



Available Online at EScience Press

International Journal of Agricultural Extension

ISSN: 2311-6110 (Online), 2311-8547 (Print)

<https://esciencepress.net/journals/IJAE>

SOCIO-ECONOMIC AND INSTITUTIONAL DRIVERS OF CLIMATE-SMART AGRICULTURE ADOPTION IN BANGLADESH

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ARTICLE INFO

Article History

Received: January 02, 2025

Revised: March 03, 2025

Accepted: April 19, 2025

Keywords

Adoption

Climate-Smart Agriculture (CSA)

Farmer Perceptions

ICT Access

Organizational Participation

Socio-economic Factors

Sustainable Agriculture

ABSTRACT

Climate change poses a significant threat to agricultural sustainability in vulnerable regions, such as Bangladesh, where farming systems face increasing risks from drought, flooding, and soil degradation. Climate-Smart Agriculture (CSA) offers a strategic framework for enhancing resilience, boosting productivity, and mitigating environmental impacts. This study examines the socio-economic and institutional factors influencing CSA adoption among smallholder farmers in Chuadanga district, in southwestern Bangladesh. Data were collected through structured, face-to-face interviews with 105 randomly selected CSA-practicing farmers. The survey instrument was pre-tested and included both open- and closed-ended questions. Eleven variables—including education, organizational participation, ICT access, and farmer perceptions—were analyzed using multiple regression in SPSS (Version 20). The findings indicated that factors such as education level, involvement in organizations, access to information and communication technologies (ICT), and positive attitudes toward CSA had a significant impact on its adoption. In contrast, variables such as farm size and access to finance had less impact. The model explained 47.7% of the variation in CSA adoption. These findings suggest that targeted policies to strengthen education, institutional support, and digital access are crucial for scaling up Community Supported Agriculture (CSA) in climate-vulnerable regions.

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INTRODUCTION

The projected increase in the global population to nearly 10 billion by 2050 poses significant challenges for global food security, particularly in developing countries

(Cohen, 2002; Espenshade et al., 2003; FAO, 2014). To meet future food demand, agricultural systems must not only boost productivity but also address the mounting constraints imposed by climate change (Serdeczny et al.,

2017). Rising temperatures, erratic rainfall, prolonged droughts, and soil degradation are already reducing yields of staple crops such as rice, wheat, and maize in many regions (Aggarwal et al., 2018; Lipper et al., 2014; Waaswa and Satognon, 2020; Adhikari et al., 2015; FAO, 2019).

Climate-Smart Agriculture (CSA) has been developed as a proactive strategy to address these challenges by promoting sustainable productivity growth, strengthening resilience to climate impacts, and minimizing greenhouse gas emissions (FAO, 2013). Governments and development agencies have promoted CSA through regulatory frameworks, financial incentives, and awareness programs (Taylor et al., 2015). However, the effectiveness of these interventions often depends on local socio-economic, institutional, and environmental contexts.

Recent literature emphasizes the importance of tailoring CSA strategies to site-specific conditions. For example, the adoption of CSA in Kenyan potato farming has been shaped by access to extension services, credit, climate information, and infrastructure while being constrained by gender inequality and low-income levels (Waaswa et al., 2021). Scherr et al. (2012) advocate for integrating ecological restoration into Community Supported Agriculture (CSA), and Chandra et al. (2017) highlight the value of participatory policy frameworks. Well-aligned agri-environmental policies that match farmers' risk perceptions and resource capacities are also key to driving adoption (Pagliacci et al., 2019).

A growing body of research has identified key factors that influence CSA adoption, including Socio-demographic characteristics (e.g., education, gender, age) (Waaswa et al., 2021); Institutional factors (e.g., access to credit, extension services, farmer organizations) (Junpeng et al., 2020); Resource endowments (e.g., land size, soil fertility) [Rabia Mazhar et al., 2020]; Economic factors (e.g., household income, labor availability) (Thottadi et al., 2020); Farming experience and training [Zhang et al., 2024, Asante et al., 2020]; and Financial and technical support [Waaswa et al., 2021, Zhang et al., 2024].

