Theme 2
Sustainable soil management for food security and better nutrition

On Multinutrient Deficiencies in Rainfed Agroecosystem – A case study from India

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INTRODUCTION

Countries' food grain demand can be achieved either by bringing additional lands under cultivation or by intensifying cultivation with better management practices. Nonetheless, both necessitate continuous soil fertility monitoring to avoid nutrient deficiency, which is one of the key restrictions to crop yield and is a critical tool for farmers and policymakers in soil nutrient management (Lalitha et al., 2021). Soil fertility in rainfed areas of arid and semiarid regions has been further complicated by widespread nutrient deficiency despite climate change (Shukla et al., 2019). The integrated watershed management program called SUJALA by the watershed development department, Karnataka, facilitated the diagnosis of soil fertility status with the objective to assess and identify the nutrient deficiency in rainfed areas of Karnataka.

METHODOLOGY

A total of 34,011 geo-referenced composite samples were collected from the plough layer (0–15 cm) at 325 X 325 m grid intervals to analyze the nutrient status of soils. Soil organic carbon (SOC), available phosphorus (P), available potassium (K), sulphur (S), boron (B), and micronutrients (Fe, Cu, Mn and Zn) were measured following standard procedures (Jackson, 1979).

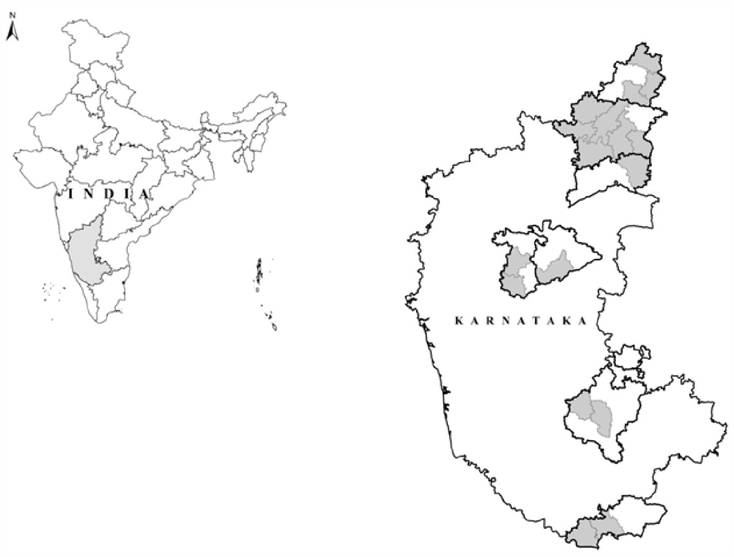

Fig.1. Location map of the study area

RESULTS

- The SOC content ranged from 0.03 to 4.3 percent with a mean value of 0.69±0.36 (mean±SD). The soil available P ranged from 1.25 to 483 kg ha^{-1} with a mean value of 16.3±22.6. The soil available K values ranged from 44 to 5986 kg ha^{-1} with a mean value of 273±215.
- The soil available S values ranged from 0.06 to 1692 mg kg^{-1} with a mean value of 17.4±52.9. The soil available B values ranged from 0.01 to 8.2 mg kg^{-1} with a mean value of 0.52±0.36.
- Extractable Fe ranged from 0.04 to 198.4 mg kg^{-1} with a mean value of 8.1±9.0. Likewise, the extractable zinc varied from 0.01 to 46.5 mg kg^{-1} with a mean value of 0.6±1.4 mg kg^{-1}. Among the micronutrients, copper and manganese were sufficient in more than 90 percent of the samples analyzed.

