



Increasing Soil Fertility in a Sustainable Way - Industry Perspective

Innovations in Soil Fertility Management

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Global Symposium on Soils for Nutrition | 26-29 July 2022

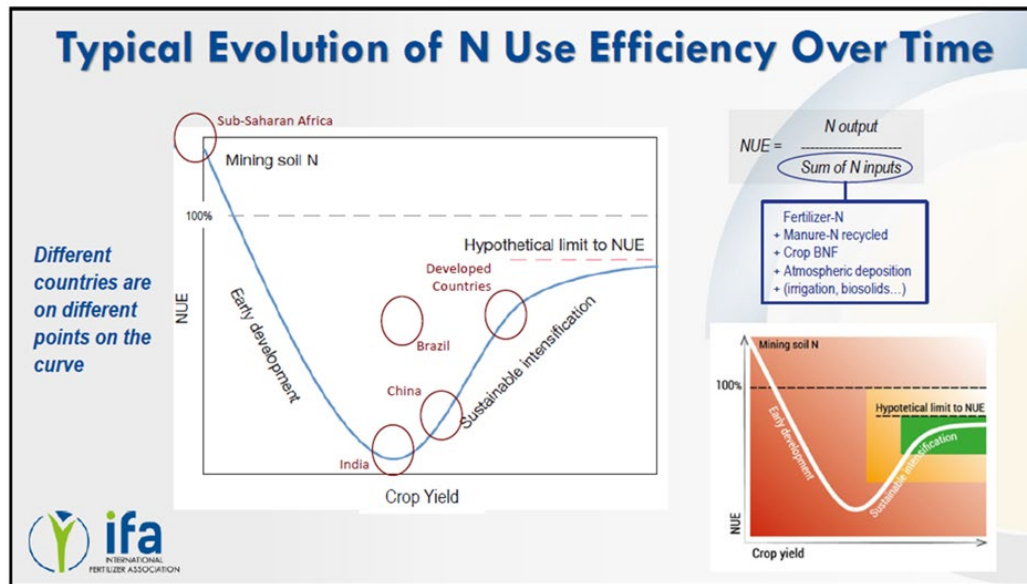


Role of Fertilizers in Soil Fertility

- Soil Fertility is the ability of the soil to supply nutrients to the plant and support plant growth
- Fertilizers are substances that provide nutrients to plant either through the soil or directly
- Fertilizers are essential for maintaining the fertility of soil as nutrients are continuously removed by plants
- While fertilizer use is essential, over or under or mis-use of fertilizers can lead to soil degradation which in the long term will adversely affect crop productivity and quality
- Appropriate use of fertilizers by adopting the 4R principles will lead to sustainable maintenance of soil fertility and thereby ensure the long term health of crops, humans and animals

Measure of Appropriate Usage of Fertilizers

- Nutrient Use Efficiency (NUE) is a good indicator of whether fertilizers have been used using the 4R principles
- IFA defines NUE as output/input ratio
NUE = Nutrient removed by Crop/Nutrient supplied by Inputs
- The typical trend of NUE for any nutrient is as below