Despite its potential, the adoption of CSA remains uneven—especially in regions vulnerable to climate hazards. Farmers across West Africa face high input costs, limited access to climate information, and inadequate technological support (FAO, 2010; Neupane et al., 2024; Agyekum et al., 2024). These issues are

further compounded by socio-cultural barriers, such as traditional beliefs and gender norms (Baffour-Ata et al., 2024). Even in high-income OECD countries, challenges persist due to labor costs and the limited affordability of CSA technologies (Long et al., 2016). In Thailand, adoption is influenced by how farmers weigh perceived risks and benefits (Piancharoenwong et al., 2023).

Practices under Climate-Smart Agriculture—such as conservation tillage, diversified cropping systems, integrated pest management, and agroforestry—contribute to greater climate resilience, more efficient resource use, and sustained food security over time (Patra et al., 2022, Sahu et al., 2020). However, adoption gaps persist due to financial limitations, technological constraints, knowledge deficits, and social exclusion (Bahinipati et al., 2021). Addressing these issues requires supportive conditions, such as secure land tenure, gender equity, accessible markets, and infrastructure development. Equitable land reforms and inclusive advisory services are particularly crucial for enabling women and youth to participate in Community-Scale Agriculture (CSA) (Rampa et al., 2020; Babu et al., 2022; Krupnik et al., 2023).

As one of the most climate-vulnerable countries in the world, Bangladesh clearly shows the urgent need for Climate-Smart Agriculture (CSA). Agriculture remains a cornerstone of rural livelihoods yet is increasingly threatened by salinity intrusion, erratic rainfall, drought, and flash flooding. In districts like Chuadanga, these climatic pressures are intensifying. While CSA programs have been introduced, adoption remains fragmented and poorly understood at the community level. Although global research has highlighted general adoption drivers, empirical data from Bangladesh—especially at the village and farm level—are scarce. Moreover, few studies integrate farmers' perspectives alongside statistical evidence, creating a gap in understanding the contextual enablers and barriers to CSA adoption.

This study aims to fill this gap by examining the socio-economic and institutional factors that affect the adoption of Climate-Smart Agriculture (CSA) among smallholder farmers in the Chuadanga district. By integrating both quantitative findings and farmers' perceptions, the study aims to support targeted, context-specific policies for advancing climate-resilient agriculture in Bangladesh.

This study explores the main socio-demographic, institutional, and resource-based factors that influence

the adoption of Climate-Smart Agriculture (CSA) practices in Bangladesh. It also examines how support systems—such as agricultural extension services and access to finance—impact farmers' decisions, to guide effective policy interventions.

METHODOLOGY

Study Area

The study was conducted in the Dauki and Jamjami unions under Alamdanga Upazila, Chuadanga District in southwestern Bangladesh. These unions were purposively selected in consultation with the research supervisory committee based on their active involvement in Climate-Smart Agriculture (CSA) interventions. The selection was based on field-level data and records from the Department of Agricultural Extension (DAE), which highlighted these unions as important areas for current CSA initiatives, such as the use of drought-tolerant crop varieties, integrated pest management, and organic soil improvement practices. Several government and NGO-led projects, such as the

National Agricultural Technology Program (NATP) and the CSA dissemination initiative under the Bangladesh Climate Change Strategy and Action Plan (BCCSAP), have been piloted in these areas over recent years. Four villages—Noatha Panchila and Gosbila in Dauki union, and Binodpur and Bademaju in Jamjami union—were randomly selected for data collection, as they represent diverse agro-ecological conditions and varying levels of CSA exposure.

Population and Sample Size

The study was conducted across four villages within the Jamjami and Dauki unions (Figure 1). The total population surveyed was 210 individuals, from which 105 participants were sampled. An additional 10 participants were included in a reserve list to account for possible non-responses. Sampling was evenly distributed across villages: 54 individuals in Noatha Panchila (27 sampled), 50 in Gosbila (25 sampled), 56 in Binodpur (28 sampled), and 50 in Bademaju (25 sampled).

