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Fertilizer Management for Horticultural Crops using Digital Soil Maps

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ABSTRACT

Production and productivity of any specific horticultural, as well as other crops, depends on the climate, soil characteristics, management inputs, etc. Digital soil maps (DSM) of Nepal, recently developed and launched by the Nepal Agricultural Research Council, can be used as an evidence-based decision-making tool to manage optimum soil-based agricultural inputs. A digital soil map can provide basic information on soil properties including soil pH, soil texture, organic matter, total nitrogen, available phosphorus, available potassium, and micronutrients zinc, and boron. Based on the information generated through DSM, policymakers and planners can design and develop horticultural programs; researchers can optimize their resources by conducting research in one area and recommend it for the similar domain; extensionist can use DSM for agro-advisory services; academia can use it as teaching materials and farmers can use DSM for assessing available resources to manage their soil for enhancing production and productivity of horticultural crops.

Keywords: Digital Soil Map, Horticultural crops, Production and productivity

INTRODUCTION

Soil is a complex, and dynamic living system which is the foundation of all forms of life on earth. Increasing population, along with urbanization and industrialization is giving continuous pressure on arable land leading to the shrinking of the net production area. This creates a challenge to increase crop productivity to meet the food security target. The production and productivity of any crops including horticultural crops depend on climate: temperature, humidity, sunshine, rainfall, etc., topography, soil characteristics types, nutrient status, moisture-holding capacity, organic matter content, soil acidity, etc., and management inputs like fertilizer, seeds, irrigation water, pesticides, etc. As a result, the response of each crop varies with location, soil properties and management practices.

Among the other inputs, soil fertility and fertilizer management are important factors to improve soil health and crop productivity. In Nepal, farmers' access to information about soil characteristics and the improvement of soil fertility is very limited. Most farmers use organic inputs and chemical fertilizers based on their own experience rather than scientific recommendations. This paper highlights how digital soil maps (DSM) of Nepal, recently developed and launched by the Nepal Agricultural Research Council (NARC), can be used as an evidence-based decision-making tool to optimize soil-based horticultural inputs.

Digital Soil Mapping of Nepal

The DSM is the computer-assisted prediction of soil properties based on the laboratory results of georeferenced soil samples and environmental covariates. During this process, a machine learning approach would be used in which measured data are combined environmental factors that affect soil properties. It was developed recently by National Soil Science Research Centre, NARC in collaboration with Nepal Seed and Fertilizer Project implemented by CIMMYT International and International Fertilizer Development Center. Official launching of DSM was done on 24th February 2021.

The DSM, in general, predicts soil properties like soil pH, organic matter, total nitrogen, available phosphorus, available potassium, soil texture, available zinc, available boron, parent material, etc. Based on the information generated through DSM, horticulturists can make a plan for enhancing production and productivity by efficient and effective management of the available resources, particularly soil fertility and soil health.

Benefits of DSM

DSM can offer multiple benefits for different categories of stakeholders including policy makers, planners, researchers, agri-input suppliers, farmers, etc. DSM provides information on the nutrient status of the soil including macro and micronutrients zinc and boron. Based on nutrient status in the soils, a domain with similar soil properties can be identified. This helps to develop a domain-specific fertilizer recommendation and to estimate fertilizer requirement for a particular crop in a particular site.

It provides easy access to location specific information on soil properties and soil nutrients status. Concerned stakeholders can use DSM as an evidence-based decision support tool to increase crop productivity through improved soil management. Policy makers can design an appropriate program to increase soil fertility, correct soil acidity, improvement of organic matter in the soils, selecting the appropriate type of fertilizers, decide the best horticultural crops for a specific location.

It helps to identify areas with deficient plant nutrients and provide site specific fertilizer formulations. DSM could be helpful to industry practitioners and potential investors to understand key trends and emerging opportunities in the sector. Farmers can get soil information of their land at a single click and accordingly apply management options. They can improve soil health, decide horticultural crops to be grown, decide the amount and type of fertilizers to apply according to the soil information. Farmers inventory with a soil health card can be initiated. It also encourages innovation and the adoption of best practices to support scalable and sustainable services.

