

# **Essays on the Economics of Sustainable Agricultural Technologies in Ethiopia**

av

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**AKADEMISK AVHANDLING**

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## Abstracts

This thesis consists of five self-contained papers:

### **Paper 1: Adoption of multiple sustainable agricultural practices in rural Ethiopia**

The adoption and diffusion of sustainable agricultural practices (SAPs) have become an important issue in the development-policy agenda for Sub-Saharan Africa, especially as a way to tackle land degradation, low agricultural productivity, and poverty. However, the adoption rates of SAPs remain below expected levels. This paper analyzes the factors that facilitate or impede the probability and level of adoption of interrelated SAPs, using recent data from multiple plot-level observations in rural Ethiopia. Multivariate and ordered probit models are applied to the modeling of adoption decisions by farm households facing multiple SAPs which can be adopted in various combinations. The results show that there is a significant correlation between SAPs, suggesting that adoptions of SAPs are interrelated. The analysis further shows that both the probability and the extent of adoption of SAPs are influenced by many factors: a household's trust in government support, credit constraints, spouse education, rainfall and plot-level disturbances, household wealth, social capital and networks, labor availability, plot and market access. These results imply that policy makers and development practitioners should seek to strengthen local institutions and service providers, maintain or increase household asset bases, and establish and strengthen social protection schemes, to improve the adoption of SAPs.

### **Paper 2: Cropping systems diversification, conservation tillage and modern seed adoption in Ethiopia: Impacts on household income, agrochemical use and demand for labor**

The type and combination of sustainable agricultural practices (SAPs) adopted has a significant effect on agricultural productivity and food security. Previous studies on adoption and impact have focused on single practices. However, in reality several adoption decisions are made simultaneously. We developed a multinomial endogenous switching regression model of farmers' choice of combination of SAPs and impacts on maize income and use of agrochemicals and family labor use in rural Ethiopia and found four primary results. First, adoption of SAPs increases maize income and the highest payoff is achieved when SAPs are adopted in combination rather than in isolation. Second, nitrogen fertilizer use is lower in the package that contains systems diversification and conservation tillage. Third, conservation tillage increased pesticide application and labor demand, perhaps to compensate for reduced tillage. However, when it is used jointly with systems diversification practices such as legume rotations it does not have a significant impact on pesticide and labor use. Fourth, since women contribute much of the farm labor needed for staple crops, adoption of packages increases their workload, in most cases, suggesting that agricultural intensification technology interventions may not be gender neutral. This implies that policy makers and other stakeholders promoting a combination of technologies can enhance household food security through increasing income and reducing production costs, but need to be aware of the potential gender related outcomes.

### **Paper 3: The impact of shadow prices and farmers' impatience on the allocation of a multipurpose renewable resource in Ethiopia**

In a mixed farming system in which farmyard manure (FYM) is considered an important multipurpose renewable resource that can be used to enhance soil organic matter, provide additional income, and supply household energy, soil fertility depletion could take place within the perspective of the allocation pattern of FYM. This paper estimates a system of FYM allocation regressions to examine the role of returns to FYM and farmers' impatience on the propensity to allocate FYM to different uses. We parameterize the model using data from a sample of 493 households in Ethiopia. Results indicate a heightened incentive for diverting FYM from farming to marketing for burning outside the household when returns to selling FYM and the farmer's discount rate are high. These reveal the need for policies that will help to reduce farmers' impatience and encourage the substitution of alternative energy sources to use FYM as a sustainable land management practice.

### **Paper 4: Jointness in agricultural production and livestock technology adoption in Ethiopia**

Even though farmyard manure is considered a promising soil fertilizer in many developing countries, its use in soil fertility restoration is constrained by a multitude of factors. Yet the adoption of a crop-livestock technology could relax these constraints. This paper examines the impact of a joint crop-livestock technology on farmyard manure production and the effect of farmers' risk preference on livestock technology adoption. An endogenous switching regression model is employed to account for self-selection in technology adoption. The model is implemented using survey data from 491 households collected in the central highlands of Ethiopia. The results show that farmers' risk preference, distance to the extension service center, and market access to complementary inputs significantly influence the adoption of improved livestock technology. Adoption of crossbreeding technology creates a positive and significant impact on organic fertilizer production. The positive indirect effect of crop technology is significantly higher for those who adopt livestock technology. This implies that a policy supporting crop-livestock synergies through joint provision of technologies is important in order to increase agricultural productivity through better soil fertility management.

### **Paper 5: Risk preferences as determinants of soil conservation decisions in Ethiopia**

Soil degradation is one of the most serious environmental problems in the highlands of Ethiopia. The prevalence of traditional agricultural land use and the absence of appropriate resource management often result in the degradation of natural soil fertility. This has important implications for soil productivity, household food security, and poverty. Given the extreme vulnerability of farmers in this area, we hypothesized that farmers' risk preferences might affect the sustainability of resource use. This study presents experimental results on the willingness of farmers to take risks and relates the subjective risk preferences to actual soil conservation decisions. The study looks at a random sample of 143 households with 597 farming plots. We find that a high degree of risk aversion significantly decreases the probability of adopting soil conservation. This implies that reducing farmers' risk exposure could promote soil conservation practices and thus more sustainable natural resource management. This might be achieved by improving tenure security, promoting access to extension services and education, and developing income-generating off-farm activities.

**JEL Classification:** D81, Q01, Q12, Q16, Q18, Q24, Q57

**Key words and phrases:** Ethiopia; Adoption; risk preference; soil conservation; mixed farming; technology; Impatience; Shadow price; Allocation; Farmyard manure; Sustainable Agricultural Practices; switching; Multivariate probit; Ordered probit; multinomial switching regression; income; agrochemicals use; demand for labour.

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