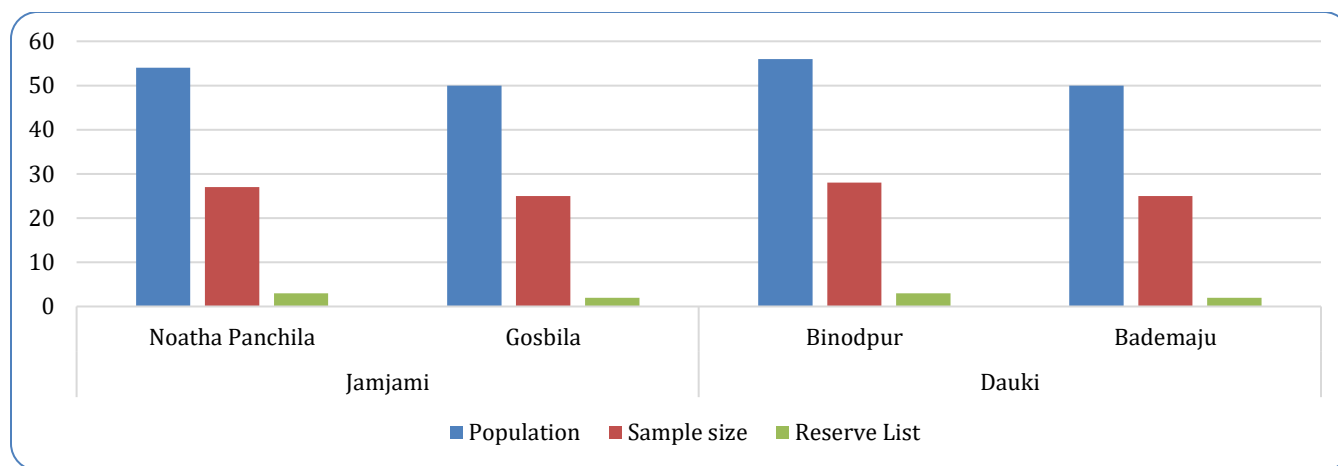


Figure 1. Distribution of Population, Sample Size, and Reserve List across Selected Villages in Jamjami and Dauki Unions. The chart highlights the proportional sampling framework adopted for each village, ensuring representativeness and contingency through a reserve list.

Data Collection

Data were gathered through a structured interview schedule, originally prepared in English and later translated into Bangla to ensure clear and effective communication with the respondents. The instrument included both open- and closed-ended questions designed to align with the study's objectives. To ensure clarity, relevance, and cultural appropriateness, the tool was pre-tested with 10 CSA-practicing farmers from

villages adjacent to the study area who were not included in the final sample. Feedback from the pre-test was used to refine the wording, sequencing, and response formats of the questions.

The reliability of the instrument was assessed using Cronbach's alpha, explicitly applied to Likert-scale items measuring constructs such as farmers' perceptions of Community-Supported Agriculture (CSA). Items with alpha values above 0.70 were retained, indicating

acceptable internal consistency. To establish content validity, the instrument was reviewed by a panel of three experts in agricultural extension and climate-resilient farming. The experts evaluated the questionnaire for completeness, relevance to CSA, and clarity of language. Revisions were made based on their suggestions before final data collection commenced.

Data Analysis

The collected data were systematically coded and inputted into SPSS (Version 20) for analysis. Descriptive statistics, including frequencies, means, and standard deviations, were calculated to provide an overview of the data. To examine the impact of various socio-economic and institutional factors on the adoption of climate-smart agriculture (CSA), multiple regression analysis was conducted. Open-ended responses were quantified using thematic scoring techniques but were not analyzed in detail due to scope limitations.

Ethical Consideration

The research supervisory committee granted ethical approval. All participants provided informed verbal consent before participation. Respondent confidentiality and anonymity were strictly maintained throughout the research process.

