is between 6 and 7.[1] However, 71% of Indian soils are moderately alkaline and hence deficient in micronutrients.

2. **Soil temperature:** The uptake of micronutrients by plants decreases in low temperatures due to decreased root activity, low rates of dissolution, and nutrient diffusion. Low temperatures in the northern region during the winter hence result in micronutrient deficiencies in crops.

Human-induced factors:

1. **Low soil organic matter (SOM):** SOM retains large quantities of micronutrients and continuously supplies nutrients through decomposition over time. Due to intensive cultivation, soil erosion, and non-addition of organic manures, the level of Soil Organic Carbon (SOC) content—a measure of SOM, has decreased to 0.3-0.4% in Indian soils where the ideal measurement is approximately 1.0-1.5%.

2. **Intensive agricultural practices:** Since 1960, India has achieved a five-fold increase in food grain production due to the Green Revolution through intensive cropping methods such as greater use of chemical fertilizers and high yielding

1. Soil *pH* is a measure of soil acidity or alkalinity. Soil *pH* 0–7 is acidic and *pH* 7–14 is alkaline.

seed varieties. However, over time, this has prevented native micronutrients from being replenished, leading to deficiencies.

3. **Imbalanced use of fertilizers:** The disproportionate application of fertilizer nutrients has resulted in large disparities between the nutrients soil needs and those applied through fertilizers. For example, nitrogen forms nearly 66% of the total fertilizer nutrient consumption in India. This has resulted in secondary and micronutrient deficiencies. Additionally, excessive application of phosphorous increases soil pH content, thereby reducing the uptake of zinc by plants.

Factors that affect the improper use of micronutrients

Farmers have not addressed the decreasing levels of micronutrients in the soil. The following demand- and supply-side reasons explain such behavior:

1. **Poor communication and awareness:** The primary reason for low micronutrient uptake is the lack of knowledge among farmers about the nutritional status of their land and the nutrients required for crop growth. Even farmers who are aware of these nutritional gaps believe that primary nutrients are sufficient for crop growth. This belief is fueled by inadequate access to trusted and relevant information on the use of fertilizer nutrients.

2. **Low use of soil health card recommendations:** The Government of India (GoI) implemented the Soil Health Card (SHC) program in 2015 to increase awareness among farmers regarding the nutritional status of their land and provide recommendations on fertilizer usage. However, compliance with these recommendations has thus far been low. This non-compliance can be attributed to the difficult-to-understand format of the recommendations and a lack of trust among farmers that hinders them from changing their current fertilizer use patterns due to fear of yield losses.

3. **Lack of soil testing facilities:** At present, India has 1,454 soil testing labs, only 700 of which are equipped with micronutrient testing facilities. These labs also lack the skilled human resources and functional equipment required for testing. This is insufficient, considering the approximately 140 million farmers spread across India. Consequently, these farmers are forced to travel long distances to access the labs and wait three to four months to receive results.

4. **Policy gaps by the GoI and the lack of state government initiatives:** The current nutrient subsidy structure of the government heavily subsidizes primary fertilizer nutrients such as nitrogen in the form of urea. This incentivizes farmers to use these fertilizers and limits the uptake of micronutrient fertilizers. Only a few states including Kerala, Karnataka, and Andhra Pradesh have provided micronutrient subsidies, which are limited to specific crops or geographies. Moreover, micronutrients attract a higher Goods and Services Tax (GST) and customs duty on import, as compared to primary nutrient fertilizers.[2]

2. Goods and Service Tax (GST) is an indirect tax levied on the supply of goods and services in India

Recommendations

The micronutrient space in India is likely to receive renewed attention due to the government's recent focus on agriculture productivity to feed its growing population and its aspiration of achieving the second Sustainable Development Goal of "Zero Hunger." The government should adopt the following set of recommendations to improve micronutrient use:

1. **Communication and awareness campaigns:** Widespread micronutrient deficiencies prevalent in Indian soils adversely affect the crop yield and quality.[3] The GoI, with support from state governments, should launch a nationwide campaign on balanced soil nutrition that can be adapted regionally to increase farmer awareness of the benefits of micronutrient fertilizers. Limited-term incentives should also be offered to farmers to encourage micronutrient usage. For example, cashback on purchase of micronutrients and in-kind benefits such as free or reduced cost of agriculture inputs or small loans for early adopters.

2. **Investment in channel partners as the champions of behavioral change:** Currently, agriculture input dealers such as pesticide and fertilizer dealers are dominant channel partners in the agriculture value chain. Most farmers use micronutrients only as a curative measure based on the recommendations of their dealers. These dealers hence have a large degree of influence on the purchasing behavior of farmers. The government should incentivize dealers to create micronutrient awareness among farmers through training programs and promote micronutrient usage, not only as a curative measure but to enhance soil quality and thereby improve yield. These incentives could include one-time cash benefits or subsidized stock availability.

