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From Subsistence to Sustainability: Examining Farmer Willingness to Adopt Climate-Smart Agricultural Technologies for Apple Cultivation evidence from Himalayan state of Jammu and Kashmir, India

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Abstract
Apple is one of the high-value agricultural commodities in Kashmir. It is one of the major fruit crops in the Union Territory of Jammu and Kashmir, India, in terms of potential growing area, production, and domestic consumption. The overall fruit production has increased by 3.95 LMTs during 2021–22, i.e., from 20.36 LMTs in 2020–21 to 24.31 LMTs, recording a growth of 19.39 percent. The climate smart agriculture technology adoption in the form of high-density apple plantation covered an area of 6090.91 ha in the financial year 21–22, registering a growth of 591% over the previous year. The paper aims to investigate the relationship between climate smart agriculture technologies and farmers adoption behaviour in Himalayan state of Kashmir, India. It proposes a novel extension of UTAUT model. The paper uses structure equation modelling to estimate the influence of factors on intention to adopt climate smart agriculture technologies for farm production in Kashmir. The paper presents an empirical insight that farmers extension contacts, perceived climate risk, government subsidy and facilitating conditions positively influence farmers intention to adopt CSA technologies for apple farming in Kashmir. Furthermore, perceived cost and social influence was found to be insignificant in determining farmers intention to adopt CSA technologies. This model more accurately predicts CSA technology adoption by identifying the factors that either encourage or hinder farmers from adopting it. Researchers have previously studied the adoption of CSA technology in Jammu and Kashmir from a socioeconomic perspective. Previous studies have overlooked other factors that influence CSA technology adoption. We also recommend strengthening factors like cost and bank credit to enhance the adoption of CSA technologies. Climate-smart agriculture technology has immense potential to enhance food security, environmental preservation, and agricultural productivity.

Keywords: Sustainability: Climate: Technology, UTAUT: Adoption Behaviour

Introduction

Climate change poses a severe danger to food security, especially in developing nations (Campbell *et al.*, 2014).In tropical regions, severe temperatures and little rainfall jeopardize agricultural development (Aydinalp and Cresser, 2008; Tripathi, 2018). Climate change is linked to a heightened incidence of agricultural pests and diseases, as well as a reduction in soil fertility, resulting in crop failures and diminished output (Sidique and Hadi, 2016).Forecasts indicate a probable loss in agricultural output of 4.5% to 9% in medium-term (2010–2039) and a decline of 25% or greater in long long-term (2070–2099) (Prabakaran, Vaithiyanathan and Ganesan, 2018).Climate-Smart Agriculture (CSA) technologies are advocated as strategies for both adaptation and mitigation of the adverse effects of climate change and serve as a fundamental basis for attaining Sustainable Intensification(Taylor, 2018). Climate-Smart Agriculture (CSA) is a farming methodology that enhances farmers' resistance to climate change, improves their livelihoods, and bolsters food security (Lipper et al., 2014).

Although Climate-Smart Agriculture (CSA) is extensively advocated by various private and public sector entities and integrated into numerous national policy frameworks), its adoption among smallholder farmers in union territory of Jammu & Kashmir remains minimal and inconsistent, with many technologies underutilized. Notwithstanding these advantages in achieving sustainability objectives, prior studies reveal a sluggish and predominantly restricted long-term adoption of Climate-Smart Agriculture (CSA) technologies by smallholder farmers (Mahdi *et al.*, 2021).This adoption is a crucial prerequisite for the effective implementation of CSA and the sustainability of agricultural systems. This underscores the necessity for further investigation into the factors influencing CSA adoption in Jammu and Kashmir.

The Himalayan area is particularly vulnerable, as it is prone to catastrophic weather events in both the present and the future due to climate projections (Nandargi and Dhar, 2011; Romshoo *et al.*, 2018; Para *et al.*, 2020). The Kashmir Valley, spanning approximately 15,000 km^2, is a nappe zone situated in northern India, sandwiched between the Pir Panjal Range (Lat: 73°54′–75°35′ E; Lon: 33°22′–34°42′ N) and the Greater Himalayas (Rashid *et al.*, 2020). The Kashmir region, which is in the western part of the Himalayan range, is expected to have seen much more frequent unpredictable weather events by the end of this century because of ongoing warming (Gujree et al., 2017; Rafiq & Mishra, 2018).