RESULTS

The study examined key socioeconomic and institutional characteristics of Climate-Smart Agriculture (CSA) farmers to understand their contextual backgrounds and capacity for CSA adoption (Table 1). The findings revealed a diverse range of attributes. Educational attainment among farmers varied from no formal education to higher secondary levels, with an average of 5.63 years of schooling. Farm sizes ranged from marginal plots to larger holdings, averaging 1.43 hectares. Training received by farmers, mainly on agricultural practices, averaged 22.58 days, suggesting moderate engagement in capacity-building activities. Farmers exhibited varying degrees of organizational participation, market access, and access to finance, with respective mean scores of 20.58, 4.29, and 17.85—indicating moderate involvement in social and economic networks. Accessibility to extension services and ICT was also moderately high, with mean scores of 4.14 and 19.56, respectively. Furthermore, farmers demonstrated substantial knowledge of CSA practices ($\bar{x}$ = 16.36) and generally positive perceptions of CSA's effectiveness ($\bar{x}$ = 39.32), reflecting their awareness and acceptance of sustainable agricultural innovations. These characteristics collectively inform the farmers' adaptive capacity and readiness for scaling CSA interventions.

Table 1. Key Characteristics of Farmers in the Study Area.

Variable	Unit of Measurement	Theoretical Range	Observed Range	Mean	S.D
Education	Years of schooling	–	0 – 15	5.63	3.98
Farm Size	Hectares	–	0.02 – 4.00	1.43	1.07
Training received	Number of days	–	20 – 28	22.58	1.49
Organizational participation	Composite score (0–30)	0 – 30	17 – 25	20.58	1.98
Market access	Composite score (0–6)	0 – 6	3 – 6	4.29	.74
Access to finance	Composite score (0–30)	0 – 30	12 – 24	17.85	3.33
Accessibility to extension services	Composite score (0–6)	0 – 6	3 – 5	4.14	.73
Access to ICT	Composite score (0–30)	0 – 30	12 – 25	19.56	2.95
Knowledge on CSA Practices	Composite score (0–20)	0 – 20	13 – 19	16.36	1.46
Farmers perceptions on the effects of CSA	Composite score (0–50)	0 – 50	36 – 46	39.32	1.87

Education

Table 2 illustrates the distribution of CSA farmers according to their formal education levels. Most respondents (39.1%) had completed secondary education, which corresponds to 6 to 10 years of schooling, followed by 27.6% who had completed

primary education (1–5 years). Approximately 23.8% of the farmers were illiterate, having received less than one year of formal schooling, while only 13.3% had pursued education beyond the secondary level (10–15 years). Respondents' educational attainment varied from 0 to 15 years, with an average of 5.63 years and a standard

deviation of 3.98 years. Most farmers had received some level of formal education, though the overall educational attainment remained modest. Education is crucial for facilitating the adoption of CSA, as it broadens farmers' knowledge base, enhances their ability to process agricultural information, and supports informed decision-making regarding climate-resilient technologies.

Farm Size

Table 3 displays the distribution of farm holders by scale, with medium-scale farmers representing the largest group at 38.1%, followed by small-scale farmers (36.2%), and marginal farmers (15.2%). These findings suggest that most CSA farmers fall within the small to medium-scale categories. The average farm size in study area was 0.92 hectares, exceeding the national average of 0.60 hectares.

Training Received

Table 4 shows that the highest proportion of CSA-adopting farmers (41.9%) fell into the medium training category (scores ranging from 22 to 23), followed by 28.6% in the low training category (score ≤ 21), and 27.6% in the high training category (score > 23). In total, about 70.5% of the respondents had attained low to medium levels of agricultural training. Training scores among participants ranged from 20 to 28, with an average score of 22.58 and a standard deviation of 1.49. This indicates that most farmers had similar levels of training exposure, clustering around the medium level. Agricultural training plays a crucial role in CSA adoption, as trained farmers are generally more familiar with climate-resilient practices and better equipped to implement new technologies and make informed decisions in the face of climate variability.

Table 2. CSA Farmers' Distribution Based on Education Level.

