Application of Geographic Information Systems in Socioeconomic Analysis: A Case of Integrated Soil Fertility Management in the Savannas of Nigeria

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Introduction

Population pressure increases, shortened fallow cycles, cropping intensification, inaccessibility and low output prices as well as concerns about agricultural sustainability and self-sufficiency have combined to contribute to increased demand for integrated soil fertility management of the agricultural resource base. Following this situation, organic fertilizer in the form of animal manure becomes one of the principal sources of nutrients for soil fertility maintenance and crop production. Hence, this study assessed the socioeconomic and ecological interactions in organic fertilizer use in northern Nigeria with the application of geographic information system.

Materials and Methods

This study made use of global positioning systems (GPS) and geographic information system (GIS) in sample design to gather and analyze data on socioeconomics characteristics that influence ISFM in the savannas of Nigeria. The application of GIS helped us to make good comparison of the use of ISFM within and across four identified resource use domains comprising human population density and market access, and their interactions with ecologies.

Results and Discussion

Integrated soil fertility management (ISFM)

Animal manure is important in the agricultural production system in integrated soil fertility management. The study confirmed the use of animal manure as a well established practice in the agricultural production system. Ninety percent of the farmers used manure though at levels of intensity. This result is similar to the 86 percent use in the semi-arid zone and 91 percent use in the semi-humid zone of Nairobi, Kenya (Omiti et al., 1999). The mean manure use in the study area was 1853.6 kg ha^{-1}. This represents 382 percent increase over the 485 kg ha^{-1} as reported by Manyong et al. (2003), but close to the 2000 kg ha^{-1} reported by Chianu et al. (2004). The results thus show higher level of intensification in manure use in the study area. Also, there was higher level of manure use or intensification of 1874.4 kg ha^{-1} in the Sudan savanna zone compared to the of 1832.78 kg ha^{-1} in the northern Guinea savanna. However, the averages are still insufficient to meet the animal manure of 3–5 t ha^{-1} required to maintain cereal grain yields (Bationo and Mokwunye, 1991; Chianu et al., 2004). Increased use of manure is required to meet the challenges of increasing population, low

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productivity, high land-use intensity and expansion of agriculture to marginal lands.

Similarly, the extent of manure use varied widely across socio-economic domains (Figure 1). The low population density and low market access (LPLM) socio-economic domains had higher intensification (2100 kg ha^{-1}) in manure used in the SS compared to the 1803 kg ha^{-1} of the NGS. Given the socio–economic domains of low population, the difference observed in the intensification levels (reduction) of manure used per hectare (1685 kg ha^{-1}) when we considered the LPHM in the SS could be explained by the difference in access to the market. While there were differences in the manure used per hectare across the socio-economic domains, the low market access areas intensified more in manure use as hypothesized than the high market access area; perhaps because of the greater graze land and availability of fodder in the low market access areas.

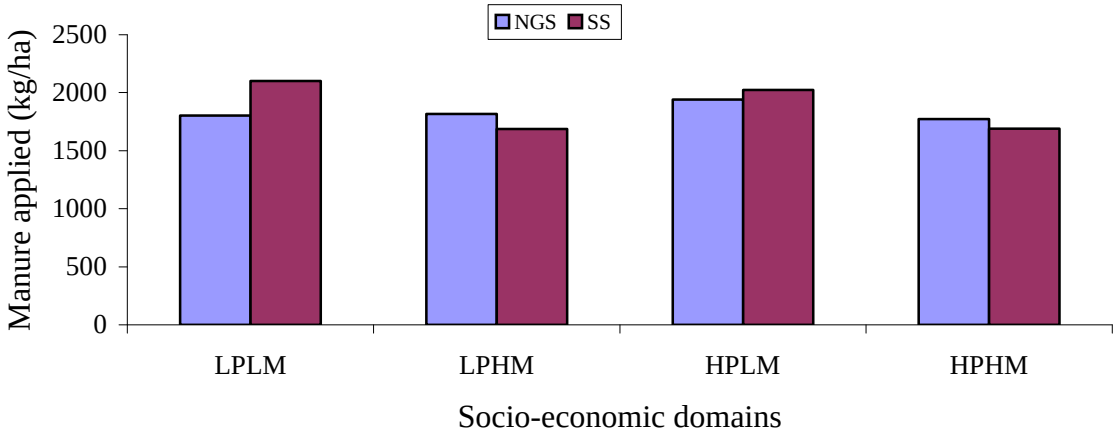

Figure 1. Manure applied by socio-economic resource domains.

Conclusion

Our results show that there is a close link between human population density and market access in ISFM. More significantly, the market access was important in explaining the difference in land intensification through the use of manure in the high population density area in the savannas of Nigeria. We found evidence for hypothesis that agricultural intensification is driven by human population growth and higher returns to farming which arise when market infrastructure improves and farm gate prices increase. Our study could serve as benchmark for future study to access the impact of agricultural growth, social welfare, and development of organic agriculture since the coordinates and roadmaps of the study area are available.

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