The Union Territory of Jammu and Kashmir continues to have an agrarian economy. Nearly 70 percent of the population is directly or indirectly involved in agriculture. According to the latest data, agriculture in Jammu and Kashmir contributes 17.2 percent to the total gross state domestic product (GSDP), and its growth rate of 9 percent is substantially higher than the national average of 2.9 percent (Economic Survey-2023,). Among the agricultural activities, horticulture is the most important driver of the growth rate, contributing 40 percent to the total output value from agriculture in Jammu and Kashmir (Hassan et al., 2020; Shah et al., 2022).

Jammu and Kashmir primarily grows apples on around 51% of the 2.72 lakh hectares used for all other temperate fruit growing in the state. Presently, the state contributes 75 percent of total Indian apple production, with an average yield of commercially important apple cultivation per unit area that is the highest in the country, ranging between 10 and 13 t/ha, but compares poorly with yields of 20–40 t/ha in horticulture advanced countries (Wani *et al.*, 2021). The Kashmir valley's temperature and other agro-ecological features are ideal for cultivating a wide variety of apples, as well as other temperate fruits. The apple industry directly or indirectly engages over 30 lakh people, or roughly 5–6 lakh households, and generates an annual revenue of Rs. 8000 crores for the state (Shah et al., 2022).

Recent years in Kashmir have seen abrupt and intense weather patterns that have badly damaged ecosystems as well as the economy (Rafiq and Mishra, 2018; Romshoo *et al.*, 2018). Two of these unpredictable snowfall events occurred in Kashmir Valley in the late autumn of 2018 and 2019, both of which devastated apple orchards throughout the valley (Rashid *et al.*, 2020). This is significant because the government implemented a sustainable intervention to boost the value of the horticulture industry from INR 60 billion to INR 300 billion (Hassan, 2021; Mir & Raja, 2021.). The government has launched the heavily subsidised High Density Apple Plantation (HDAP), a subset of climate smart agriculture intervention initiative with plant protection mechanisms such as anti-hail netting, drip irrigation, and trellis systems made of metallic or wood poles and wire in response to recent losses and to increase apple output.

Apple is one of the high-value agricultural commodities in Kashmir (Hassan, 2021; Mir & Raja, 2021., 2022). It is one of the major fruit crops in the Union Territory of Jammu and Kashmir, India, in terms of potential growing area, production, and domestic consumption. Indian states, viz., Himachal Pradesh, Uttarakhand, and Arunachal Pradesh, including the union territory of Jammu and Kashmir (J&K), provide a niche for commercial apple cultivation (Mir & Raja, 2021.). The area under fruit crops has increased by 6978 ha, i.e., from 334719 ha in 2020–21 to 341697 ha in 2021–22, thereby recording a growth of 2.08 percent (Economic Survey–2023). The overall fruit production has increased by 3.95 LMTs during 2021–22, i.e., from 20.36 LMTs in 2020–21 to 24.31 LMTs, recording a growth of 19.39 percent. The climate smart agriculture technology adoption in the form of high-density apple planation covered an area of 6090.91 ha in the financial year 21–22, registering a growth of 591% over the previous year (Economic Survey 2023).

The aims of the research paper are to demonstrate the application of an UTAUT model to unveil factors affecting acceptance and user behavior of climate smart agriculture technology adoption among farmers of Kashmir. Previous studies have overlooked the behavioral aspects of farmers' adoption process and focused more on binary variables. This study adds novelty by extending UTAUT model to predict accurately the factors affecting CSA technologies among farmers.

Review of Literature

The Unified Theory of Acceptance and Use of Technology (UTAUT) model was created by (Venkatesh *et al.*, 2003). It is a framework for thinking about how performance expectation, effort expectation, social influence, facilitating conditions, and demographic factors affect intention and adoption of new technology. To tackle this issue, (Venkatesh *et al.*, 2008, 2012; Venkatesh, L Thong and Xu, 2016) developed the Adapted Unified Theory of Acceptance and Use of Technology (AUT2) model by adding new constructs. This study modified the UTAUT by incorporating perceived cost, perceived climate risk and farmer extension contacts to the model.