Use of DSM for Horticultural Management

DSM can be utilized for multipurpose to manage soil fertility and soil health. Given the less research, particularly in fertilizer management for horticultural crops, the importance of DSM to the horticultural sector is higher than cereal crops. Due to the lack of comprehensive soil fertility maps, it is difficult to identify the area with nutrient deficiency. It is reported that there is mining of secondary and micronutrients in Nepalese soils. However, due to limited research and lack of maps, it is not possible to identify which areas are deficient in those nutrients. Based on the information generated through DSM, policy makers can identify a suitable area for a specific commodity and accordingly can be upgraded to block, zone or superzone in future. Existing programs can be better managed based on soil information and its implications. Researchers working in one area can recommend his findings in areas with similar soil properties and agro-ecology. This helps to minimize the duplication of research activities and optimize the use of research resource. It can save time, money and human resources; and also help to prepare a database of the resources.

In addition to researchers, academia can also utilize the results as teaching material and guide them to carry out basic research. Similarly, private sectors like agri- input retailers and cooperatives can decide on suitable nutrient based fertilizer to import and sale in their locality.

Synthesis and Way forward

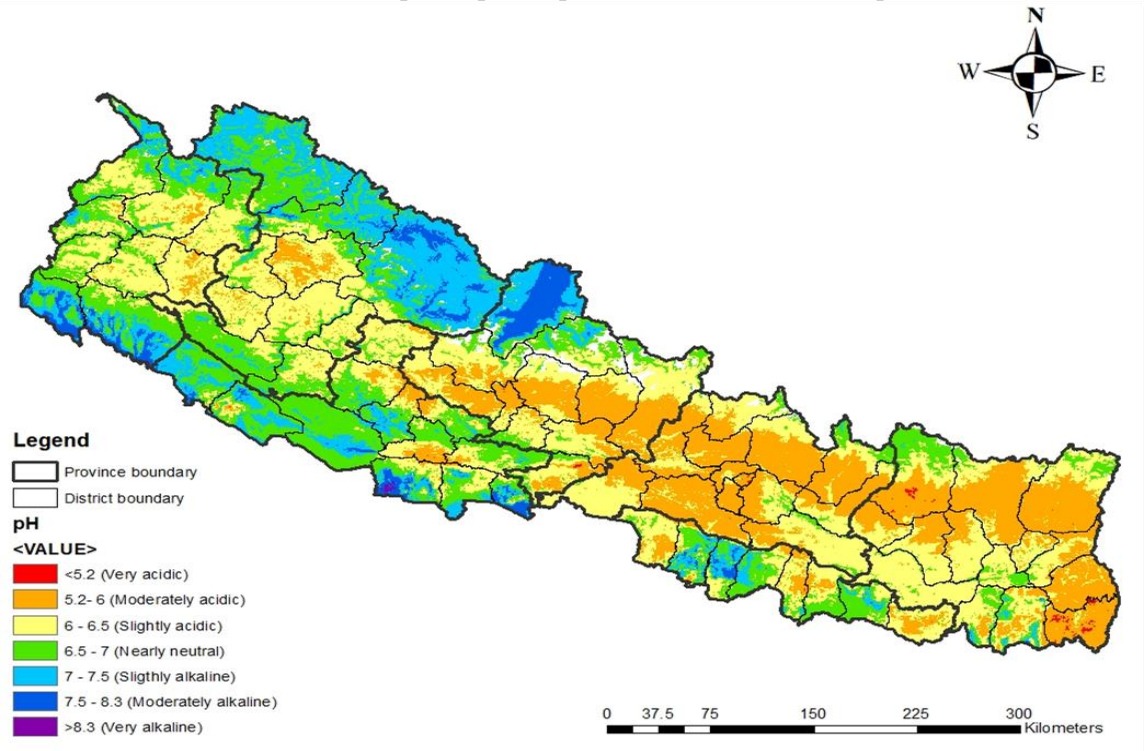
DSM can be utilized not limited to horticultural crops but for other crops in predicting the nutrient status and other soil properties of the specific location. This technology needs to be disseminated at the local level so that all farmers can be benefitted from the use of DSM. It should be revised every year based on the availability of data. NSSRC is planning to initiate a National soil information system in the days to come.

