Estimation of Fertilizer Use Efficiency in Current Maize Production System in Ethiopia

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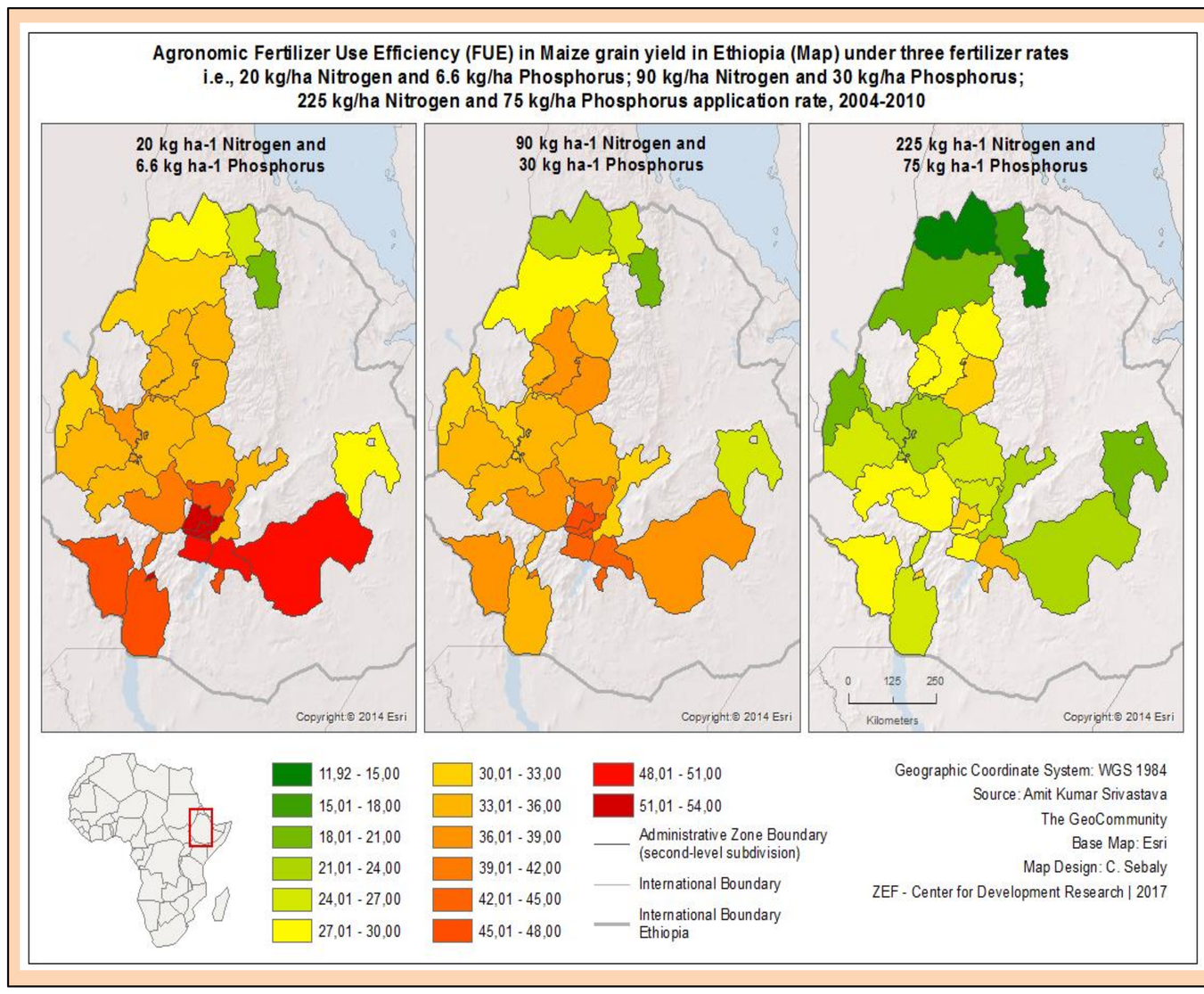
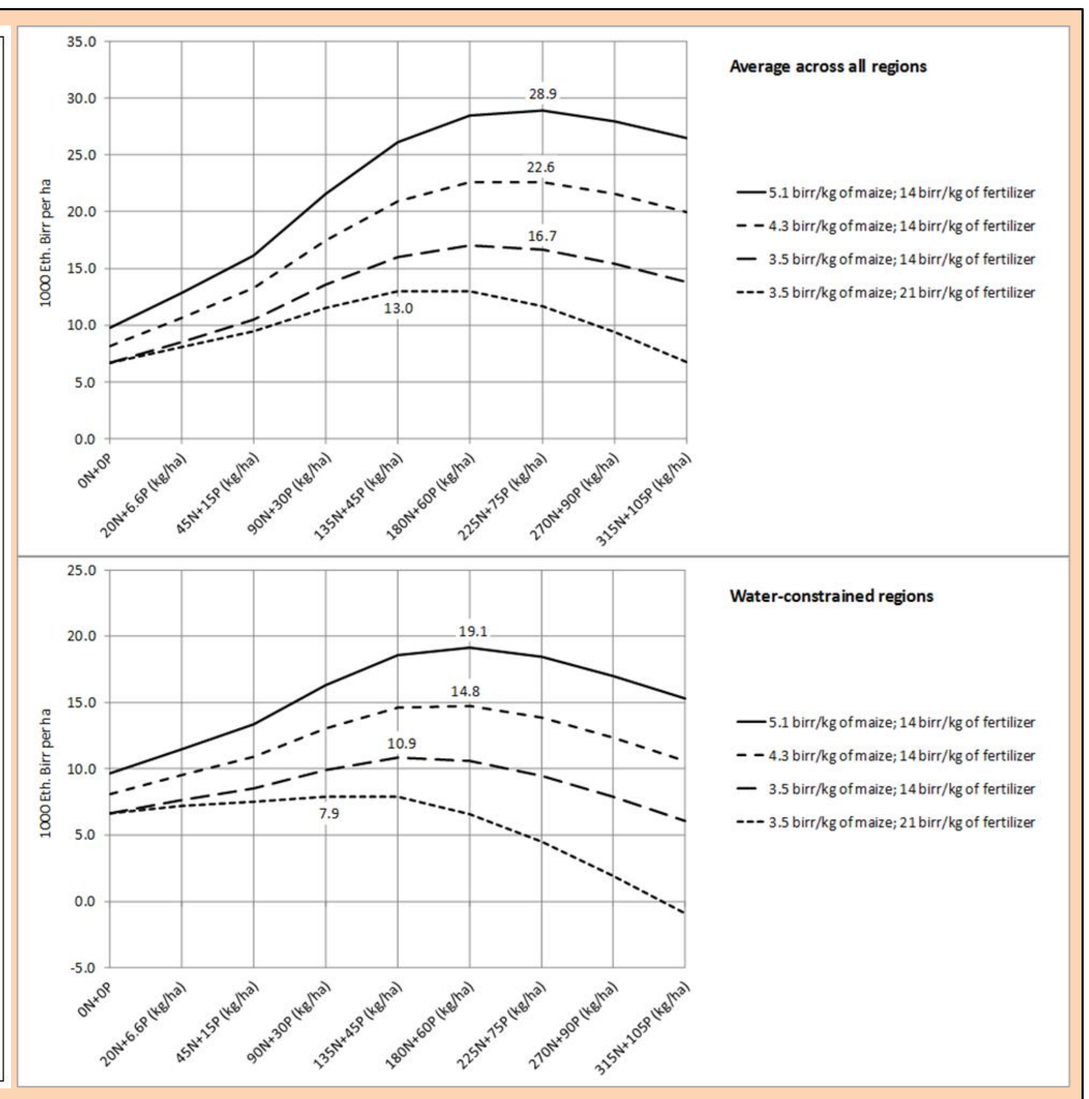
Introduction