Social Influence (SI)

Social influence refers to the extent to which individuals perceive the opinions or beliefs of important people in their social circles regarding the use of a particular technology (Moussaïd *et al.*, 2013).The social environment, including friends and family, somewhat influences the operational development of a farm (Foster & Rosenzweig, 1995).Furthermore, (Rieple and Snijders, 2018)found that a farmer's current experiences with new technology significantly influence their future use of it. The discussion allows us to formulate the following hypothesis as:

H1: Social Influence has a significant impact on farmers acceptance of climate smart agriculture technologies.

Perceived Cost

The phrase "perceived cost" (PC) refers to how people calculate the costs involved in putting new technology into use (Shafinah *et al.*, 2013; Faridi, Kavoosi-Kalashami and Bilali, 2020). There is strong evidence that implementation of water and soil conservation measures is negatively correlated with perceived cost (Schaafsma et al., 2019). Furthermore perceived cost is defined all the material expenses (financial, time-related, etc.) and social costs that the farmers anticipate incurring because of new agriculture technology adoption (Arfi et al., 2020). The discussion allows us to formulate the following hypothesis as:

H2: Perceived cost has a significant impact on farmers acceptance of climate smart agriculture technologies

Perceived Climate Risk

climatic risk encompasses local circumstances, such as exposure, climatic risks, and susceptibility. Climate risk information encompasses data and insights into the possible effects and probabilities of climate and weather-related trends and occurrences(Arbuckle, Morton and Hobbs, 2015) Perceived risk significantly influences the acceptance of new technologies, according to research on perceived climate risk (PCR) (Poortvliet *et al.*, 2018). Research reveals that individuals are more inclined to adopt conservation measures when they perceive a higher risk of adopting water and soil conservation measures (Faridi et al., 2020).Additionally, research has shown that the effective creation of technological breakthroughs depends on people's perceptions of risk and benefit (Poortvliet *et al.*, 2018). Similarly, a good correlation between opinions on climate change and the application of adaptation strategies has been found by (Arbuckle, Morton and Hobbs, 2015) The discussion allows us to formulate the following hypothesis as:

H3 Perceived climate risk has a significant impact on farmers acceptance of climate smart agriculture technologies.

Facilitating Conditions

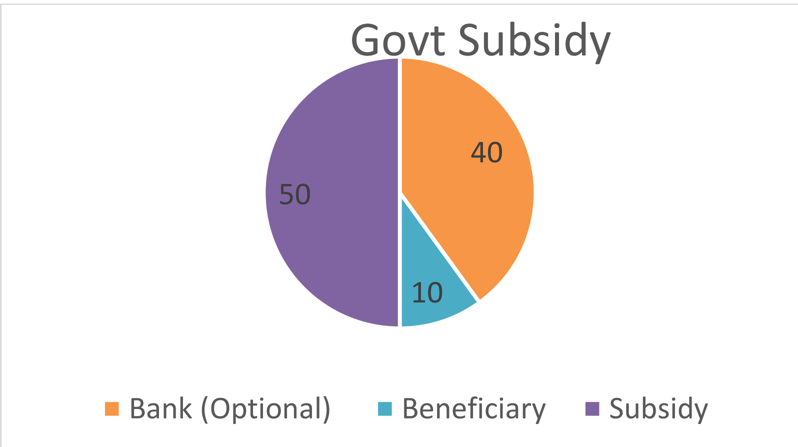
The degree to which a person feels that the technological and organizational infrastructure is in place to assist and make it easier for them to utilize a certain system is known as the facilitating condition (Venkatesh and Bala, 2008).The concept of enabling circumstances encompasses all the necessary operational prerequisites for the initial use of new technology. According to (Martins, Oliveira and Popovič, 2014) the supportive atmosphere influences both the adoption process and its usage. Climate smart agriculture technology acceptance described as "the possibility that a person may engage in certain behaviors in the future under certain conditions and do something," is frequently linked to technology usage (Venkatesh *et al.*, 2003). Drawing from the discussion above, we can propose the following hypothesis:

H4: Facilitating conditions have a positive impact on user behavior of climate smart agriculture technologies.