ACKNOWLEDGEMENT

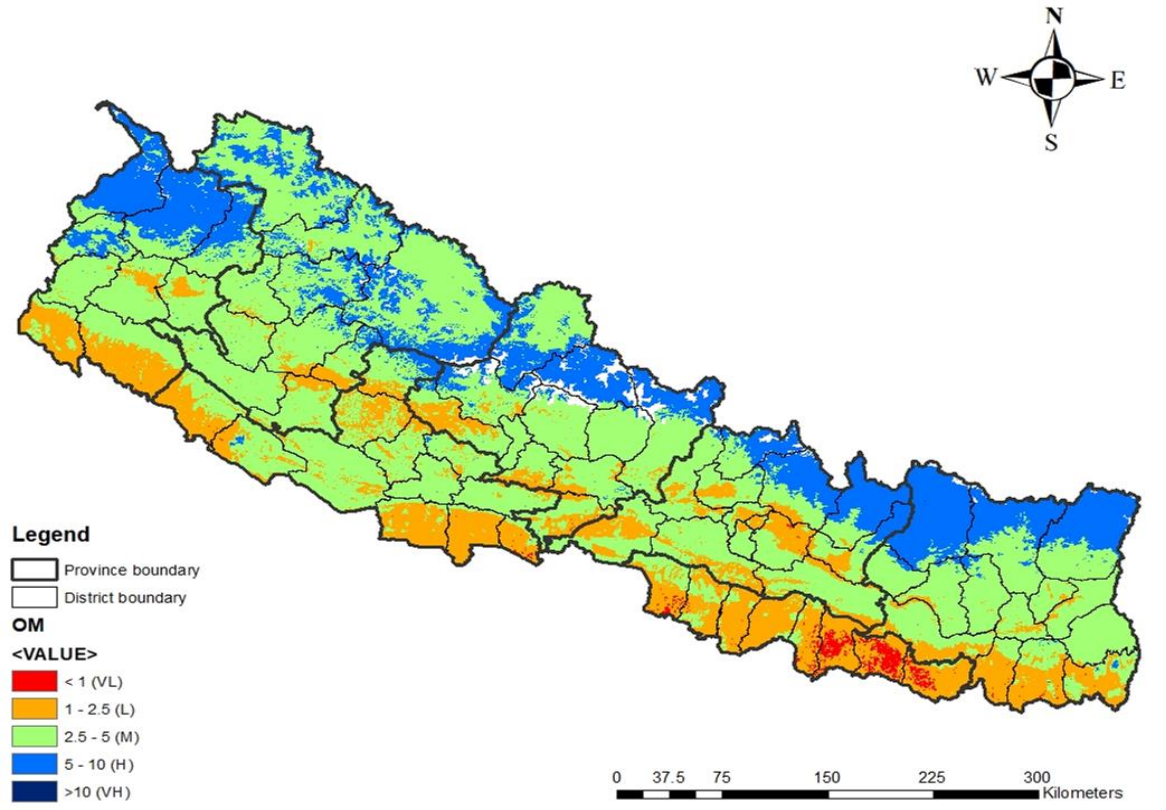
We would like to thank USAID for providing financial support to initiate DSM in Nepal. Special thanks to GIS team of CIMMYT and NSSRC for their time and effort in bringing the DSM to this shape. We would like to thank Nepal Agricultural Research Council for continuous support and encouragement during the preparation of DSM.

