

Strong smallholder farmers' perception of Climate-Smart agriculture(CSA) technologies enhances adoption

The purpose

- Given the threats of climate change, climate-smart agriculture would be a viable path to pursue among smallholder farmers in Ethiopia.
- The adoption of specific CSA technologies has become a challenging issue in the agricultural development policy agenda for sub-Saharan Africa especially in Ethiopia.
- As new agriculture technology, CSA technologies' adoption decision is the outcome of the mixed effect and interaction of environmental, technical, personal, economic, and institutional factors .
- The adopter perception paradigm states that adoption perception about the perceived benefit of agricultural technology is the key to its adoption. The question is how do perceptions of farmers towards agricultural technologies affects their decision to adopt?
- Therefore, the objective of this study was to analyze how farmers' perception of CSA technologies determine their decision to adopt CSA technologies in the Blue Nile highland of Ethiopia .

Method and study area

- The study site, Choke Mountain Watershed, is the part of the Blue Nile Highlands(BNHs) of Ethiopia.
- The study is based on a cross-sectional survey of 424 sample households selected from five Agro-ecosystems in the upper Blue Nile highland of Ethiopia.
- The dependent variables are adoption of improved crop varieties, marketable crop, conservation agriculture, compost, row planting, Soil and water conservation (SWC) and agro-forestry.
- Variables examined in the analysis includes CSA practice increases productivity, soil fertility, income, soil organic matter, alternative fodder source, and alternative energy source; while CSA practice reduces cost of production, reduces use of inorganic fertilizer, soil erosion, seeding rate, weed infestation, and crop failure.
- Multivariate probit (MVP) model was used for the multivariate analysis of the determinants of adoption of CSA technologies.