Government Subsidy

The High-Density Apple Plantation Scheme, a subset of climate smart agriculture technologies package is a fully state-funded initiative, aims to enhance productivity and production while augmenting farmer income (HDAP-Scheme, 2017.)The broader contours include reducing pest and fertilizer usage and minimize water usage. under the scheme, funding is split 50:50 between the government and the farmers.

Figure 2



H5: Government subsidies have a significant impact on farmers acceptance of climate smart agriculture technologies

Farmers Extension Contact

Agricultural-extension services are defined as "the entire set of organizations that facilitate and support people engaged in agricultural activities to solve problems and obtain information, skills, and technologies to improve their livelihoods and well-being"(Davis et al., 2020).Extension services offer farmers timely and pertinent information to help them solve farming-related issues and make better agricultural decisions (Kassem et al., 2021).The quality of the extension and advisory services offered determines how well extension programs work to achieve a sustainable development strategy (Kishore *et al.*, 2018). Extension services offer farmers timely and pertinent information to help them solve farming-related issues and make better agricultural decisions(Cawley *et al.*, 2015; Moyo and Salawu, 2018). From the above discussion we propose the following hypothesis as:

H6: Farmer extension contacts have a positive impact on user behavior of climate smart agriculture technologies.

Research Questions.

1. What are the factors that influence the farmers acceptance and use behavior of climate smart agriculture technologies?
2. How effective are policy environment in promoting farmers acceptance and user behavior of climate smart agriculture technologies?
3. How do social demographic and farmer characteristics effect on smart climate technology acceptance?

Research Objectives:

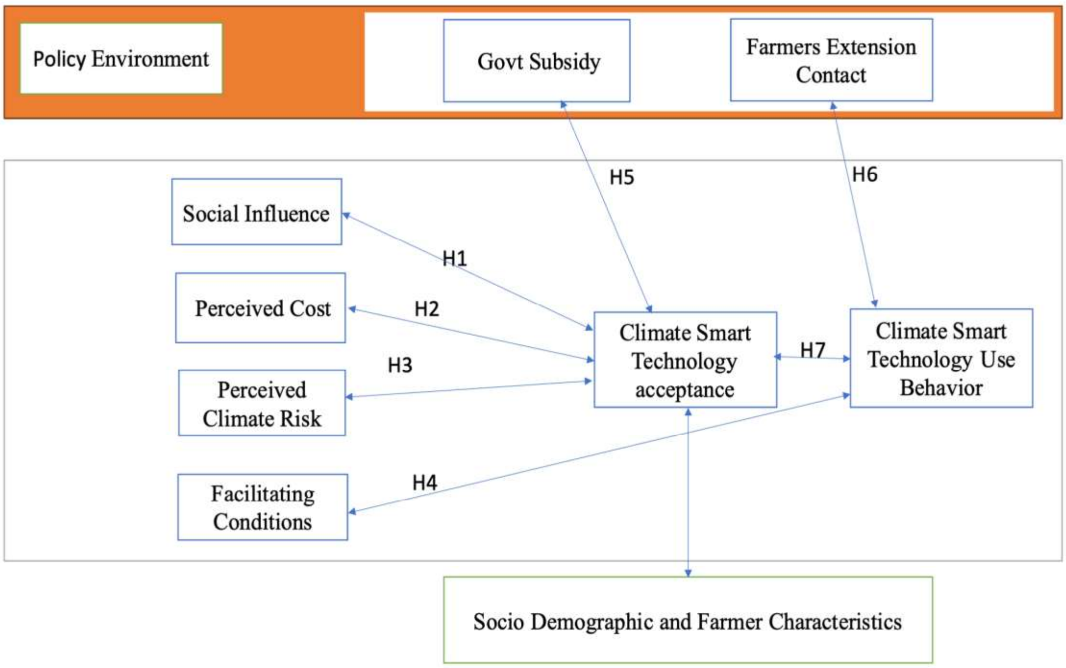
1. To ascertain the factors that influence farmers acceptance and use behavior of climate smart agriculture technologies

2. To study the influence of social demographic and farmer characteristics effect on climate smart technology acceptance

4. *To determine the role of* policy environment (govt. subsidy and farmer extension contact) on farmers acceptance and user behavior of climate smart agriculture technologies?