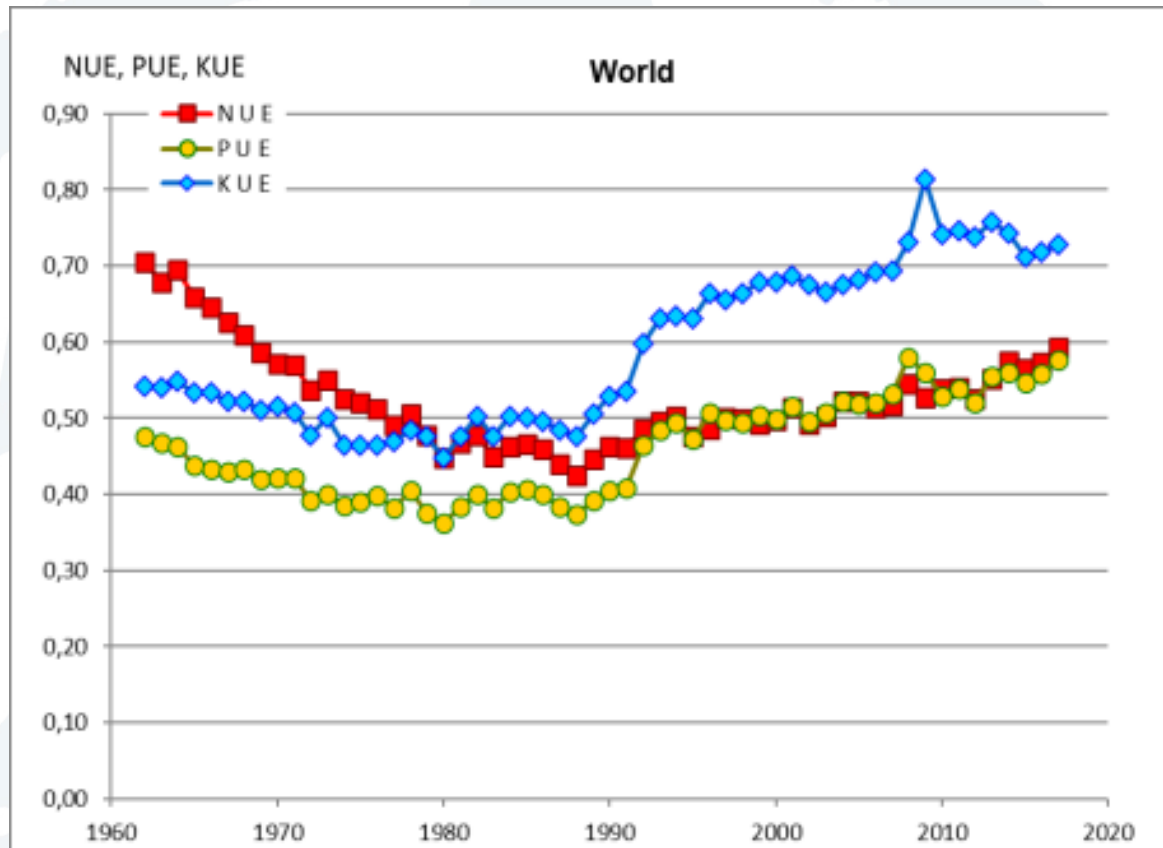


Ref: Analysis of Crop Nutrient Use Efficiency Trends, International Fertilizer Association, 6 May 2020

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Global Trends in NUE



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- NUE is increasing for all primary nutrients with Nitrogen and Phosphorus at nearly 60% and K slightly above 70%

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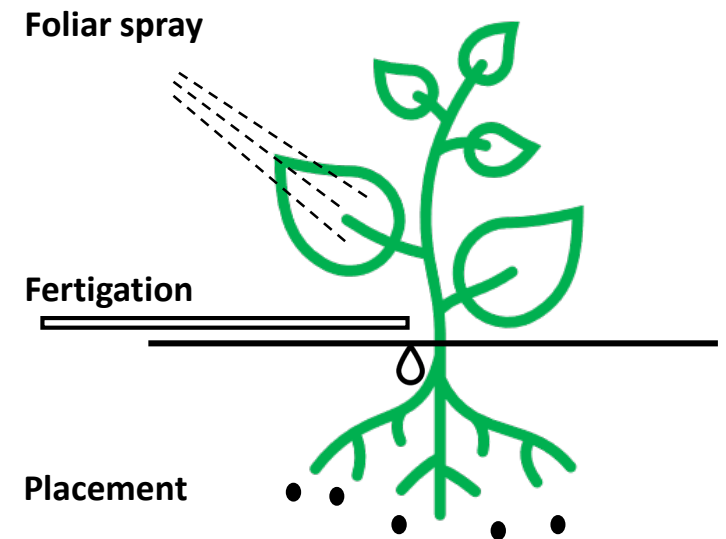


Major Themes underlying More Efficient Fertilizers

- Feed the crop in addition to the soil
- Match nutrient availability in soil with crop demand
- Keep nutrients applied to soil in available form for longer time
- Add bio-agents to enhance nutrient retention/release in soils
- Use digital technologies to customize offerings to suit soil type