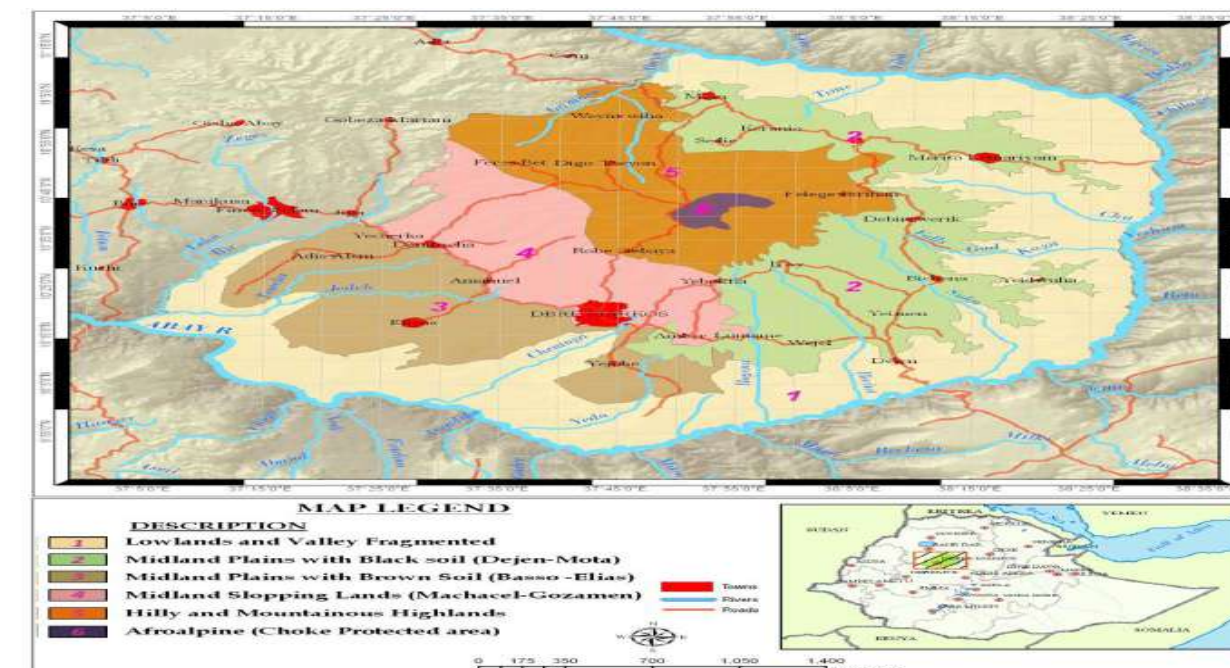


Figure 1. Map of the study area

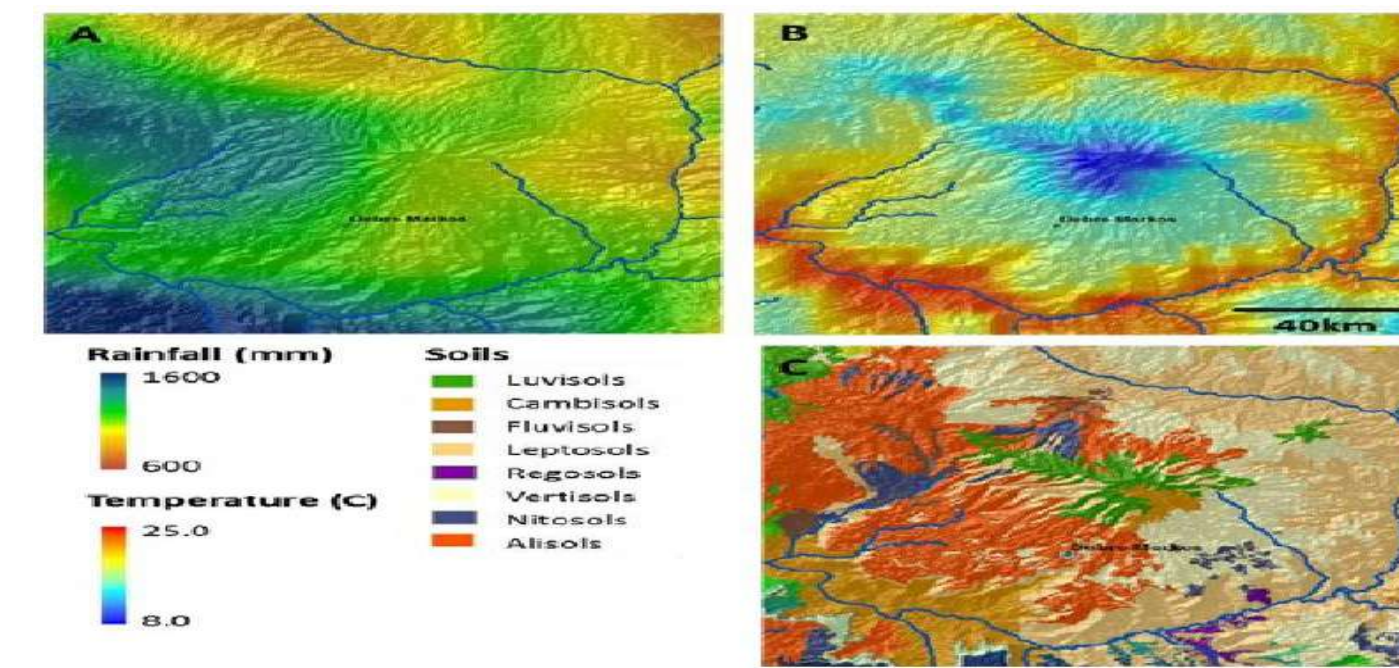


Figure 2. Bio-physical characteristics of the study area

Table 1. Perception of CSA technologies.

Variable	Percent	Description
Yield improvement		
Increase productivity	91	CSA practice increases crop productivity
Soil health		
Increase soil fertility	85	CSA practice increases soil fertility
Increase soil organic matter	64	CSA practice increases soil organic carbon
Profitability and cost reduction		
Increase income	80	CSA practice increases income
Reduces inorganic fertilizer	61	CSA practice reduces use of inorganic fertilizer
Reduces cost	59	CSA practice reduces the cost of production
Reduces seeding rate	55	CSA practice saves seed rating
Vulnerability		
Reduces erosion	50	CSA practice reduces soil erosion
Rehabilitates land	40	CSA practice rehabilitates land
Reduces crop failure	13	CSA practice reduces crop failure
Reduces weed infestation	10	CSA practice reduces weed infestation
Environmental degradation		
Increases animal fodder	43	CSA practice increases alternative animal fodder source
Increase fuel source	29	CSA practice increases alternative energy source