3. To enhance the strategies and suggestions on climate smart technology acceptance

Fig 1 Proposed Conceptual Model



Research Methodology

Variable Measurement and Data Collection

Previous studies on the adoption of new technologies by ('davis1989' ; Zhou, Lu and Wang, 2010; Clark et al., 2018) provided the survey questions. A few professors from Jamia Millia Islamia University in New Delhi, India, and Prof Glynn Jones from New Castle University and few horticulture officers from Jammu and Kashmir helped in questionnaire formulation. A survey questionnaire was prepared in English to collect data. The experts' perspectives guaranteed that the survey questions reflected farmers' perspectives on the implementation of climate smart agriculture technologies. The data was collected using questionnaires and interview methods emphasis was laid to translate the questionnaire in local language to make the respondents better understand the questions. We measured the survey indicators using a five-point Likert scale, with "5" representing strongly agree and "1" representing strongly disagree, except for demographic variables. We conducted a pilot study with 75 farmers from five different districts of Jammu and Kashmir to test the survey questionnaire.

Sampling Technique

The present study was conducted in the union territory of Jammu and Kashmir-the northern most region of India. Five districts from Kashmir valley namely, Anantnag, Baramulla, Budgam, Ganderbal and Shopian were selected purposively. A multistage sampling procedure was adopted for the selection of districts, horticultural zones, villages, and sample orchardists. From the selected districts, three horticultural zones from each district having maximum area under apple cultivation were selected purposively. From each horticultural zone, five villages were selected having maximum area under apple cultivation. A list of apple growers (orchardists) of selected villages was obtained from concerned Horticultural Development Offices and a sample of different growers (orchardists) having marginal, small, medium, and large land holdings, were selected proportionately from selected villages. Thus, a total of 353 growers (orchardists) were selected purposively from seventy-five selected villages with the following formula.

$$ni = \frac{Ni}{N}n$$

Where, ni = Number of sampled apple growers in each village, n = Total number of apple growers selected for the present study (353), N = Total number of apple growers in sampled villages, Ni = Total number of apple growers in ith village.

Table 4. 1 District wise sample

	Frequency	Percent	Valid Percent
Anantnag	79	22	22
Baramulla	115	33	33
Budgam	53	15	15
Ganderbal	25	7	7
Shopian	81	23	23
Total	353	100.0	100.0

Data Analysis and Results

The data analysis process for this research involved four steps. We conducted descriptive statistics in the first phase to understand the sample's structure. We received a total of 353 out of 400 responses from five major apple-producing districts of the Union Territory of Jammu and Kashmir (Baramulla, Budgam, Ganderbal Shopian, and Anantnag); we discarded 47 responses due to missing data points, this research study examined 353 valid responses, 78% from male participants and 22% from female participants, ensuring the results were free from gender bias. In addition, 38% of the participants were from the age group 35–45 years, followed by 26% above 45-55 years, 19% between 25–35 years, 10% above 55 years, and 7% below 25 years. In this survey, the income range of farmers was less than 1 lac = 1%, 1 lac to 3 lac = 9%, 3 lacs to 5 lacs = 16%, 5 lac to 10 lac = 40%, and above 10 lac = 34%. furthermore, the landholding of farmers lies between 1 hectare (12%), 1-2 hectares (27%), 2-4 hectares (32%), and 4–24 hectares (29%). Table 1.1 summarizes demographic variables relevant to the collected and analysed sample.

Table 1.1: Demographic profile

Characteristics	Category	Frequency	Percentage
Gender	Male	274	78
	Female	79	22
	Total	353	100
Age	Below 25	23	7
	25-35	67	19
	35-45	133	38
	45-55	93	26
	Above 55	37	10
	TOTAL	353	100
District	Baramulla	115	33
	Budgam	53	15
	Shopian	81	23
	Ganderbal	25	7
	Anantnag	79	22
	Total	353	100
Income	Less than 1,00,000	5	1
	1,00,000 – 3 00,000	31	9
	3,00,000 – 5,00,000	56	16
	5 00,000 - 10, 00,000	140	40
	10, 00,000 or above	121	34
	Total	353	100
Land Holding	Marginal (up to 1 Hectare/8 Kanals)	42	12
	Small (1-2 hectare/ 8- 16 Kanals)	96	27
	Medium (2-4 hectare/ 16-24 Kanals)	109	32
	Large (4 and above/ 24 Kanals and above	103	29
	Total	353	100