3. **Policy initiatives:** In India, fertilizer is included in the Essential Commodities Act and fertilizer nutrients such as N-P-K are regulated and sold at highly subsidized prices as compared to micronutrients. This results in overuse and creates imbalances in plant nutrition. The GoI should either rationalize the subsidy regime for primary nutrient fertilizers or subsidize micronutrient fertilizers.[4]

4. **Promotion of fortified fertilizers:** The GoI has taken small steps to promote micronutrient fertilizers. The inclusion of 23 fortified fertilizers under the Fertilizer Control Order (FCO) has allowed fertilizer manufacturers to fortify 20% of their total subsidized fertilizer production with secondary nutrients and micronutrients.[5] Fertilizer manufacturers can also charge a price 10% higher than the Maximum Retail Price (MRP) for subsidized fertilizers. However, this has not resulted in higher uptake of fortified fertilizers since fortification is an expensive process and its cost is higher than the 10% markup permitted. The government should introduce policy changes related to price and costing, such as a larger percentage uptick above the MRP to match the cost of fortification.

3. Page no. 4 and 6; Micronutrient in soil, plants, animals and humans; Arvind K Shukla, et al; Indian Journal of Fertilizers Volume14 (4).
4. Hyperlink it to the PB on "Reforms in Fertilizer Subsidy in India – The Way Forward."
5. Fortified or coated fertilizers are manufactured by coating conventional fertilizers with one or more micronutrients.

5 **Rationalization of the tax structure:** The GST levied on fertilizers containing primary nutrients is 5% while that on micronutrient fertilizers is 12%. A rationalized tax structure would likely increase the production of micronutrients and lower the prices of micronutrient fertilizers. Rationalization of the tax structure is possible and has precedence, as the GoI has reduced taxes on several commodities in the past, including fertilizers.

Conclusion

India must ramp up its agriculture productivity to meet the demands of its growing population. The balanced use of nutrients, including micronutrients, is essential to achieve the desired levels of production. The governments, through policy and operational initiatives, should promote and facilitate micronutrient usage to lay the framework for sustainable agriculture and ensure that the quantity and quality of food are more than sufficient for the years to come.

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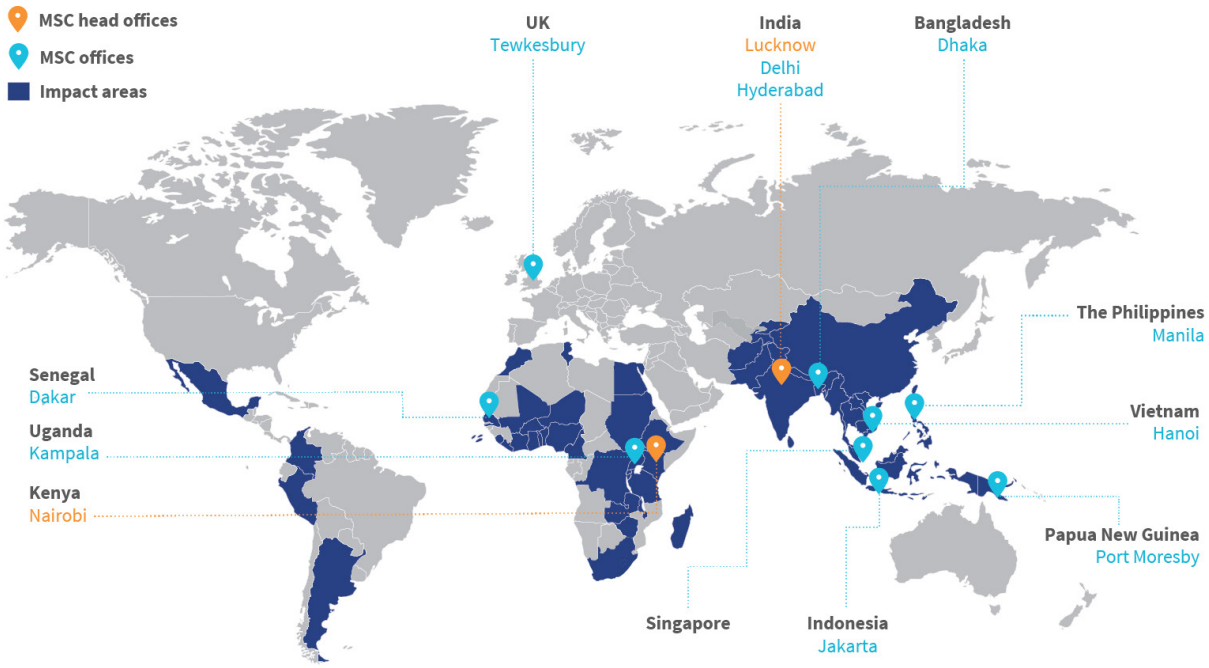

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