Category	Ranges (Years)		Respondents		Mean	SD
	Score	Observed	f	%		
Illiterate	0-0.5		25	23.8		
Primary level	5-Jan		29	27.6		
Secondary level	10-Jun	0-15	37	39.1	5.63	3.98
Above Secondar Level	15-Oct		14	13.3		

Table 3. Farm Size Distribution of CSA Adopters.

Category	Ranges (Hectare)		Respondents		Mean	SD
	Score	Observed	Number	%		
Landless	≤ 0.02		6	5.7		
Marginal	0.021-0.02		16	15.2		
Small	0.21-1.00	0.02-4.00	38	36.2		
Medium	1.01-1.30		40	38.1	1.43	1.07
Large	>3		5	4.8		

Table 4. Levels of Training Received by CSA-Adopting Farmers

Category	Range(score)		Respondents		Mean	SD
	Score	Observed	Number	%		
Low	≤ 21		30	28.6		
Medium	22-23	20-28	48	41.9	22.58	1.49
High	Above 23		27	27.6		

Organizational Participation

As indicated in Table 5, the most significant proportion of farmers (39.1%) showed medium levels of organizational participation, followed by 31.4% with low

participation and 29.5% with high participation. Involvement in organizations is vital for farmers to acquire knowledge and gain access to climate-smart agricultural practices.

Table 5. Categorization of CSA Farmers Based on Organizational Participation.

Category	Range(score)		Respondents		Mean	SD
	Score	Observed	Number	%		
Low	≤ 19		33	31.4	20.58	1.98
Medium	20-21	17-25	41	39.1		
High	Above 21		31	29.5		
Total			105	100		

Market Access

As shown in Table 6, the vast majority of farmers (82.9%) reported medium market access, followed by 16.2% with low access and only 0.9% with high access. These results indicate that nearly all farmers had limited access to strong market linkages, which may restrict their ability to sell produce at competitive prices or scale up their operations.

Access to Finance

Table 7 reveals that 49.6% of farmers had moderate access to financial services, 33.3% had high access, and 17.1% reported low access. Despite a relatively higher proportion with better access compared to market linkages, over half (66.7%) still had only low to moderate access, suggesting that financial constraints may continue to hinder investment in improved agricultural practices and technologies.

Access to Extension Services

According to the data given in Table 8, 43.8% of farmers had medium access to extension services, 35.2% had high access, and 21.0% had low access. These findings underscore the importance of strengthening extension networks, as better access is often associated with increased awareness and uptake of improved agricultural practices, including climate-smart innovations.

Access to ICT

Figure 9 indicates that 41.9% of farmers had moderate access to ICT, 30.5% had low access, and 27.6% had high

access. With nearly three-quarters of respondents reporting low to moderate ICT access, there is a clear need to enhance digital infrastructure and literacy to support technology-driven agricultural development.

Knowledge of Climate-Smart Agriculture (CSA)

Table 10 shows that 53.3% of farmers had a moderate level of knowledge about CSA practices, while 22.9% demonstrated high knowledge and 22.8% had low knowledge. These results suggest that although general awareness of CSA exists, the majority of farmers lack a comprehensive understanding, highlighting the need for targeted educational interventions to build capacity and promote informed adoption.

Perception of CSA Effects

As presented in Table 11, 48.6% of farmers had a neutral perception of the effects of CSA, 31.4% viewed them positively, and 20.0% held unfavorable views. With 80% of farmers expressing neutral to favorable perceptions, the overall outlook toward CSA is largely positive, which presents an opportunity for scaling up through appropriate awareness and support mechanisms.

Extent of CSA Adoption

Table 12 illustrates that 58.1% of farmers had adopted CSA practices at a moderate level, 23.8% at a low level, and only 18.1% at a high level. These figures suggest that while adoption is underway, most farmers remain in the early or intermediate stages, emphasizing the need for continued support to deepen and broaden CSA integration in farming systems.

Table 6. Farmer Access to Agricultural Markets in Relation to CSA Adoption.

Category	Range(score)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Low	≤ 3		17	16.2	4.29	0.74
Medium	5-Apr	6-Mar	87	82.9		
High	Above 5		1	0.9		

Table 7. Availability and Use of Financial Resources Among CSA-Adopting Farmers.