Reliability And Validity Analysis

In the second round of data analysis, we evaluated the validity and reliability of the constructs. We utilised the statistical software programmes SPSS 26.0 and AMOS 20. to analyse suggestions for the assessment of reliability and validity components. We also subjected all retained items to tests for construct reliability and validity. Both composite reliability (CR) and average variance extracted (AVE) were considered, as suggested by(Hair, 2009). Table 1.2 reveals that all constructs have CR values above 0.70 (Fornell and Larcker, 1981). Social influence recorded the largest CR value, while perceived benefit had the lowest value. All constructs have an acceptable value of AVE higher than 0.50, as suggested by (Fornell and Larcker, 1981) and (Hair *et al.*, 2012). Social influence (0.935) had the highest AVE value, while perceived climate risk (0.769) had the lowest value.

Table 1.2 Reliability and Validity Analysis

	CR	AVE	MSV	MaxR(H)	PERC	FAC	GSUBB	FEXCC	USB	S0I	CSAT	PERCR
PC	0.865	0.684	0.016	0.904	**0.827**							
FC	0.954	0.838	0.262	0.961	0.023	**0.915**						
GSUB	0.947	0.817	0.114	0.961	0.032	0.147	**0.904**					
FEXC	0.935	0.783	0.171	0.943	0.046	0.253	0.238	**0.885**				
UB	0.931	0.77	0.35	0.931	0.066	0.512	0.286	0.336	**0.878**			
SI	0.954	0.874	0.122	0.975	0.128	0.101	0.143	0.349	0.256	**0.935**		
CSAT	0.91	0.771	0.35	0.91	-0.032	0.423	0.337	0.251	0.592	0.188	**0.878**	
PCR	0.808	0.592	0.176	0.869	-0.025	0.419	0.178	0.413	0.338	0.152	0.379	**0.769**

Measurement Model
In the third step, confirmatory factor analyses were evaluated to make sure there was a suitable level of model fitness along with construct validity and reliability. As seen in Table 1.3, a number of the fit indices of the measurement model were found to be within their acceptable level (GFI: Goodness-of-Fit Index=.918; AGFI: Adjusted Goodness-of-Fit Index=.896; CFI: Comparative Fit Index=.984; CMIN/DF: Normed Chi-Square= 1.420; NFI: Normed-Fit Index=.949; and RMSEA: Root Mean Square Error of Approximation=.035). Therefore, the model has adequate level of model fitness as all fit indices were within acceptable level as suggested by (J. Hair, 2009; Tabachnick & Fidell, 2007).

Table 1.3: Results of Measurement Model.

Fit indices	Cut off point	Model Fit (Measurement model)	Result
MIN/DF	≤3.000	1.420	Accepted
GFI	≥0.90	.918	Accepted
AGFI	≥0.80	.896	Accepted
NFI	≥0.90	.949	Accepted
CFI	≥0.90	.984	Accepted
RMSEA	≤0.08	.035	Accepted

Structural Model
Before proceeding with the structural model analysis, we must use Harman's single-factor test (1976) to prevent any issues related to the common method bias. We used SPSS 26 to retrieve eight latent constructs and their unremoved items for Harman's single-factor test. This value was less than the recommended one (< 0.50) (Podsakoff *et al.*, 1990). As a result, it appears that there was no problem with the common method bias.

Variance inflation factors (VIF) were checked to make sure there wasn't a multicollinearity issue between the main dependent and independent constructs. All the values found were within the recommended level of (< 10)

We tested the structural model of SEM in the last stage to verify the conceptual model and its associated hypotheses. Like the measurement model, we observed that all fit indices of the structural model, GFI = 0.911, AGFI = 0.890, NFI = 0.945, CFI = 0.981, CMIN/DF = 1.505, and RMSEA = 0.038, were within their acceptable levels (J. Hair, 2009).

