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Socioeconomic factors influencing adoption of climate-smart agriculture technologies by smallholder farmers in semi-arid areas, Tanzania

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Abstract

Climate change poses significant challenges to agricultural productivity and food security, particularly in developing countries where agriculture remains a critical livelihood source. In response, climate-smart agriculture technologies (CSATs) have emerged as vital tools to enhance resilience and sustainability in farming systems. This study investigates the socioeconomic factors influencing the adoption of CSATs, with a focus on maize-common bean intercropping systems among smallholder farmers in the semi-arid districts of Singida Rural, Babati, and Kondoa in Tanzania. A mixed-methods approach was employed, combining a structured questionnaire survey with 240 smallholder farmers, focus group discussions, key informant interviews, and document reviews to ensure data triangulation. Quantitative data were analyzed using descriptive statistics and logistic regression through the Statistical Package for Social Sciences (SPSS). The results indicate that several socioeconomic variables significantly influence the adoption of maize-common bean intercropping as a CSAT. These include gender, age, level of education, household size, farm size, access to extension services, and availability of agricultural credit. Male-headed households and farmers with better access to information and resources were more likely to adopt CSATs. The findings underscore the need for policy frameworks and development interventions that address these critical socioeconomic barriers to adoption. Strengthening institutional support, improving access to extension and credit services, and enhancing farmer education and awareness are recommended to foster widespread adoption of CSATs. Ultimately, promoting inclusive adoption strategies to enhance agricultural resilience, improve food security, and contribute to sustainable rural livelihoods in Tanzania's semi-arid regions.

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Introduction

Climate change emerged as one of the most urgent and complex challenges of the 21st century, exerting far-reaching impacts on ecosystems, economies, and societies. Among the most vulnerable sectors is agriculture, particularly in low and middle income countries where rural livelihoods are largely dependent on climate-sensitive resources such as rainfall, temperature, and soil fertility (Summary, 2023). Smallholder farmers, who constitute the majority of the agricultural workforce in sub-Saharan Africa, faced mounting challenges including erratic weather patterns, declining yields, and increasing frequency of extreme weather events (Bett *et al.*, 2022). These realities significantly threatened food security, income stability, and overall economic resilience in the region.

To address the multifaceted risks posed by climate variability, the concept of Climate-Smart Agriculture (CSA) was introduced as an integrative approach to simultaneously achieve three goals: sustainably increase productivity, enhance adaptive capacity and resilience, and reduce or remove greenhouse gas emissions where possible (Kakzan *et al.*, 2013). CSA encompasses a broad set of practices including conservation agriculture, agroforestry, intercropping, integrated soil fertility management, use of drought-tolerant crop varieties, and improved water management techniques. These technologies and practices are context-specific and their success depends on local agro-ecological conditions, institutional support, and socioeconomic dynamics.

The adoption of CSA technologies is not only a technical decision but also a socially embedded process influenced by numerous socioeconomic factors (Mnukwa *et al.*, 2025). Studies conducted in various African contexts highlighted that variables such as age, gender, education level, household size, income, access to credit and extension services, and land ownership status significantly affected farmers' willingness and ability to adopt CSA practices (Musafiri *et al.*, 2022). Moreover, cultural norms, risk perceptions, and the availability of social capital played essential roles in the diffusion and sustained use of CSA technologies (Bremer *et al.*, 2022). Despite the demonstrated benefits of CSA in enhancing resilience and increasing productivity, adoption rates in many parts of sub-Saharan Africa remained low and uneven, raising questions about the underlying drivers and barriers to uptake.

In Tanzania, agriculture contributed approximately 30% of the national GDP and employed more than 65% of the population, with smallholder farmers dominating production in both food and cash crops (URT, 2021). However, the agricultural sector remained highly vulnerable to climate change, particularly in semi-arid regions such as Babati, Kondoa, and Singida Rural districts. These areas experienced increasingly erratic rainfall, prolonged dry spells, and declining soil fertility—all of which contributed to poor yields and heightened food insecurity (Kangalawe and Lyimo, 2013). In response, the government of Tanzania, in collaboration with development partners, promoted CSA interventions through various agricultural development programs and climate adaptation strategies (Luhunga *et al.*, 2018). One such promising intervention was maize-common bean intercropping, a climate-smart practice known to enhance soil fertility, improve land-use efficiency, and provide a buffer against weather-related shocks (Thierfelder *et al.*, 2017).