Results

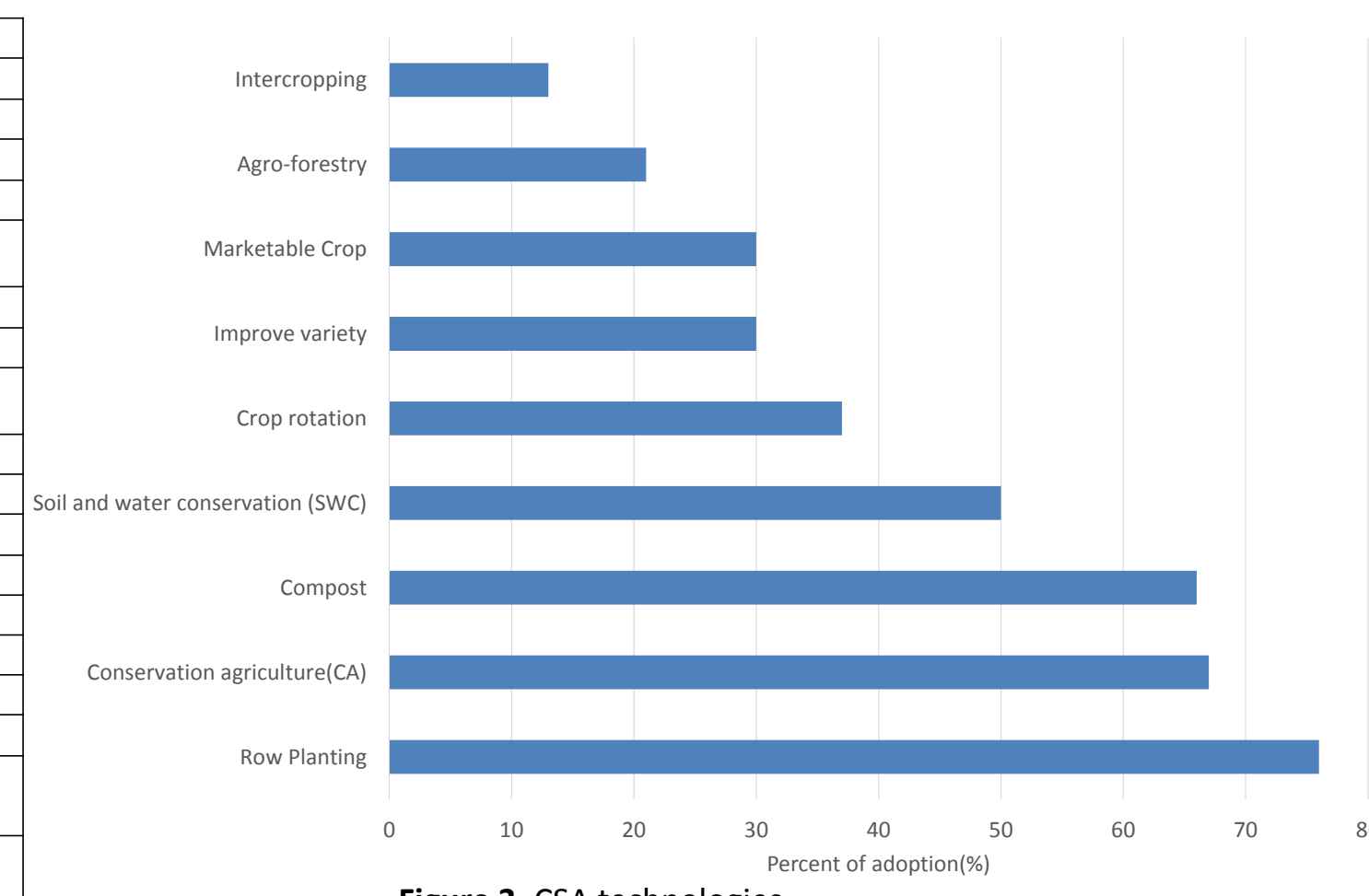


Figure 3. CSA technologies

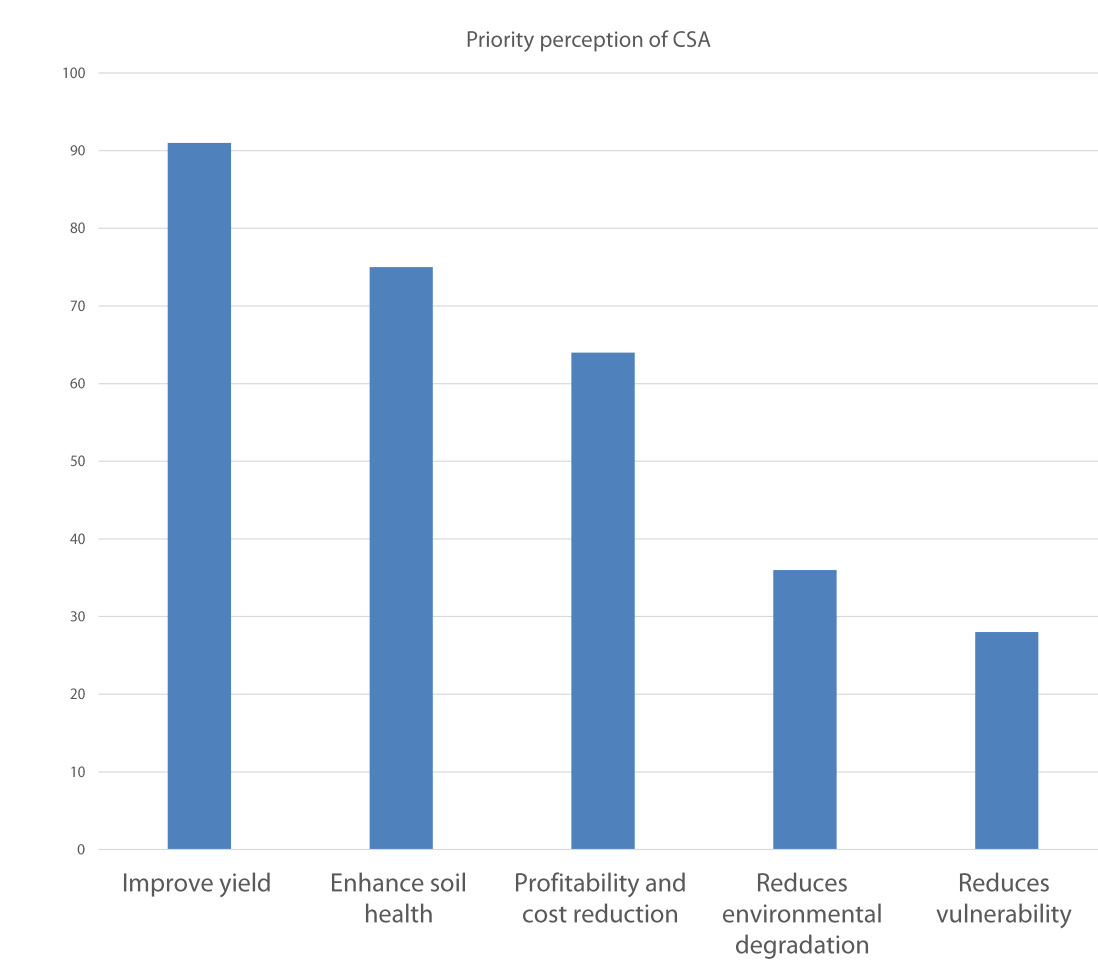


Figure 4. Priority perception of CSA

Table 2. Perception determinants of adoption of CSA technologies

Explanatory variables	Marketable Crop	Conservation Agriculture	Compost	Row planting	Intercropping	Soil and water conservation	Agro-forestry
Increase productivity	0.5*(0.3)		0.2(0.3)	0.3(0.4)	1.3****(0.5)	-1.4****(0.4)	0.8***(0.4)
Increase soil fertility	1.1****(0.34)	1.0****(0.3)		0.1(0.3)	0.6(0.5)	-0.2(0.3)	0.5(0.4)
Increase soil organic carbon	-0.2(0.2)	1.3****(0.2)	1.0****(0.2)	0.2(0.2)	-0.1(0.2)	0.08(0.2)	0.2(0.2)
Increase income	0.7****(0.3)	0.1(0.2)	0.3(0.2)	-0.1(0.3)	0.5(0.4)	0.1(0.2)	-0.2(0.3)
Increase animal fodder	-0.3*(0.2)	0.2(0.2)	-0.3(0.2)	-0.6****(0.2)	0.1(0.2)	-0.01(0.2)	-0.7****(0.2)
Increase fuel source	0.4***(0.2)	0.3(0.2)	0.2(0.2)	0.4(0.3)	0.3(0.2)	0.4***(0.2)	1.5****(0.2)