Table 1.4 Results of Structure Model

Fit indices	Cut off point	Model Fit (Structure Model)	Result
CMIN/DF	≤3.000	1.505	accepted
GFI	≥0.90	.911	accepted
AGFI	≥0.80	.890	accepted
NFI	≥0.90	.945	accepted
CFI	≥0.90	.981	accepted
RMSEA	≤0.08	.038	accepted

Hypotheses Testing

The main causal paths were tested using path coefficient analyses as seen in Table 1.4. The main factors of adopted UTAUT namely GSUB), shows (CR=.5.057), P < 0.001), PCR (CR= 4.449, P < 0.001), , SI (C. R= 2.106, P < 0.05) were found to have a significant impact on farmers intention to adopt climate smart agriculture technology , while as PC (C. R= -0.774, P > 0.05) shows negative and insignificant impact on farmers intention to adopt climate smart agriculture technologies

Furthermore FEXC (CR=3.303 P<0.001), FC (CR=6.43 P<0.001) and CSAT (CR=8.734 P<0.001 were found to have a significant impact on use behavior of climate smart agriculture technologies. Therefore, except for H2, all other research hypotheses (HI, H3, H4, H5, H6, and H7) were supported.

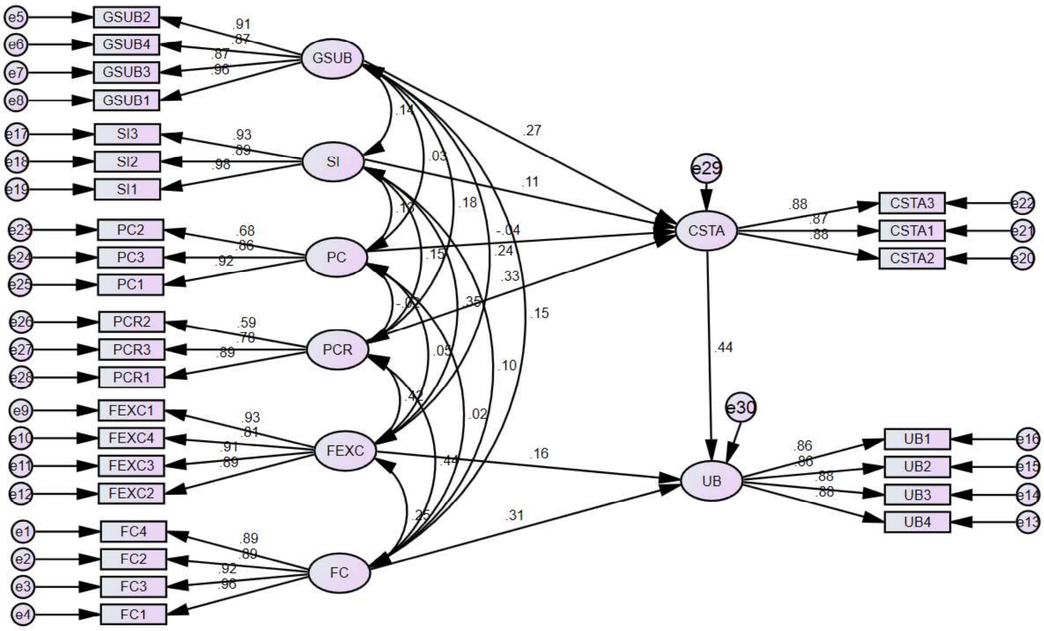


Table 1.5. Hypothesis Testing

			Estimate	S.E.	C.R.	P	Decision
CSTA	<-	GSUB	0.261	0.052	5.057	***	Accepted
CSTA	<-	SI	0.096	0.046	2.106	0.035	Accepted
CSTA	<-	PC	-0.048	0.062	-0.774	0.439	Not Supported
CSTA	<-	PCR	0.533	0.098	5.449	***	Accepted
UB	<-	CSTA	0.488	0.056	8.734	***	Accepted
UB	<-	FEXC	0.169	0.051	3.303	***	Accepted
UB	<-	FC	0.347	0.054	6.43	***	Accepted

Discussion

This study seeks to identify the key factors that influence farmers' intentions to adopt climate-smart agricultural technologies. As shown in Fig. 2, the conceptual model was also able to predict a significant portion of the variance in farmers' adoption climate smart agriculture technologies with an R2 value of 0.63. This, in turn, supports the predictive validity of the current study model.