Despite the availability of CSA options and institutional support, the adoption of such technologies among smallholder farmers in the study areas remained variable. Some farmers adopted intercropping and soil management practices while others continued with conventional mono-cropping systems that offered limited resilience to climate shocks. This inconsistency highlighted the need for a deeper understanding of the socioeconomic factors that shaped adoption decisions. For instance, farmers with limited access to extension services or agricultural credit may have lacked the knowledge or inputs required to implement CSA practices effectively. Similarly, gender dynamics and intra-household decision-making power often influenced the ability of women to participate in climate-resilient farming activities (Hussein, 2024).

This study examined the key socioeconomic factors influencing the adoption of climate-smart agriculture technologies specifically maize-common bean intercropping—among smallholder farmers in Babati, Kondoa, and Singida Rural districts of Tanzania. By employing a mixed-methods approach combining surveys, focus group discussions, and key informant interviews, the study aimed to generate empirical evidence on the determinants of CSA adoption. The findings were intended to inform policy formulation and the design of extension programs that are context-sensitive and responsive to the needs of rural farmers. Understanding these adoption dynamics was critical for scaling up climate-smart innovations and ensuring the long-term sustainability of agriculture in Tanzania's semi-arid zones.

Materials and methods

Description of the study locations

The study was conducted in three districts: Babati (Manyara region), Kondoa (Dodoma region), and Singida Rural (Singida region), which are among the focus areas of the Agriculture and Fisheries Development Programme (AFDP) for the 2020–2026 period. This programme, funded by the International Fund for Agricultural Development (IFAD), focuses on developing climate change adaptation technologies in the drier Agro-Ecological Zone (AEZ) of Tanzania's central mainland corridor. The farmers selected from each district were the representative of semi-arid agro-ecological zones of Tanzania. The rainfall and temperature in the study area are presented in Table 1; and the study area Fig. 1.

Table 1. Geographical location and weather information of the study area

Location	Geographical position		Mean annual rainfall (mm)	Mean annual temperature (°C)
	Latitudes	Longitudes		
Babati (Manyara region)	04° 24′ 60″ S	35° 49′ 26″ E	600-1020	15-26
Kondoa (Dodoma region)	04° 54′ 23″ S	35° 46′ 47″ E	500-800	16-28
Singida rural (Singida)	04° 63′ 25″ S	34° 95′ 07″ E	250-600	18-30