APPENDICES

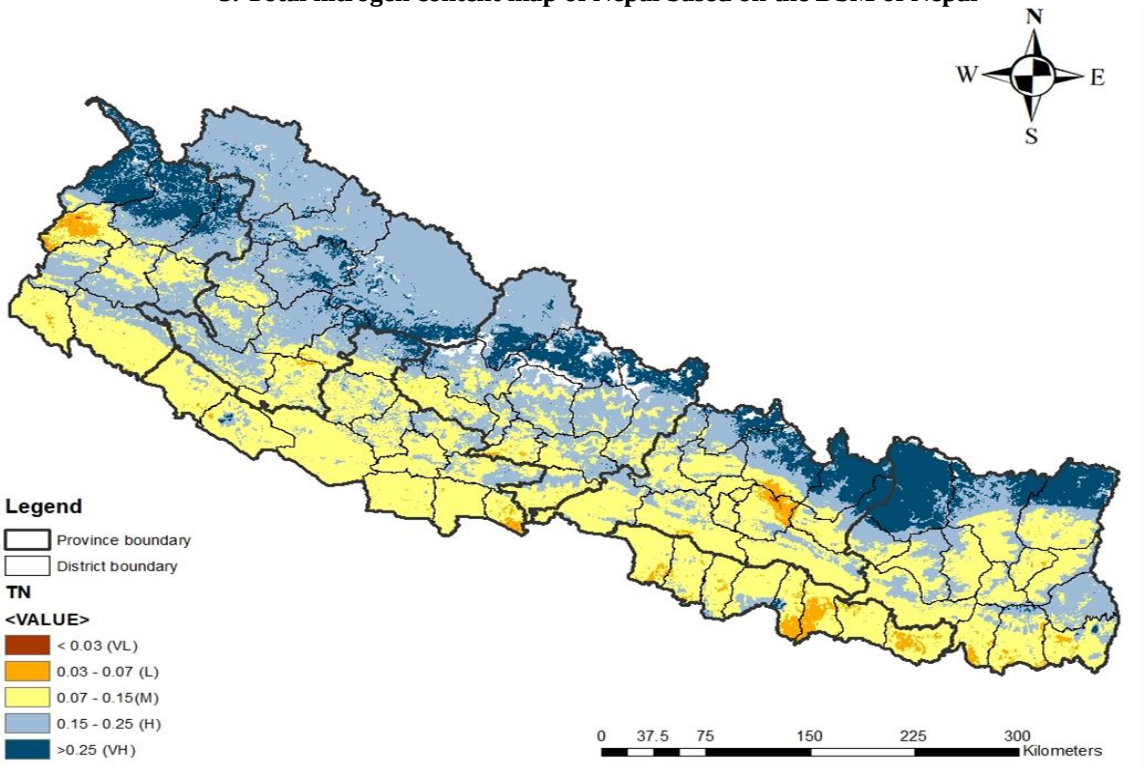
1. Soil pH map of Nepal based on the DSM of Nepal



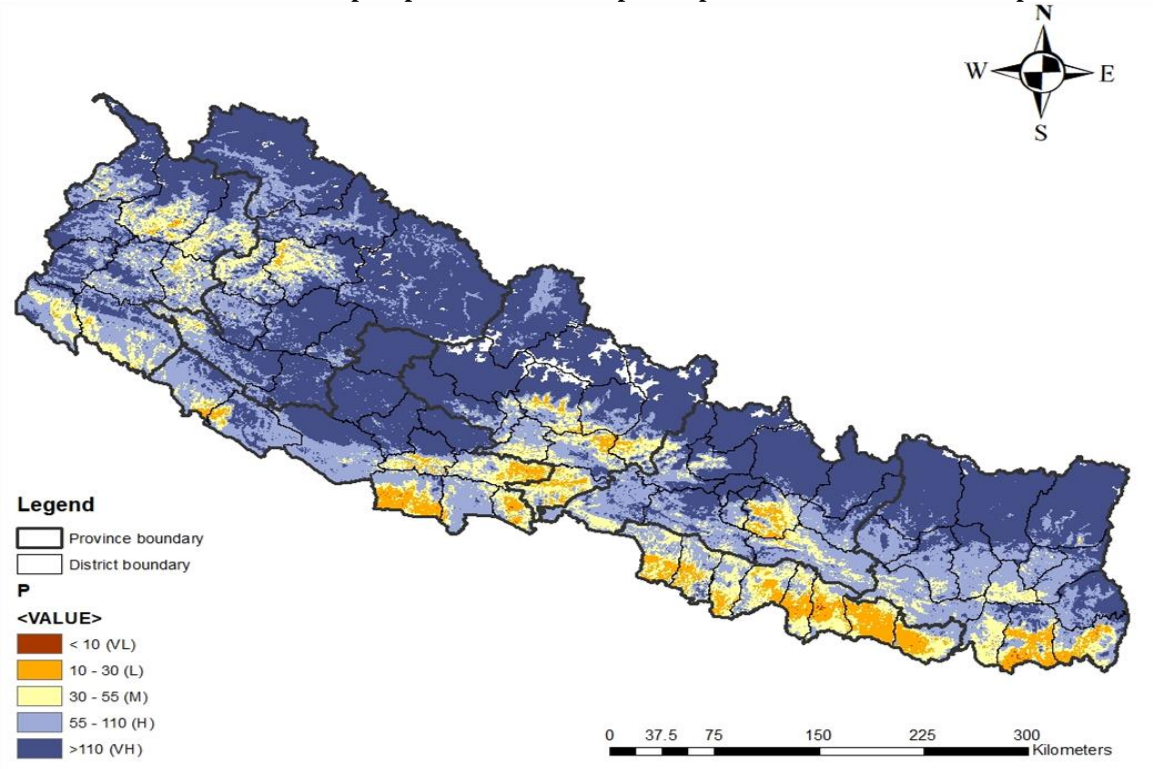
2.Soil organic matter content map of Nepal based on the DSM of Nepal