First, farmers' perceived climate risk has the strongest influence on their intention to use climate-smart agricultural technologies (0.33), making it the strongest determinant of climate-smart agriculture adoption (Arbuckle, Morton and Hobbs, 2015). This finding is consistent with (Bunn *et al.*, 2015; Aryal *et al.*, 2018; Rodríguez-Barillas, Klerkx and Poortvliet, 2024). Agriculture in Kashmir valley is susceptible to weather vagaries and horticulture crops like apple has been the prime victim of climate change. uneven rains and cold in spring season led to late or reduced flowering and early snowfall in the month of November in recent years has led loss amounting to millions of dollars.

State intervention in terms of government subsidy has been an important determinant in motivating farmers to adopt climate smart farming in recent years. Government subsidy was fund to be the second important determinant of farmers' intention to use climate-smart agricultural technology (0.27). This result is consistent with previous studies (Liu and Liu, 2024) that the government encourages (Zhang *et al.*, 2017; SHI, PAUDEL and CHEN, 2021). Continuous policy support in terms of subsidy has enhanced the pace of climate smart agriculture practices in Kashmir for both sustainability and productivity.

Farmer extension contacts are pivotal in demonstrating the benefits of new technology to farmers. It was found that farmers' extension contacts positively and significantly influenced how they used climate smart agriculture technology (0.16) (Silva, 2016; Suvedi, Ghimire and Kaplowitz, 2017; Kassem *et al.*, 2021). Kisan Kendras have ben outreaching to farmers with the help of horticulture extension officers to demonstrate new and sustainable technologies along with making the adoption of climate smart agriculture technology adoption hassle free and one stop solution for farmers.

Facilitating conditions has a significant and positive impact on the use behaviour (0.31) of climate-smart agricultural technologies. The results are consistent with earlier studies (Schukat and Heise, 2021; Wiliam *et al.*, 2022). Climate smart agriculture technology adoption has been demarked as one of the high priority sectors in doubling farmers income. Keep in consideration the eco fragile landscape of Kashmir valley, the administration has been a proactive facilitator in climate smart agriculture technology adoption process.

Social Influence was found to significant factor in farmers CSA technology adoption. These results are consistent with earlier studies of (Moussaïd *et al.*, 2013; Ramirez, 2013). It is pertinent to mention that farmers are get influenced by their friends and relative’s positive trade-off about CSA technology adoption. The fear of missing out plays an important role in CSA technology adoption among other farmers.

Farmers' intention to adopt climate-smart agricultural technologies showed an insignificant relation with perceived cost (-0.04). These finding are supported by earlier studies of (Arfi et al., 2020; Klerkx & Rose, 2020).Cost of climate smart agriculture technology has no bearing on the adoption decision of the farmers because of government subsidy provided in up taking the technology. State intervention reduces the burden from the farmers shoulders leaving them with more disposable income.

The final behaviour intention has a positive and significant impact on farmers' use of climate-smart agricultural technologies (0.44) (Schukat and Heise, 2021; Wiliam *et al.*, 2022).

Conclusion, Implications and Future Research Direction

Climate-smart agriculture technology has immense potential to enhance food security, environmental preservation, and agricultural productivity. Researchers have previously studied the adoption of CSA technology in Jammu and Kashmir from a socioeconomic perspective. Previous studies have overlooked other factors that influence CSA technology adoption. This study extended and adopted the Unified Theory of Acceptance and Use of Technology (AUTAUT) model. This model more accurately predicts CSA technology adoption by identifying the factors that either encourage or hinder farmers from adopting it. Therefore, throughout the CSA technology innovation process, providers and regulators must consider the relationship between technological features and farmers' demands. There should be an effort to contact end users and other interested stakeholders early in the invention process to ensure efficient coproduction of CSA technologies that meet end-user expectations.

The study provides novel findings which can be incorporated in other countries to understand the factors affecting climate smart agriculture technology adoption among farmers. Despite this the study has few limitations as the area of study was limited to Kashmir valley. Future research can be built on these factors and increased the scope of study by doing comparative study of two states and increase the sample size. Along with that an integrated model can be applied where in factors like bank credit, Continuous policy support, Task technology characteristics and social media exposure can be explored in determining farmers intention to adopt new technology.

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