

## Abstract

The *purpose* of this thesis is to investigate economic and natural science aspects of soil management and agricultural production in a developing country context. It does so by theoretical as well as empirical investigation, based on data from field surveys in Kenya's central highlands over several years. The *rationale* for the thesis is the need to increase our understanding of the economics of soil capital, land use and agricultural production in order to design policies promoting sustainable development. The thesis includes papers on: optimal soil use with downstream externalities (Ch. 2); determinants of soil capital and agricultural production (Ch. 3; 4); links between farmers' resource levels, soil properties and agricultural productivity (Ch. 5); and land use-change and determinants of rural-urban migration in Kenya (Ch. 6).

Chapter 2 shows that farmers may need incentives (taxes, subsidies or charges) to induce them to reduce soil erosion and thereby downstream damages. Furthermore we find other factors (low discount rate, tenure security, access to credits, crop insurance) that promote accumulation of soil capital and reduce soil loss and nutrient leakage.

Regression analyses in Chapter 3 show that farmers' soil capital is not a given or fixed factor but depends on soil conservation investments, and the allocation of labour, crops, manure and fertilizer in agricultural production. The wide distribution of soil properties across farms indicates the need to tailor technical extension advice to farmers' preferences and the farm-specific economic and agro-ecological circumstances, and enhance the use of integrated soil analysis, field assessment and detailed soil mapping at farm level.

Regressions in Chapter 4 show that agricultural output is determined not only by farmers' input of land, labour, manure and fertilizer, but also by the quality of soil conservation investments and farm-specific soil properties. Hence, integrating economics and soil science is highly worthwhile in this research area. Omitting soil capital measures can cause omitted variables bias since farmers' choice of inputs depend both on the quality and status of the soil capital and on other economic conditions (e.g. availability and cost of labour, fertilizers and other inputs).

Chapter 5 shows that: relatively richer farmers have higher crop yields; poorer farmers have lower soil nutrient levels; farms with gentle slope and high resource level have the highest land management rating. These results indicate that actions aimed at promoting higher yields and sustainable agriculture will have to differ depending on farmers' endowment, and that agricultural policy advice needs to be adapted to farmers' resource levels.

Chapter 6 shows that farmers have changed their farming system considerably during the last 40 years: introduced new (cash) crops, increased tree cover, reduced terracing, diversified crops and income sources, and increased market orientation and temporary work in cities. The study emphasizes the need to improve extension advice, rural roads, supply of inputs, local ownership of public soil conservation investment programs, access to credits and output markets, and job opportunities for farmers during agricultural off-season e.g. work in local food processing industries.

**Key Words:** Optimal control theory, Microanalysis of farm firms, Resource management, Soil capital, Soil productivity, Agricultural production

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