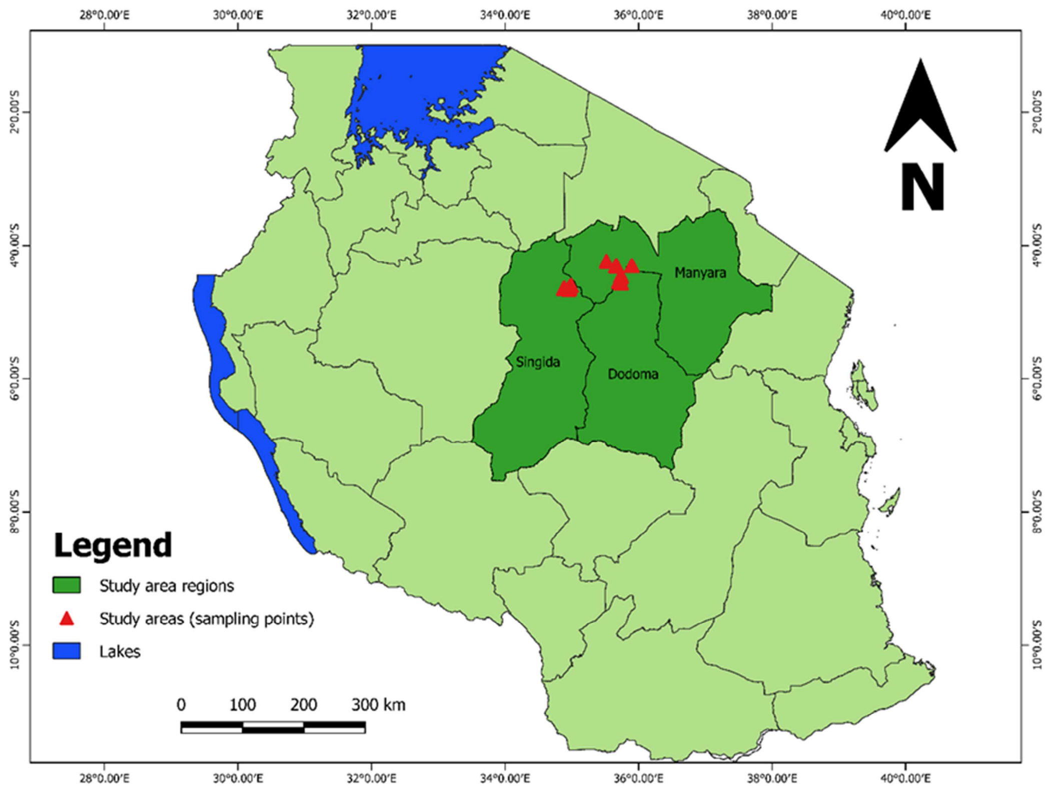

Fig. 1. The map showing the study area

Experimental design and participant sampling

This study employed questionnaires survey as data collection technique involving CSATs (Nkumulwa and Pauline, 2021; Oppong *et al.*, 2021). The survey was selected as the most common and popular in social science research (Eyitayo Raji *et al.*, 2024; Oppong *et al.*, 2021). This method has become highly valued for its ability to provide insights that cannot be obtained by using any other means (Oppong *et al.*, 2021). The questionnaire survey was inexpensive way to get information flexible to collect a wide range of information (Balogun and Onokerhoraye, 2022). It also a standardized method and efficient means of gathering information from a significant number of participants beside often free from many types of measure errors (Ayinu *et al.*, 2022). The unit of inquiry in which the researcher took in his study was whole population from which sample was selected (Shen *et al.*, 2022). The target population of the study will be stratified into the following groups; Farmers, Farmers Organizations, County Agricultural Officials, Social Welfare, Community/beneficiaries.

The data was collected from a statistical population by a defined procedure, the researcher use a set of questions to probe the findings for this study by inhabitants of Babati, Kondoa and Singida rural, and the sample size comprised of 240 respondents in the study area. The study uses the respondents from the farmers, Farmers Organizations, County Agricultural Officials, Community/beneficiaries and the Research department. The sample size was distributed as follows; Smallholder farmers was (M&F80/60) equal to (33.3% male & 25.0 female), Farmers organizations (M&F6/6) equal to (5% male & 5% female), County Agricultural Official (M&F9/3) equal to (7.5% male & 2.5 female), Social welfare (M&F9/6) equal to 7.5% male & 5.0 female) and Community/beneficiaries (M&F6/5) equal to 5.0 % male & 4.2 female) as shown in Table 2.

Table 2. Showing distribution of respondents

Respondents	Male	Female	No. of respondents	% of sample population	
				M	F
Farmers	80	60	140	33.3	25.0
Farmers organizations	12	12	24	5.0	5.0
Agricultural extension officials	18	6	24	7.5	2.5
Social welfare	18	12	30	7.5	5.0
User/beneficiaries	12	10	22	5.0	4.2
Total	140	100	240	58.3	41.7

Source: Researcher's findings, June 2024

Sampling procedures

Sampling was the process of selecting units such as people or organizations from a population of interest so that by studying the sample we may fairly generalize our results back to the population from which they was chosen. It was the procedure a researcher uses to gather people, places or things to study (Kombat *et al.*, 2021). This study used both purposive and random sampling (Etikan, 2016). Purposive Sampling was non-probability sampling technique whereby the researcher selects participants on the strength of their experience of the phenomenon under study (Schreuder *et al.*, 2001). It was also called critical or thoughtful sampling, the choice of the sample elements depends exclusively on the discretion of the researcher or investigator (Rai and Thapa, 2019).

Data collection and analysis

A household survey, key informant interviews, a focused group discussion, and field observations were utilized to collect primary data of the participants. Secondary data was gathered from the actual sources of information, including thorough desk reviews of both published and unpublished literature, peer-reviewed journals, books, conference papers, dissertations, and research reports.