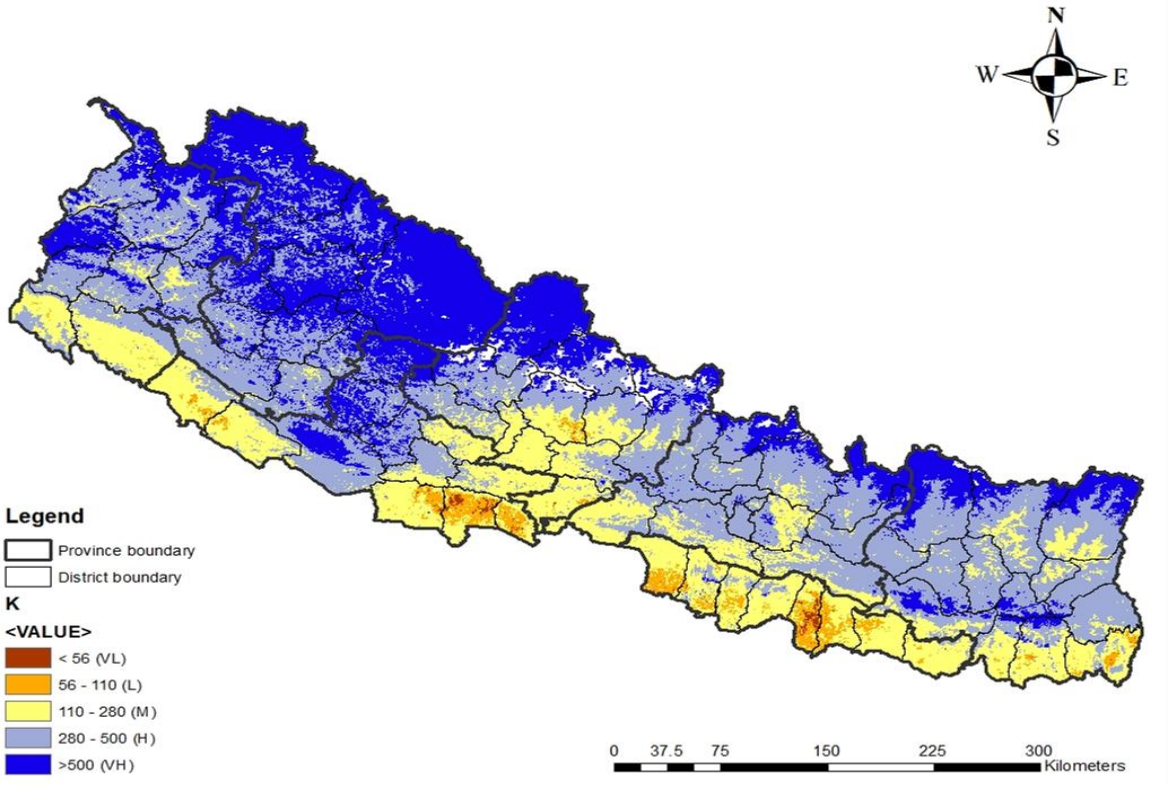
3. Total nitrogen content map of Nepal based on the DSM of Nepal



