

Extended Abstract

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Paper/Poster Title	Impact of the adoption of sustainable land management technologies on yield, profit and labor productivity of smallholder farmers in North Eastern of Benin republic
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Abstract prepared for presentation at the 97th Annual Conference of the Agricultural Economics Society, The University of Warwick, United Kingdom

27th – 29th March 2023

Abstract	200 words max
<p>Africa's soils in general are highly degraded and this resulted into low agricultural productivity over the last two decades. Yet, to combat the threat of various forms of land degradation in Benin, sustainable land management (SLM) is considered as one of the useful approaches. This study investigates the impact of SLM technologies (SLMT) on yield, profit and labor productivity of maize farmers in Benin. The study uses cross sectional data of maize farmers and the Local Average Treatment Effect (LATE) model supported by a multinomial endogenous switching regression (MESR) model framework to correct for selection bias and endogeneity originating from both observed and unobserved heterogeneity. Findings showed that adopters and non-adopters of the SLMT are distinguishable in terms of outcomes and household characteristics. While all SLMT have positive effects on welfare and productivity measures, we found that the greatest impact was observed with cattle manure adopters. In addition, results showed also that the adoption of cattle manure contributed to an increase in yield, labor productivity and profit of maize farmers by about 21%, 41% and 15%, respectively. Policy actions such as provision of improved support services and input supply will improve adoption of SLMT.</p>	
Keywords	Maize producers, welfare impacts, SLMT, MESR, LATE, Benin
JEL Code	Q12, Q18, C93, D10, 055 see: www.aeaweb.org/jel/guide/jel.php?class=Q)
Introduction	100 – 250 words
<p>Land degradation is an environmental problem that reduces the productivity of all natural ecosystems and crops production and has been a great challenge in Sub-Saharan Africa. Soil erosion concerns both developed and developing countries and results in an overall average loss of 0.3% of annual crop yield worldwide (FAO, 2015). The causes of land degradation are complex and vary from place to place. In Benin, land degradation due to water erosion is a</p>	

major threat to large agricultural zones. For several decades, SLM has been the subject of research through research and development programs and projects in Benin. The present study assesses the impact of SLMT adoption on yield, profit, and labor productivity in Northeast Benin. Although literature exists on the impact of SLMT (Hörner and Wollni, 2020; Asfaw et al., 2016; Etsay et al., 2019b; Kassie et al., 2015). This is among the first studies using two-stage evaluation method with the Bourguignon et al. (2007) model to correct for selection bias before estimating the Multinomial Endogenous Switching Regression (MESR), which no study has yet used in the field of soil fertility management in Benin, to measure the impact of SLMT. The Local Average Treatment Effect (LATE) is also estimated to jointly account for the heterogeneity of the impact and we also address the inequalities observed in gender on the adoption of SLMT.

Methodology

100 – 250 words

The study was carried out in the ProSOL project intervention area in Benin. Data were collected during the 2021 cropping season from a total of 431 maize producers in six villages of Bembéréké, seven villages of Gogounou and 6 villages of Kandi country. Data were collected by enumerators trained using the web-based application Kobo toolbox and the android terminals using the ODK Collect installed on tablets. STATA 14 software was used for data analysis. In this study, we use a MESR model to estimate the average treatment effects of SLMT adoption on the outcome variables. Since farmers themselves decide to use or not to use a given agricultural technology, observable and unobservable factors associated with the outcome variables may influence their choices. MESR enables to control this self-selection bias as failure to capture the selection bias leads to biased estimates. This approach is used in many studies (Bourguignon, et al, 2007; Hörner and Wollni, 2022) and is based on a multinomial logit model. In this empirical study, farmer’s adoption of SLMT leads to five possible combinations that a farmer could choose namely: (i) no adoption, (ii) only *cajanus cajan*, (iii) only cattle manure, (iv) only crop residues, and (v) only *mucuna pruriens*. The MESR framework is used to model farmers’ choice of the above SLMT and the outcome variables. “belong to a farmer’s organization” is considered as the selected instrument in this study and is confirmed by conducting a simple falsification test.

Results

100 – 250 words

We found evidence that adopters and non-adopters of SLMT are different in terms of outcomes and household characteristics. Mean difference tests showed that the null hypothesis that no difference between adopters and non-adopters of SLMT is rejected for the majority of



characteristics. These results underscore the presence of selection into adoption and heterogeneity between adopters and non-adopters must be taken into account in the impact assessment of SLMT. Results showed that adopters of SLMT are older and mainly men, and tend to have all contact with SLM project' extension agents. Adopters of *mucuna pruriens* tend to use more mineral fertilizer (43%) and their agricultural income is greater than others SLMT adopters. Adoption of SLMT had significant impacts on all outcomes (yield, productivity and profit), suggesting that SLMT can be used to increase farmer income and food production in Benin. More importantly, the findings affirm that all SLMT had positive impact on yield, productivity and profit of farmers and are complementary to one another. The greatest impact was observed with cattle manure adopters. Adoption of cattle manure improved maize farmers' yield, labor productivity and profit by about 21%, 41% and 15%, respectively. Furthermore, adoption of *cajanus cajan* increased maize farmers' yield, labor productivity, and profit by about 19%, 38%, and 7%, respectively; while adoption of crop residues increased yield, labor productivity, and profit by about 13%, 23%, and 11%, respectively.

Discussion and Conclusion

100 – 250 words

To increase the resilience of farmers to land degradation (soil erosion), SLMT have been developed and applied in Benin. This study assessed the ex post impact of SLMT adoption on yield, profit and labor productivity of maize farmers. The results revealed that adoption of SLMT had significant impacts on all three outcomes, suggesting that SLMT can be used to increase the resilience of smallholder farmers to land degradation in Benin. The positive effect of adoption of SLM on yield and productivity is in line with the study of Motavali and Bardhan (2013), Aminu and Bamidele (2015), Adeyemo et al. (2017) and Aminu et al. (2018) who all reported that adoption of land management practices improves productivity of smallholder farmers. Results of the current study are consistent with the findings of Kassie et al. (2008) who reported a significant crop yield increment as a result of introducing soil and water conservation practices on farm plots. The gender analysis showed that from one SLMT to another, men are more productive compared to women. This could be explained by the fact that female producers' decision to apply a technology is made jointly with their husbands (Gebre et al., 2019). Also, Holden et al. (2001) showed that female producers have much lower land productivity than male producers. Our results suggest that efforts aimed at raising household yield, productivity and farmers welfare should focus on promoting the adoption of SLMT through provision of improved support services such as extension and input supply.