Household survey questionnaire

A household questionnaire survey was done to supplement the participatory assessment sources for more qualitative data. A random selection approach was employed to generate samples of individual households from the total households (Kassa and

Abdi, 2022). The village registry and the head of household served as the sample frame and unit, respectively. About 240 respondents were interviewed; this sample size is consistent with the recommended sample size of 10% of the actual sample size for the study (Musafiri *et al.*, 2022).

Focused group discussion (FGD)

The FGD was held with a diverse range of participants, including household heads, women-headed households, development agents, and youngsters. Nine (9) focus group sessions with five to ten participants each were organized (one focus group discussion in each village). The primary goal of the FGD was to better comprehend the adoption of CSA practices and people's perceptions about the causes and effects of climate change (Agarwal *et al.*, 2022).

Data analysis methods

The survey data were analyzed using descriptive statistics, including the mean, frequency, standard deviation, percentages, distribution, and graphs (Wadood *et al.*, 2021). A probit model of CSA for selection equations is estimated by using a function of explanatory variables that is also likely to determine the CSA intensity (Kurgat *et al.*, 2020; Negera *et al.*, 2022). The inverse mill ratio (IMR) was predicted by the first-stage probit regression (Mthethwa *et al.*, 2022).

Results and discussion

Socio-economic characteristics of respondents in the study area

The socioeconomic characteristics of the population including age, gender, marital status, education level, family size, farm size, farming experience and land ownership are critical to farm decisions and performance in relation to crop production. For example, gender determines responsibilities for male and female farmers in crop production; and family size determines labour force in production. Studying these characteristics is important in understanding the contribution of each attribute in maize-bean production under climate change in the study area.

Age of respondents

The respondents involved in the study were of different ages as shown in Table 4. The average age was 43.5 years with a minimum of 20 years and a maximum of 77 years. Most (92.07%) of the household heads were individuals in the age class of 18-60 whereby 46.66% were involved in intercropping farming system and 45.41% practiced non-intercropping farming system. About 7.9% was aged between 56 to 77 age class with 2.7% in the intercropping farming and 5% in the non-intercropping farming system. When the percentages of age were tested using Chi square the results showed insignificant difference among the two farming systems (intercropping and non-intercropping).

Gender and marital status

During the study, male and female respondents were involved and the household heads were the targeted group. Based on gender, 38.3% and 11.25 % of the respondents were males and females practicing intercropping farming system. On the other hand, 38.75% of the males and 11.67% of the females were under non- intercropping farming system. However, the percentage differences were statistically not significant among the farming systems. The study also found out that the study area had more married individuals in both farming systems than the unmarried ones. Couples were actively engaged in farming activities than unmarried individuals thus making it the target population because the study targeted active farmers. The difference in marital status among the farming systems was statistically significant (p value 0.024).

Level of education of the household head

The results shows that 47.1% and 49.6% of the respondents engaged in the intercropping and non-intercropping farming systems respectively had primary education, while 0.8% had not gone to school and 2.5% attained secondary and college education, the differences in the education level were insignificance between the two farming systems.

Family size, farm size and land ownership

Households in the sample population had the average of 6.2 and 5.4 family members per household in intercropping and non- intercropping farming systems respectively. This was higher the average of 5.2 members per household which was reported in the National statistics of 2022 on household size in the study area. The results show that intercropping farming system has large average family size than non- intercropping farming system (p value = 0.02). Households with farm area ranging from 1 to 5 acres were 36.67% and 31.25 % for intercropping and non-intercropping farming systems respectively; and those with farm area ranging from 6-12 acres were12.92% and19.17% for intercropping and non- intercropping systems respectively. The differences among the two farming systems were significant (p = 0.027). Land ownership between the two farming systems showed that 29.17% and 47.92 of farmers under intercropping and non- intercropping farming systems owned the farming land and 20.42% and 2.5% under the intercropping and non- intercropping farming systems did not own the farming land. These households farmed on rented or on borrowed land. Generally, most (77%) of the respondents in the study area are farming on their own land and had enough of time for staying in the villages far farming activities. Land ownership among the two farming systems showed significant difference (p value = 0.00). More households under non- intercropping farming owned farming land than did households under intercropping systems. Table 3 provides results from descriptive analysis of socioeconomic characteristics of respondents in the study area.