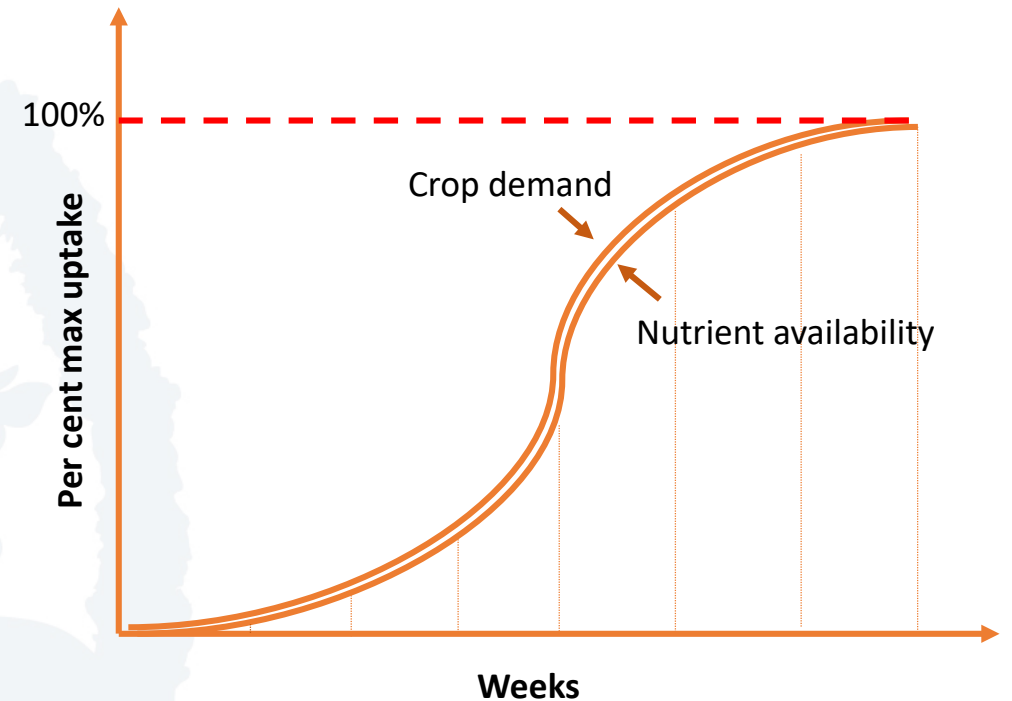
Feed the Crop in addition to the Soil

- Fertilizer uptake efficiency is higher when fertilizers are applied to the plant or placed close to the roots. Hence, the path of nutrient travel and consequently nutrient loss is minimized
- Developments in application technology have enabled this approach as fertilizers can now be applied with greater precision
- Water soluble and Liquid Fertilizers are highly amenable for directly feeding the crop through foliar sprays, fertigation and soil injection



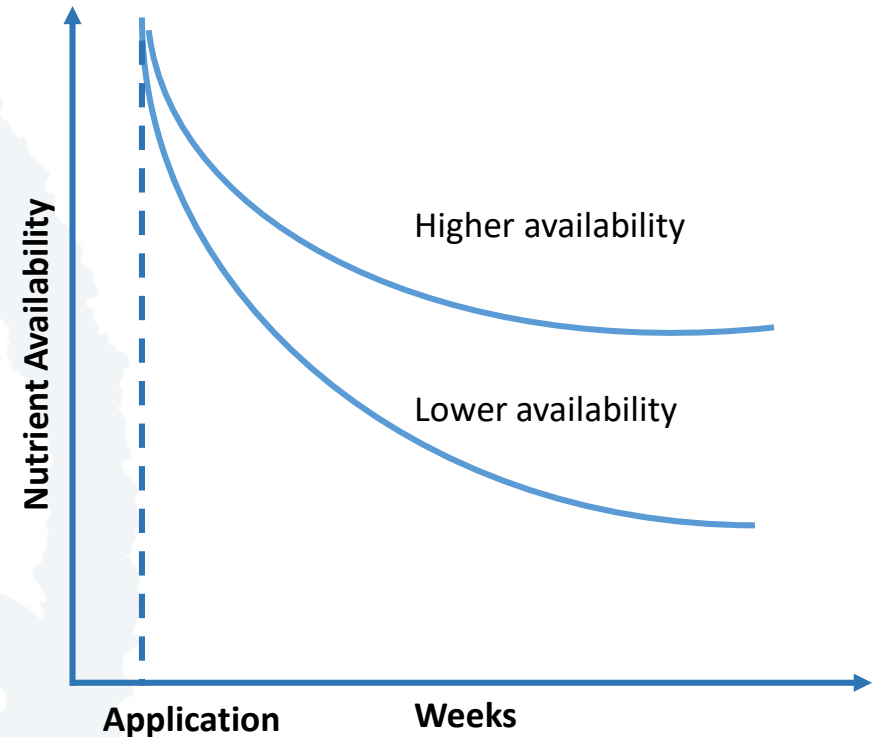
Match Nutrient Availability with Crop Demand