Reduces soil erosion	-0.1(0.2)	0.1(0.2)	0.1(0.2)	-0.4****(0.2)	0.8****(0.2)	1.8****(0.2)	0.6****(0.2)
Reduces weed infestation	0.5***(0.2)	0.3(0.2)	0.9****(0.3)	1.4****(0.5)	1.3****(0.3)	-0.8****(0.2)	0.98****(0.3)
Reduces cost of production	-0.1(0.2)	0.3(0.2)	0.2(0.2)	0.4(0.2)	-0.3(0.2)	-0.1(0.2)	-0.3(0.2)
Reduces crop failure	-0.01(0.2)	-0.2(0.2)	0.1(0.3)	0.5(0.3)	0.1(0.3)	0.6****(0.2)	0.3(0.2)
Reduces inorganic fertilizer	0.02(0.2)	0.1(0.2)	1.3****(0.2)	0.3(0.2)	0.3(0.2)	-0.5****(0.2)	0.1(0.2)
Reduces seeding rate	-0.2(0.2)	-0.9****(0.2)	0.3*(0.2)	2.0****(0.2)	0.8****(0.3)	0.2(0.2)	0.8****(0.2)
Rehabilitates land	0.7****(0.2)	-0.2(0.2)	-0.1(0.2)	-0.01(0.2)	-0.02(0.2)	0.2(0.2)	-0.06(0.2)
Constant	-2.7****(0.5)	-1.8****(0.3)	-1.5****(0.4)	-0.4(0.4)	-4.7****(0.8)	0.5(0.4)	-3.1****(0.5)
Sample size	424	424	424	424	424	424	424