Category	Range(score)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Low	≤ 14	24-Dec	18	17.1	17.85	3.33
Medium	15-20		52	49.6		
High	Above 20		34	33.3		
Total			105	100		

Table 8. Categorization of CSA Farmers Based on Extension Service Accessibility.

Category	Range(score)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Low	≤ 3	5-Mar	22	21	4.14	0.73
Medium	4-Mar		46	43.8		
High	Above 4		37	35.2		

Table 9. Levels of ICT Access Among CSA-Adopting Farmers.

Category	Range(score)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Low	≤ 17	25-Dec	32	30.5	19.56	2.95
Medium	18-21		44	41.9		
High	Above 21		29	27.6		

Table 10. Assessment of Farmers' Knowledge on Climate-Smart Agriculture.

Category	Range(score)		Respondents		Mean	SD
	Score	Observed	Number	%		
Low	≤ 15	13-19	25	23.8	16.36	1.46
Medium	16-17		56	53.3		
High	Above 17		24	22.9		
Total			105	100		

Table 11. Perception-Based Classification of CSA Farmers.

Category	Range(score)		Respondents		Mean	SD
	Score	Observed	Number	Percent		
Unfavorable	≤ 37	36-43	21	20	39.32	1.87
Neutral	38-40		51	48.6		
Favorable	Above 40		33	31.4		

Table 12. Variation in Climate-Smart Agriculture Adoption Among Farmers.

Category	Range(score)		Respondents		Mean	SD
	Score	Observed	Number	%		
Low adoption	≤ 47	45-54	25	2.8	49.36	2.19
Medium adoption	48-51		61	58.1		
High adoption	Above 51		19	18.1		
Total			105	100		

Contribution of Selected Characteristics to the Adoption of CSA Practices

Multiple regression analysis was used to assess how selected characteristics influenced the adoption of CSA practices (Table 13). Table 13 indicates that organizational participation, farmers' perception of CSA effects, access to ICT, and education significantly contributed to CSA adoption ($P < 0.05$). Organisational Participation and Farmers' Perception were highly significant at the 1% level, followed by access to ICT and Education, which

was significant at the 5% level. The model's R^2 value was 0.477, meaning that the independent variables accounted for 47.7% of the variability in CSA adoption. The adjusted R^2 of 0.421 indicates that the model maintained its strength after adjusting for the number of predictors. With an F-ratio of 8.56, which was statistically significant ($p < 0.01$), the results confirm that the model fits well and that the independent variables collectively have a meaningful impact on CSA adoption.

Table 13. Regression Results for Variables Affecting CSA Adoption Among Farmers.

Dependent variable	Independent variable	β	P	R^2	Adj. R^2	F
Adoption of Climate smart Agriculture	Education	0.113	0.19*	0.477	0.421	8.56
	Farm Size	-0.068	0.671			
	Training received	0.157	0.172			
	Organizational participation	0.372	.000**			
	Market access	0.032	0.891			
	Access to finance	0.047	0.372			
	Accessibility to extension services	0.142	0.562			
	Access to ICT	0.156	.013*			
	Knowledge on CSA Practices	-0.004	0.973			
	Farmers perceptions on the effects of CSA	0.28	.006**			

Among the eleven variables analyzed, four were found to significantly influence the adoption of Climate-Smart Agriculture (CSA) practices. Organizational participation emerged as the strongest predictor, with a β -value of 0.372 and a significance level of 1% ($p = 0.000$), indicating that greater involvement in farmer groups or local institutions substantially increased CSA adoption. Similarly, farmers' perception of CSA had a positive and significant effect ($\beta = 0.280$, $p = 0.006$), suggesting that farmers who recognized the benefits of CSA were more likely to implement such practices. Access to ICT also played a meaningful role ($\beta = 0.157$, $p = 0.013$), reinforcing the idea that timely access to climate and agricultural information via digital tools facilitates adoption. Lastly, education showed a statistically significant impact at the 5% level ($\beta = 0.113$, $p = 0.019$), indicating that farmers with higher levels of formal education were better equipped to understand, evaluate, and apply CSA techniques. These findings underscore the importance of strengthening institutional engagement, enhancing awareness, improving digital connectivity, and investing in farmer education to accelerate the transition toward climate-resilient agriculture.