Table 3. Socio economic characteristics of the respondents (n= 240) in study area

Variable	Type of farming system				χ^2 value
	Intercropping		Non intercropping		
	Frequency	% age	Frequency	% age	
Age class					0.123
18-35	30	12.5	35	14.58	
36-60	82	34.16	74	30.83	
Above 60	7	2.9	12	5	
Gender					0.9345
Male	92	38.3	93	38.75	
Female	27	11.25	28	11.67	
Marital status					0.024
Married	100	41.67	105	43.75	
Un married	19	7.92	16	6.67	
Education level					0.06
Illiterate	2	0.8	0	0	
Primary	113	47.1	119	49.6	
Secondary	3	1.3	0	0	
Post-secondary	1	0.4	2	0.8	
Family size					0.013
3-5	54	22.5	66	27.5	
Above 5	65	27.1	55	22.92	
Farming experience					0.03
Over 10 years	82	34.2	69	28.8	
Less than 10	37	15.4	52	21.67	
Farm size					0.027
1-5	88	36.67	75	31.25	
6-10	31	12.92	46	19.17	
Land ownership					0.00
Owned	70	29.17	115	47.92	
Non owned	49	20.42	6	2.5	

Influencing socioeconomic factors of smallholder farmers for adoption of CSATs the semi-arid area

The identified socioeconomic factors that influence smallholder farmers for adoption CSAT for maize-common bean production amongst smallholder farmers include age, level of education, gender, household family size, average land under farming, farmer's access to extension services, and credits. The study used multiple regression analysis tools to examine the influence of each factor on farm the yields. Maize-common beans yields were regressed against the factors to determine its influence on the yields in the intercropping farming system. The results show that the Variance Inflation Factor (VIF) for all variables in the model ranged from 1.069 to 1.242 which meets the VIF as stipulated by (Pallant, 2005). This implies that there was no problem of multi-collinearity. Durbin-Watson's was 1.781, falls within the values of $1.5 < d < 2.5$ implying that there was no auto-correlation (Lee, n.d.). Hence, there was no auto-correlation in the multiple linear regression data as shown in the Table 4. The access to the averaged land possessed by individual farmer had a beta coefficient of -0.095; this meant that limited access to land, had negative effect on maize-common beans production and decreases by 0.095 units. This implies that when the land not accessed by smallholder farmers, only fewer smallholder farmers are able to engage in maize-bean production thus decreasing the overall adoption of maize-common beans production. However, the variable in the model was statistically insignificant but influence maize-common bean production negatively. These findings supported the study's hypothesis related to the access to land (Mizik, 2021; Partey *et al.*, 2017) In another study, (Jones *et al.*, 2023; Nkumulwa and Pauline, 2021) who studied on Socio-economic factors limiting smallholder maize production reported that poor access to the land generally reduce the number of farmers to engage in farming activities which in turn, reduce the maize production. The access to improved CSATs had a negative impact on maize-common bean production with beta coefficients of -0.190; p value = 0.007 and was statistically significant. This means that an increase in the access to CSATs leads to increase in adoption of maize-common bean production by 0.19 units. Similar findings were also reported by (Yusuph *et al.*, 2023) who revealed that access to improved technologies including improved varieties and credits.

Table 4. Influence of socioeconomic on adoption of CSATs in study area

Variable	Unstandardized coefficients		t-statistics	p- value	Collinearity statistics	
	coefficient (B)	Std. Error			Tolerance	VIF
(Constant)	7.325	0.292	25.061	0.000		
Education level of the household head	0.368	0.134	2.752	0.062	0.852	1.174
Gender of respondent	0.020	0.118	0.166	0.868	0.935	1.069
Respondent's age	0.003	0.005	0.609	0.544	0.891	1.122
Family size	0.280	0.024	11.698	.000*	0.870	1.149
Average land	-0.095*	0.107	-0.886	0.377	0.909	1.100
Access to improved CSATs	-0.190	0.101	-1.885	0.007*	0.918	1.090
Farmer's access to extension services	0.192	0.105	1.835	0.069	0.876	1.142
Farmer's access to credits	0.255	0.107	2.379	0.019*	0.805	1.242
Farm size	0.282	0.108	3.066	0.003*	0.883	1.132