Standard errors in parentheses ***, **, * are significant at 1%, 5%, and 10%, respectively

- The descriptive result shows that most (more than 50%) of the farmers have adopted row planting, conservation agriculture(CA), compost, and Soil and Water Conservation (SWC)
- Perceptions of CSA technologies are improve yield (91 percent), enhance soil health (75 percent), improves profitability and cost reduction (64 percent), reduces environmental degradation (36 percent), and reduces vulnerability (28 percent) are the major perception themes in the descending order of magnitude
- There is a significant difference in the proportion of farmers' perception of CSA technologies between adopters and non-adopters of CSA technologies.
- Farmers adopt different CSA technologies based on their CSA benefit assessment.
- Farmers whose concerns most for yield improvement and income are more likely to adopt marketable crop, intercropping, and agro-forestry while less likely to adopt SWC.
- Farmers whose concern for soil health are more likely to adopt conservation agriculture and compost.
- Farmers who prioritize profitability and cost reduction are more likely to adopt marketable crop, compost, row planting, intercropping, and agro-forestry while are less likely to adopt SWC and conservation agriculture.
- Farmers who value reduction of vulnerability are more likely to adopt marketable crop, compost, intercropping, SWC, and agro-forestry while less likely to adopt row planting, and SWC.
- Farmers whose concerns most for reduction of environmental degradation likely to adopt SWC

Conclusions

- The perception of CSA technologies determines the adoption of specific CSA technology among the smallholder farmers.
- Perceptions of climate-smart agriculture technologies are heterogeneous among farmers ; and hence, interventions should consider this heterogeneity of perception during CSA technology recommendation.
- Policy makers need to carefully evaluate each CSA technology and make sure they fully understand why some farmers adopt specific CSA technologies while others do not .
- Although this paper showed the importance of farmer's perception on adoption of CSA technologies, it is short of other constraint factors such as economic, institutional and risk factors.

Contact Information

Mr. Abyiot Teklu , Addis Ababa University, email: abyiot.teklu@aau.edu.et , Ethiopia
 Dr. Belay Simane , Addis Ababa University, email: simaneb@yahoo.com
 Dr. Mintewab Bezabih, Former staff of London school of Economics, email: mintewabayele@gmail.com, Ethiopia

References

- Benjamin F. Zaitchik , Belay Simane, Shahid Habib, Martha C. Anderson, Mutlu Ozdogan, and Jeremy D. Foltz. 2012. "Building Climate Resilience in the Blue Nile/Abay Highlands: A Role for Earth System Sciences." *International Journal of Environmental Research and Public Health* 9 (12):435-61. <https://doi.org/10.3390/ijerph9020435>.
- FAO. (2013). Climate Smart Agriculture. Sourcebook. Rome
- Ngwira, A., F.H. Johnsen, J.B. Aune, M. Mekuria, and C. Thierfelder. 2014. "Adoption and Extent of Conservation Agriculture Practices among Smallholder Farmers in Malawi." *Journal of Soil and Water Conservation* 69 (2):107-19. <https://doi.org/10.2489/jswc.69.2.107>.
- Posthumus, Katrin Prager and Helena. 2010. "Socio-Economic Factors Influencing Farmers' Adoption of Soil Conservation Practices in Europe." In *Human Dimensions of Soil and Water Conservation*, edited by Pp. Ted L. Napier.
- Simane, B., B. F. Zaitchik & M. Ozdogan. (2013). Agroecosystem analysis of the choke mountain watersheds, Ethiopia. *Sustainability (Switzerland)*, 5(2), 592-616. <https://doi.org/10.3390/su5020592>
- Teklewold, Hailemariam, Alemu Mekonnen, and Gunnar Kohlin. 2018. "Climate Change Adaptation: A Study of Multiple Climate-Smart Practices in the Nile Basin of Ethiopia." *Climate and Development* 0 (0). Taylor & Francis:1-13. <https://doi.org/10.1080/17565529.2018.1442801>.

Acknowledgements

We would like to thank the farmers, agricultural development agents, and local administrators of the study area for their assistance during the field work. We are also grateful to Addis Ababa University (AAU) for providing the required facilities for the data analysis and write-up of this paper.