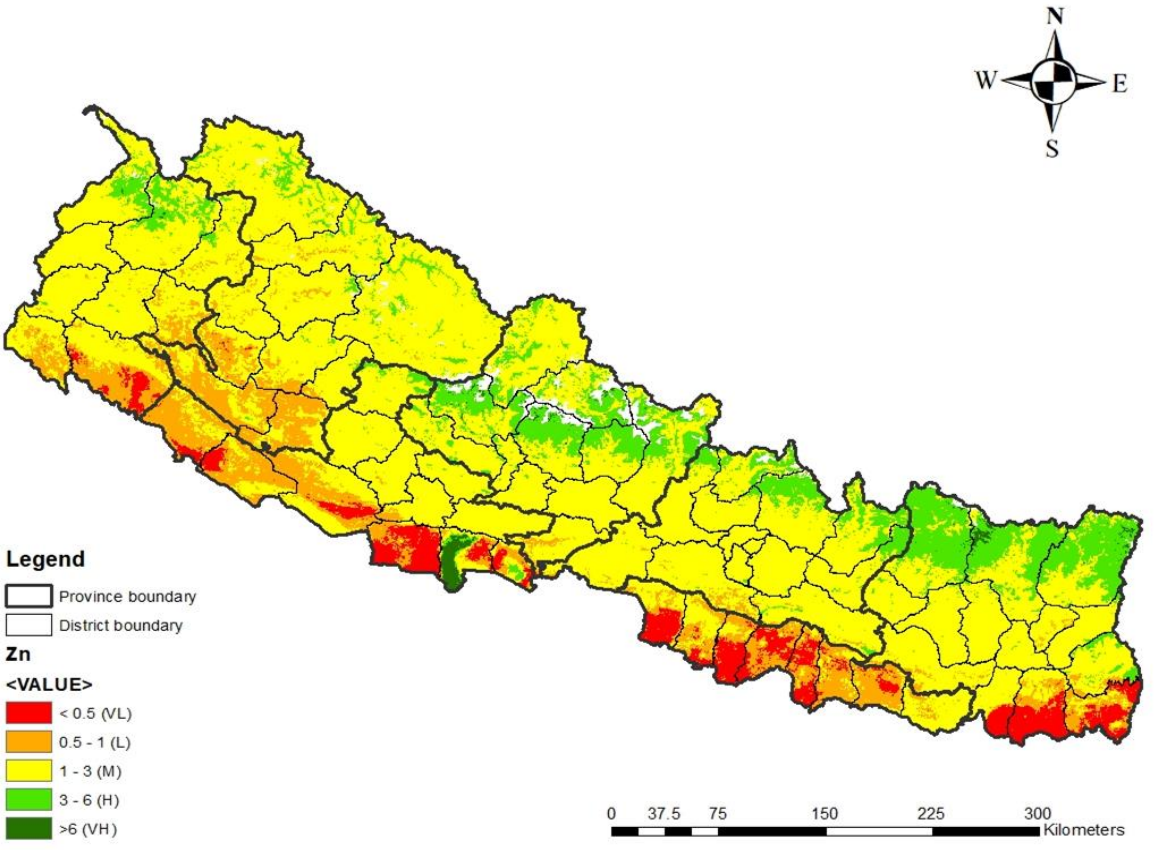
4. Available phosphorus content map of Nepal based on the DSM of Nepal



5. Available potassium content map of Nepal based on the DSM of Nepal



6. Zinc content map of Nepal based on the DSM of Nepal



7. Boron content map of Nepal based on the DSM of Nepal