Qualitative Insights from Farmer Perspectives

In complement to the quantitative analysis, qualitative data gathered through open-ended responses provided more profound insights into the perceptions, motivations, and constraints experienced by farmers about Climate-Smart Agriculture (CSA) practices. A thematic analysis of these responses revealed recurring patterns that shed light on the socio-cultural and operational dynamics influencing CSA adoption.

Perceived Benefits of CSA Practices

Farmers consistently reported positive outcomes following the adoption of Community Supported Agriculture (CSA) strategies. A prominent theme was the improvement in soil fertility and crop vigor, particularly through the use of organic inputs such as compost and green manure. These practices were frequently associated with reduced dependence on synthetic fertilizers, leading to both environmental and economic benefits. One respondent remarked that the transition to organic soil amendments had noticeably improved the visual and functional quality of their soil, thereby enhancing overall crop performance. Additionally,

several farmers emphasized the enhanced resilience of their crops to climatic extremes, with particular reference to flood-resistant rice varieties that had previously safeguarded their yields during episodes of intense rainfall. Such testimonials reflect the practical value of CSA technologies in mitigating climate-induced vulnerabilities in smallholder systems.

Motivational Drivers for Adoption

The decision to adopt CSA practices appeared strongly influenced by access to knowledge and peer-led learning platforms. Farmers who had participated in training sessions, farmer field schools, or community-based agricultural groups cited these experiences as pivotal to their understanding and implementation of new techniques. The presence of extension officers and agricultural facilitators emerged as a key enabler, bridging the gap between scientific recommendations and grassroots adoption. For many respondents, exposure to CSA concepts through trusted interpersonal networks or localized demonstrations played a critical role in reducing uncertainty and encouraging experimentation with novel practices.

Constraints and Implementation Challenges

Despite the enthusiasm for CSA, numerous farmers articulated significant barriers to effective implementation. Chief among these were the limited availability of inputs, such as drought-tolerant seed varieties, organic mulches, and biopesticides, which were either not available locally or priced beyond their means. Labor intensity was also a notable concern, particularly for practices that required additional time or manpower, such as mulching, compost application, or pest monitoring under Integrated Pest Management (IPM). A lack of timely technical guidance further compounded these constraints, with some respondents expressing frustration at the sporadic or insufficient nature of institutional support.

Gaps in Information and Technical Capacity

A critical insight from the responses was the presence of knowledge gaps and misinformation regarding CSA practices. While awareness of concepts such as bio-fertilizers or IPM was relatively widespread, many farmers indicated that their understanding remained superficial or unclear. Without structured training or follow-up support, the risk of misapplication or

abandonment of CSA techniques was markedly higher. For instance, one farmer reported awareness of IPM but lacked the procedural knowledge to implement it effectively, underscoring the need for tailored, context-specific extension interventions.

Implications for Policy and Extension Services

These qualitative findings highlight the multifaceted nature of CSA adoption. While farmers recognize and appreciate the agronomic and ecological benefits of these practices, their sustained engagement hinges on resolving issues of input accessibility, labor availability, and technical literacy. Therefore, strengthening farmer education through decentralized extension models, improving supply chain logistics for CSA-compatible inputs, and fostering community-based peer learning structures will be essential to scaling CSA adoption in smallholder farming contexts.

DISCUSSION

The present study investigated how various characteristics of farmers influence the adoption of climate-smart agriculture (CSA) practices. The findings revealed that factors such as organizational participation, farmers' perceptions of Community-Supported Agriculture (CSA), access to Information and Communication Technology (ICT), and education significantly contributed to the adoption of CSA practices. In contrast, other factors had either a lesser or no significant impact on the adoption process.