The prevailing agriculture production system is vulnerable due to the lack of irrigation systems and large spatial and temporal variability in rainfall. The situation gets aggravated by a predominance of low-input, rain-fed production systems, and depleted soils. Furthermore, interactions between these limiting resources strongly influence the efficiency with which the resources are used, crop productivity, and the sustainability of production systems. Therefore, understanding the resource use and resource use efficiency of current production systems could help to identify possibilities of producing more with the available resources. In this study, Agronomic fertilizer use efficiency was estimated for maize (*Zea mays* L) grain yield in Ethiopia based on simulation runs with the SIMPLACE modeling framework. Economically optimal fertilizer levels were also estimated across the administrative zones.

Materials and Methods

A gridded data set was built; covering the major maize producing region of Ethiopia. Within the SIMPLACE modelling framework, a combination of the LINTUL5 crop model with a detailed soil water balance model (SLIM) was used to simulate the yield of dominant a long-cycle maize variety (’BH-660’) and a medium maturing cycle variety (‘BH-540’), with prevailing agri-management practices comprising low fertilizer application rate (20 kg ha^{-1}) and no irrigation. Two scenarios of increased fertilizer application rates i.e., 90 and 225 kg ha^{-1} were also explored.The simulations were run at 25 x 25 km grid cells and Agronomic fertilizer use efficiency was calculated for each simulation grid for the period of 7 years (2004-10) and aggregated from the simulation grid to the district level for comparing them with the statistics.





Results and Discussion

The highest FUE of 54 kg kg-1 in maize grain yield was estimated with the application of 20N+6.6P kg ha-1 gradually decreasing with increased fertilizer application rate to lowest value of 11.9 kg kg-1 under the application rate of 225N+75P kg ha-1.The lowest FUE value was attributed to the lowest cumulative precipitation amount in the crop growth period. Optimal fertilizer application levels of 225N+75P kg ha-1 for maize production system under current average price rations at the national scale. In regions where water availability tends to constrain grain yields in addition to the nutrient deficit, economically optimal application rates are slightly lower at 180N+60P kg ha-1.

Conclusion

Extension services, when recommending application rates, would have to acknowledge that economically optimal rates are lower in water constrained regions compared to the average values across the administrative zones. The calculations of optimal application rates at administrative zone level should not be applied to individual farms, because at this level, the soil endowment of a farm is a decisive factor.

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