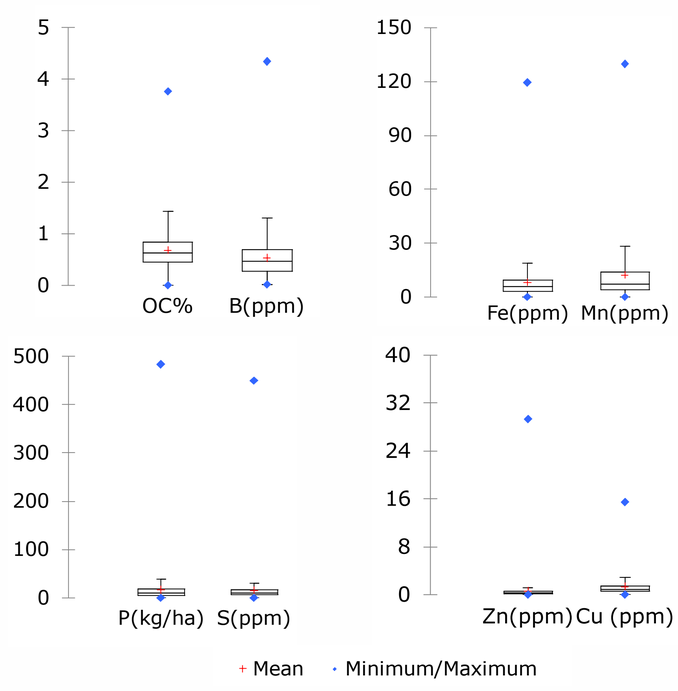

Fig.2 Box plot describing soil nutrient parameters

Table.1. Multinutrient deficiency observed in different agro-climatic zones of Karnataka (n=34010)

Taluk	% Deficient sample						MND*
	OC	P	S	B	Fe	Zn	
North Eastern Transition Zone (n=1629)	13	85	45	57	16	63	P, B, Zn
North Eastern Dry Zone (n=15473)	30	55	56	54	33	83	Zn, S, P, B
Northern Dry Zone (n=11348)	34	53	52	59	54	78	Zn, B, Fe, P, S
Central Dry Zone (n=803)	45	36	24	68	10	61	B, Zn
Eastern Dry Zone (n=693)	61	18	25	66	5	73	Zn, B, OC
Southern Dry Zone (n=1916)	40	43	57	49	39	72	Zn, S
Northern Transition Zone (n=2148)	33	72	45	54	51	89	Zn, P, B, Fe

*MND; Multinutrient deficiency

DISCUSSION

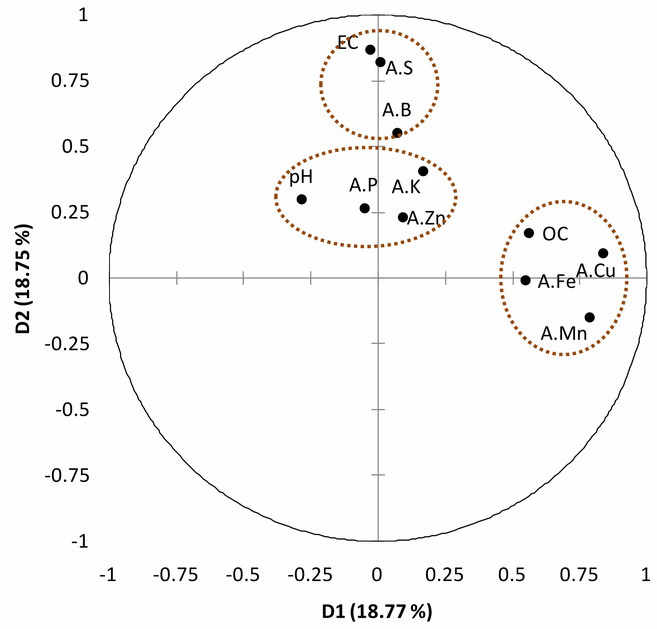

Fig.3 Factor analysis representing the relationship between soil nutrient parameters

- The principal component analysis revealed that organic carbon had a strong influence on the availability of Cu and Mn, whereas available P, K, Fe, and Zn were strongly influenced by soil pH. Soil EC had a significant effect on the availability of S & B.
- Widespread nutrient deficiency was observed for soil available Zn (80%), P (60%), B (60%), and S (50%), and to some extent for Fe (40%). The deficiency of soil available phosphorus, sulphur, boron, iron, and zinc might be foreseeable in places where crop uptake and other losses are not met by inputs because of the meager quantity of fertilizer application, minimum care taken for secondary and micronutrients and less concern towards soil constraint management such as pH and EC.

CONCLUSIONS

Widespread multi-nutrient deficiencies across the agro-climatic zones of Karnataka revealed that rainfed soils are not only thirsty but famished too. Soil fertility management is apparent in rainfed regions to improve and sustain crop production against widespread multi-nutrient deficiency across the agro-climatic zones of Karnataka. Thus, the application of secondary and micronutrients along with a recommended dose of major nutrients based on crop requirement and soil nutrient availability is desired for sustained rainfed crop production to increase nutrient use efficiency and factor productivity.

ACKNOWLEDGMENTS

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