Multiple R = 0.824; R2 = 0.679; Adjusted R Square = 0.652; p = 0.000, Std. Error of the Estimate = 5.95; Durbin-Watson =1.781

House hold size was another factor that significantly influence maize-common bean production (p = 0.00) in the study area; households with five people or above who can participate in farming activities accounted for 57.92% of the farmers. This size has a possibility of increasing maize-common bean by 0.280 units as opposed to family size with less than five members. This entails that there is enough man power to work in farming activities since most of the households use family labour for farming activities in the study area.

Farm size variable had a beta coefficient of 0.282 and was statistically significant (p = 0.003). This means that as the land for farming increases, maize-common bean production was increased by 0.282 units. This implies that households with large land area (3 to 5 acres) for farming have the potential of having chances in maize-common bean production than those with small area (less than 3 acres). However in the intercropping farming systems, farming activities are highly demanding in terms of labour, financial resources, time, and management skills. Therefore, a farmer can have a large land area but produces low due to poor management. On the other hand, a farmer can have small land area manage well and produce more farm products. Farmers with access to credit facilities are more likely to increase maize production compared to those without access. Beta coefficient of 0.255 implies that farmers with access to credit are 0.255 times more likely to produce maize-common bean than those with no access to credit. According to (Agbenyo *et al.*, 2022; Hussein, 2024; Yusuph *et al.*, 2023), households with access to credit may be of help to farmers in obtaining the capital required for adopting higher profit production technologies and therefore increase productivity.

The adoption of CSATs for maize–common bean production among smallholder farmers in semi-arid areas is influenced by several socioeconomic factors. These include age, education level, gender, household size, farm size, land ownership, and access to extension services, credit, and improved CSATs. A multiple linear regression analysis was conducted to assess the influence of each factor on the yields from maize–common bean intercropping systems.

The regression results indicated that the Variance Inflation Factor (VIF) values ranged between 1.069 and 1.242, falling well below the threshold of 10 as recommended by (Kassa and Abdi, 2022), thus confirming the absence of multicollinearity. Additionally, the Durbin–Watson statistic was 1.781, which lies within the acceptable range of 1.5 to 2.5 (Lee, n.d.), indicating no autocorrelation in the model residuals.

The average land holding size per household showed a negative influence on adoption, with a beta coefficient of −0.095. Although statistically insignificant ($p > 0.05$), this suggests that limited access to farmland may hinder farmers' engagement in CSAT-based maize–bean production. These findings align with prior studies (Jones *et al.*, 2023; Mizik, 2021; Nkumulwa and Pauline, 2021; Partey *et al.*, 2017), which indicate that insufficient land access often discourages smallholder participation in sustainable farming practices.

Interestingly, access to improved CSATs had a statistically significant negative impact on maize–bean yield ($\beta = -0.190$, $p = 0.007$). This counterintuitive result may reflect challenges such as inappropriate technology targeting, poor implementation, or lack of training and awareness among users. Despite being significant, this finding suggests a need for better alignment of technologies with farmers' capacities and local conditions. Similar concerns have been raised by (Yusuph *et al.*, 2023) regarding the importance of both availability and appropriate dissemination of agricultural technologies.

Household size had a strong positive and statistically significant influence ($\beta = 0.280$, $p < 0.001$) on adoption and yield outcomes. Households with five or more members who can contribute labour to farming—were more likely to benefit from intercropping systems. This finding underlines the role of family labour in sustaining labour-intensive practices like CSATs in resource-constrained rural settings.

Farm size also showed a positive and significant association ($\beta = 0.282$, $p = 0.003$) with CSAT adoption. Larger farms offer more flexibility and space for innovation adoption, increasing the likelihood of implementing CSATs. However, the study also notes that success with CSATs does not solely depend on land size but also on effective land and resource management. Farmers with smaller plots can achieve higher productivity through efficient use of available resources and better management practices.