- Nutrients are released by fertilizers to match the requirement of the crop. Hence, the likelihood of loss of unutilized nutrients in the soil is minimized
- The slow and controlled release of nutrients is achieved through various means – polymer coatings, slowly dissolving compounds, adsorbents for nutrients etc.
- Some examples of fertilizers which follow this approach are – Polymer Coated Urea, Condensed Urea, Struvite etc.



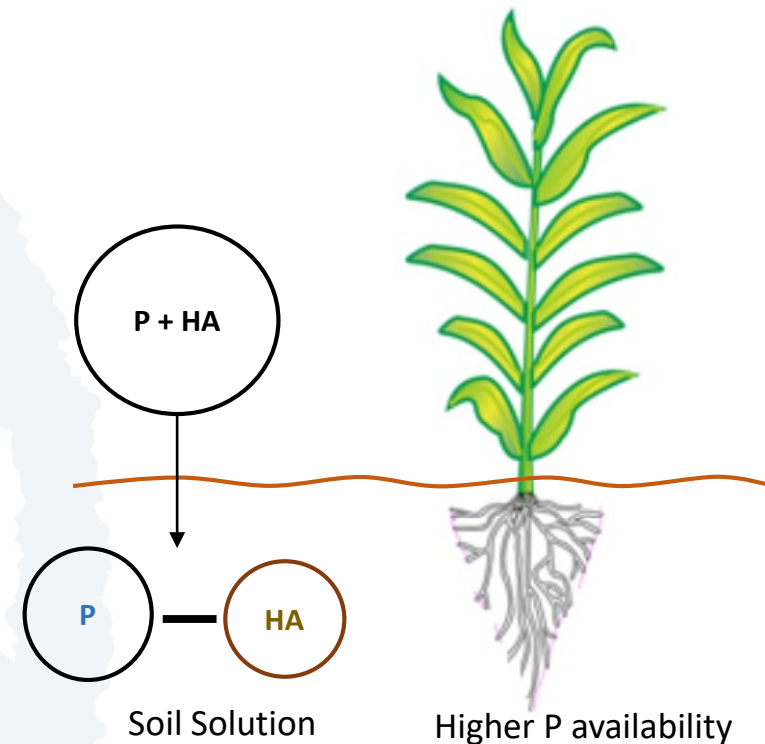
Keep Nutrients Applied to Soil in Available form

- Nutrients from fertilizers are made available in soil for a longer time by blocking the action of agents which tend to convert them into forms which are easily lost or are unavailable
- Availability of urea nitrogen can be increased by urease and/or nitrification inhibitors
- Phosphate availability can be increased by additives that block the fixation by calcium
- Micronutrient availability can be increased by chelation



Combine Bio-agents and Inorganic Fertilizers

- Nutrient availability and uptake are enhanced by harnessing the power of natural biological agents such as microbials, humic acid, organics, plant extracts etc.
- These agents when added to fertilizers help in releasing locked nutrients, protecting nutrients from fixation, and improving uptake of nutrients
- Addition through fertilizers ensures the availability of these agents in soil in proximity to the nutrients



