

Extended Abstract

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Paper/Poster Title	Climate-Smart Agricultural Technologies and Farm Household Welfare Nexus in Sub-Saharan Africa.
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Abstract prepared for presentation at the 97th Annual Conference of the Agricultural Economics Society, The University of Warwick, United Kingdom

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Abstract	200 words max
<p>Global climate change has threatened sustainable agricultural growth over the years. The Sahelian region of Sub-Saharan Africa is one of the most vulnerable regions to the adverse effect of climate change in the world. The Climate-Smart Agricultural Technologies (CSAT) offers pathways for mitigating the negative effect of climate change on crop farmers. This study uses cross-country (Mali and Niger) cross-sectional data to examine the welfare impact of multiple adoptions of CSAT on 3,371 smallholder farmers' households. We employed the multivalued multinomial endogenous treatment effect (METE) model for the analysis. The results revealed that sociodemographic (education, age, location, assets), plot (farm size, soil topography and quality), institutional (farmer-based organization and extension agent contact) and climatic factors (crop disease shock) significantly influence different combinations of CSAT adoption. The impact estimates show that multiple adoption of CSAT has a significant and positive effect on crop sales revenue and crop income among smallholder farmers. These findings, therefore, suggest that both government and non-governmental organizations should promote and disseminate CSAT to enhance farmers' welfare in the study area. Moreover, factors such as education, credit access, farmer-based organizations and extension service system could be strengthened for easy and rapid adoption of CSAT by smallholder farmers.</p>	
Keywords	Adoption; Climate-smart agricultural technologies; Smallholder farmers; Sahelian region, Sub-Saharan Africa.
JEL Code	C31; O12; O33; Q12; Q16; Q18 see: www.aeaweb.org/jel/guide/jel.php?class=Q
Introduction	100 – 250 words
<p>Climate change is perceived as a threat to agricultural and socioeconomic development. The magnitude and severity of the Sahelian drought and flooding have generated a significant threat to agricultural development, food security and livelihood of smallholder farmers in the Sub-Saharan Sahel region (including Mali and Niger). Climate-smart agricultural technologies (CSAT) are considered a panacea for sustainable development goals (SDGs) one and two relating to poverty and zero hunger). However, the implementation of these adaptation strategies by smallholder farmers in Mali and Niger is still low. The role of CSAT in promoting food security underpins our motivation for this study. Moreover, the literature has focused more on the impact of CSAT adoption in a single/binary framework (adoption of any CSA or not) and mostly single crop-specific, but the synergy between different adoption of CSAT categories has received less attention. This study extends the literature by focusing on multiple adoptions</p>	

of CSAT among smallholder farmers cultivating major staple crops (millet, sorghum, cowpea, groundnut, and maize) in the Sahel. To the best of our knowledge, this is the first study to evaluate the multiple impacts of CSAT on the welfare of multiple crop farmers in the Sahel. In addition, we focused on two welfare outcome variables: “crop sales revenue” and “crop income”. The inclusion of crop income in our outcome variable makes our study unique because CSAT adoption is known to be financially dependent which increases farmers’ production costs; however, previous studies have drifted away from focusing on this important outcome variable.

Methodology

100 – 250 words

We utilized cross-sectional data collected in 2019 by the International Institute of Tropical Agriculture (IITA), social science and agribusiness department, Bamako, Mali. A sample size of 3371 smallholder farm households (2004 in Mali and 1367 in Niger) was used for the analysis. We modelled the impact of farmers’ decision to adopt multiple CSAT (agrochemicals (AGC), improved seed varieties (ISVs) and sustainable land management technologies (SLM)) on welfare outcome variables using a multinomial endogenous treatment effect (METE) framework. This econometric technique was used for our empirical analysis to account for potential endogeneity that might occur due to self-selection of technology adoption.

The METE equation is specified below.

$$W_i = \chi_i' \beta + \eta_1 C_1 + \eta_2 C_2 + \eta_3 C_3 + \eta_4 C_4 + \eta_5 C_5 + \lambda_1 v_{1i} + \lambda_2 v_{2i} + \lambda_3 v_{3i} + \lambda_4 v_{4i} + \lambda_5 v_{5i} + \xi_i \tag{1}$$

where W_i denotes welfare outcome variables (farm income and profit), χ_i is a vector of exogenous variables with associated parameter β . C takes a value of 0 for non-adopters of CSAT, 1= adopters of AGC only, 2= adopters of SLM only, 3= adopters of AGC and SLM only, 4= adopters of ISVs only or with a combination of either SLM or AGC, and 5= adopters of all the AGC, SLM and ISVs. η_j refers to the treatment (adopting either of CSAT packages) effects relative to the control (non-adopters). v_{ij} control for potential unobserved factors that influence the selection of farmers who adopt CSAT and welfare outcome.

Results

100 – 250 words

The results revealed that sociodemographic (education, age, farm experience, household and farm assets), plot (farm size, soil topography and quality), institutional (farmer-based organization (FBO), access to formal credit and contact with extension agent), and climatic factor (crop disease shock) significantly influence the different combinations of CSAT adoption. Specifically, age and farming experience negatively influenced combinations of CSAT adoption. Education, farm size, credit access, extension agent contact, crop disease shock, soil fertility and flat land slope were found to be positive and significantly influence different adoption of CSAT combinations.



The impact estimates show that the different categories of CSAT have a positive and significant impact on crop sales revenue (ranging from 123788.4 to 194424.8 FCFA) and crop income (ranging from 53609.8 to 113641.5 FCFA).

Discussion and Conclusion

100 – 250 words

The findings on the negative significance of farmers age and farm experience on combinations of CSAT implies that older farmers and those with more farm experience are less likely to adopt CSAT in the study area. This is because older and more experienced farmers are accustomed to their traditional farming practices and might be rigid to new innovations. However, an increase in years of education increases the likelihood of multiple CSAT adoption. This implies that educated farmers are more exposed to the importance of CSAT than their counterparts.

Furthermore, results showed that farmers who belong to FBO; those who have access to formal credit and extension agent are more likely to adopt different CSAT categories. This implies that institutional factors play a major role in enhancing CSAT adoption due to its financial and information diffusion features.

The impact estimates indicated that farmers adopting the various combinations of CSAT would have experienced less crop sales revenue and crop income had they not adopted CSAT. Farmers adopting the three CSAT combinations had the largest sales revenue, and second largest crop income.

This study provides evidence that multiple CSAT adoption improves farmers welfare. The implication of our findings suggests that both government and non-governmental organizations should promote and encourage multiple CSAT among smallholder farm households in the Sahelian region to enhance their welfare. Moreover, some sociodemographic and institutional factors such as education, credit access, farmer-based organizations and extension service system should be strengthened for easy and rapid adoption of CSAT by smallholder farmers.