Access to credit facilities was another important factor influencing adoption. It had a positive and statistically significant effect ($\beta = 0.255$, $p = 0.019$), indicating that farmers who can access credit are better positioned to adopt and benefit from CSATs. Access to credit helps farmers purchase inputs, invest in improved technologies, and manage risk—factors critical for climate-resilient farming (Agbenyo *et al.*, 2022; Hussein, 2024; Yusuph *et al.*, 2023).

The model's overall performance was strong, with an R-squared value of 0.679, suggesting that approximately 67.9% of the variation in maize–common bean yield in intercropping systems can be explained by the socioeconomic variables included. The adjusted R^2 was 0.652, and the overall model was statistically significant ($p < 0.001$).

Conclusion

The study was concerned with evaluate the CSA performances and accelerate the adoption of CSA technologies for sustainable maize and common beans production of smallholder farmers in semi-arid areas, Tanzania. In developing countries in Sub-Saharan Africa face challenges in agriculture development due to change in market conditions, food demand and climate. Climate change causes a major threat to agricultural production and food security in Tanzania, and climate-smart agriculture is crucial in addressing the potential impacts. CSA-practices can increase crop productivity; income mitigate the greenhouse gases hence improve food security. Whereas previous research mostly focused on the usage of single CSA- practices, usage of multiple combinations of CSA-practices on households in Africa has recently received attention, even though empirical evidence is still scant. In this paper, we have identified the determinants of usage of multiple combinations of CSA-practices. The results show that usage of CSA practices is primarily influenced by number of factors, including household, plot and institutional characteristics. Nevertheless, there is scope for promoting greater complementarities among these CSA-practices. The study found that the major determinants of farming households' decisions to use combination of CSA-practices are the household size, production diversity, and farm size, access to extension services, livestock ownership and occupation. Analysis of determinants of usage revealed that crop diversification and gender inclusion had a positive and significant influence on the usage of combination of crop residue and intercropping. In addition, education level and gender of the household head positively and significantly influenced the usage of combination of crop rotation, crop residue and intercropping. Based on the above results, it is important to focus on policies and plans that promote each CSA- practice as a combination including other inter-related practices could contribute to upscale CSA-practices usage while harnessing the synergies between them. Dissemination of CSA- practices knowledge and its role in climate risk mitigation is critical to promote it. More CSA training for farmers, government extension staff working at the local level, and use of communication tools to share and promote knowledge on CSA-practices use to combat the global challenge of climate change are essential.

Understanding barriers and enabling conditions to CSA-practices usage helps in designing and formulating extension messages and agricultural policies that can accelerate CSA-practices dissemination and help safeguard agricultural production and food security in Tanzania. In addition, agricultural policy makers should focus at enhancing smallholder farmers' household characteristics by reviewing farmer extension so as to come up with a package that is tailored to the perceived actual needs of farming households and designing farm management usage programmers based on the farmers' household characteristic, such as education, gender, livestock ownership and membership to social groups. However, it is important to notice that even though the study estimated the determinants of multiple combination of CSA-practice but the study did not consider the implication for the usage to household welfare. Therefore, other research should go further to investigate whether the usage of combination of CSA-practices has higher and positive welfare and productivity effects in the face of climate change.

Recommendation(s)

Based on the analysis and findings of the study, I wish to make the following recommendations;

1. Agriculture officers (From Singida rural, Babati and Kondoa), should involve the community to

assistance in agriculture activities, development programmer and agriculture provision projects. Members of the community should come up with other ideas to supplement the current water sources and make communal contribution to support that, for example to provide information about the all system of agriculture which are used to transmit agriculture from the water source to another and implementing any water conservation techniques that may be beneficial.

2. The government should establish more capacity building programmers for both agriculture officers and the households (members of the community) to equip them with adequate skills and abilities to handle any issues that are related to agriculture activities and to enhance agriculture program.

3. Agriculture management organ should be provided with the required capacity building, training such as financial management, office practices and procedures, agriculture project management skills to have active participation in management of the agriculture activities.

4. Local government should do the following
    1. Support the application of the bylaws on damage of agriculture sources, environment and regulating water eruptions.
    2. Offer the percentage of the fund from the community development fund to nourishment the agriculture activities.
    3. The agriculture user committees should take full answerability and should be accountable to agriculture issues.
    4. Support in defining the communities of agriculture user associations

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