Use Digital Technologies for Customization

- Geospatial maps which describe the variability in soil fertility are used to provide customized fertilizers
- This is helping in design of soil specific fertilizers which provide balanced nutrition and therefore address micronutrient deficiencies which can adversely affect human health
- The digital soil fertility maps also facilitate targeted delivery of these fertilizers through GPS guided applicators such as tractors, drones, sprayers etc

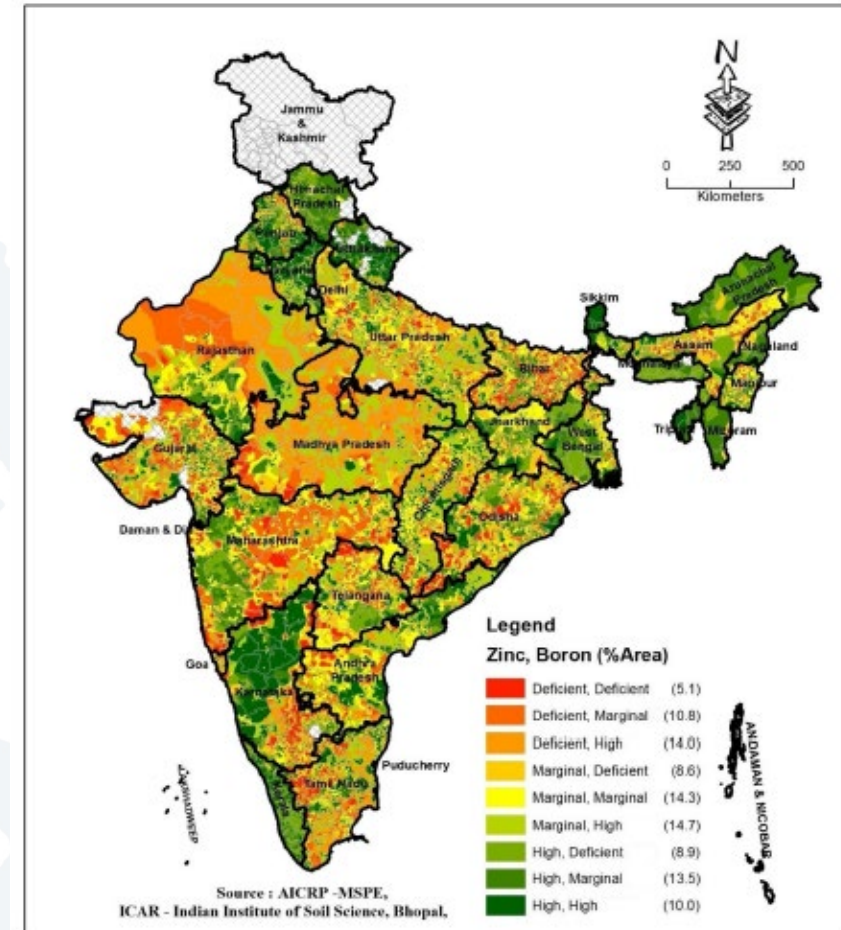


Figure 1. Spatial distribution of Zn + B deficiency in different states of India (The figure has been prepared using ArcGIS software (version 10.5.1), Environmental Systems Research Institute, Redlands, California).

Ref: Arvind Kumar Shukla et.al, www.nature.com/scientificreports, 2021

Conclusions

- Fertilizers are essential for maintaining soil fertility
- Judicious use of fertilizers is required for sustainable management of soil fertility
- Nutrient Use Efficiency is a good indicator of appropriate use of fertilizers
- Global NUE is showing an upward trend which indicates that fertilizers are becoming more efficient and are being used more efficiently
- The strategies underpinning efficient fertilizers include – feeding of crop directly, matching of availability with demand, ensuring higher availability with synthetic and organic additives, and using digital technologies for soil specific fertilizers
- The journey towards more sustainable soil fertilization continues as there is scope to further improve Global NUE from current levels to 70%
- There is need to reduce the wide disparity between NUE values of different countries – India and China have lower NUE in comparison to USA and Europe



Thank you !

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