Factors Influencing CSA Adoption

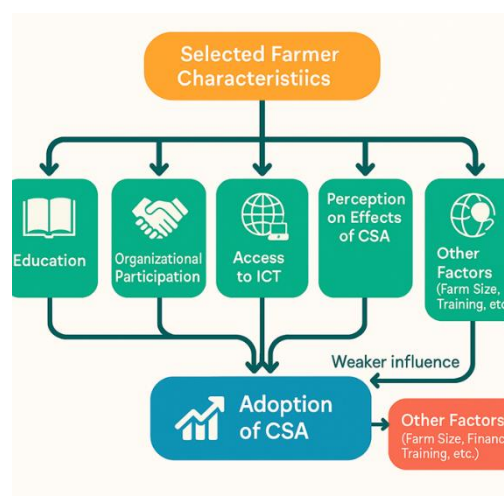


Figure 2. A chart of factors influencing CSA Adoption.

Education and Adoption of CSA

Education was found to have a positive and significant influence on farmers' adoption of CSA practices. Educated farmers were more capable of understanding new information, critically assessing agricultural innovations, and implementing new practices effectively. This is consistent with earlier studies that demonstrated that higher educational attainment enhances farmers' ability to process information, make informed decisions, and thus adopt sustainable agricultural innovations (Mignouna et al., 2011, Deressa et al., 2009). Education plays a crucial role in broadening farmers' horizons and enhancing their adaptive capacities to climate variability and technological changes (Asfaw and Admassie, 2004). Therefore, increasing farmers' access to formal and informal education may be a critical policy intervention to promote CSA.

Organizational Participation and CSA Adoption

The study showed that organisational participation had the most substantial positive contribution to CSA adoption. Farmers actively engaged in community-based organisations, cooperatives, or farmer groups were more likely to be aware of climate-resilient practices and motivated to adopt them. Participation facilitates access to collective learning, knowledge exchange, and social support networks, which can reduce the perceived risks associated with adopting new practices (Franzel et al., 2001; Teklewold, 2003). This result underscores the importance of promoting organisational membership and strengthening farmers' groups as a platform for CSA diffusion.

Access to ICT and Adoption of CSA

Access to information and communication technologies (ICTs) was also significantly associated with higher adoption of CSA. ICT tools such as mobile phones, radio, and the internet allow farmers to access timely information regarding weather forecasts, market conditions, and innovative farming techniques. This finding aligns with studies by Mittal and Mehar (2016) and Aker (2011), who reported that ICT-based interventions significantly improve agricultural decision-making and technology adoption by reducing information asymmetries. Thus, enhancing rural ICT infrastructure and training farmers on ICT use could significantly improve CSA adoption.

Farmers' Perception of CSA

Farmers' perception of the benefits and effects of CSA had a significant positive influence on adoption. Farmers with favorable or neutral perceptions toward CSA technologies were more willing to adopt them, supporting findings by Below et al. (2012) and Bryan et al. (2013) who emphasized that perceptions of risk and benefit directly affect climate adaptation behavior. Perceptions are often shaped by previous experience exposure to extension services, training, and peer influence, highlighting the critical role of extension and communication strategies in shaping farmers' attitudes towards Community-Supported Agriculture (CSA).

Other Factors

Although farm size, access to finance, extension contact, training received, and market access were positively related to CSA adoption, their effects were not statistically significant in this study. This contrasts with findings in other contexts e.g., Di Falco & Veronesi (2013), suggesting that while these factors matter, their influence may be context-specific, depending on the region, the type of CSA practices promoted, and farmers' socio-economic environment. The model's adjusted R^2 of 0.421 indicates that the selected independent variables explained approximately 42% of the variation in CSA adoption among farmers, which is satisfactory for socio-economic research where unobserved factors influence behavior.

CONCLUSION

This study highlights that socio-economic and institutional factor—especially education, organisational involvement, ICT access, and farmer perceptions—significantly influence CSA adoption in Bangladesh. To overcome challenges like limited knowledge and support, policymakers should enhance extension services, farmer groups, education, and digital literacy. A targeted approach addressing these areas is crucial to expanding CSA and fostering climate-resilient agriculture.

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