Farmer's environmental orientation as an antecedent to the intention for adopting conservational agriculture practices: the moderation analysis

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Abstract

Purpose – Pakistan has long been regarded as one of the most vulnerable countries to climate change. The Food and Agriculture Organisation of the United Nations promotes conservational agricultural practices (CAP); however, they received little attention. Therefore, this study aims to explore the antecedents of farmers' intention to adopt CAP with empirical evidence to enhance CAP in developing countries.

Design/methodology/approach – Using a random sampling strategy, the data has been gathered from 483 Pakistani's farmers of the most agriculture-producing province, Punjab and Sindh via a questionnaire survey. Regression-analysis (Haye's process approach) is implied for testing the hypothesis.

Findings – The findings indicated that a farmer's environmental orientation positively affects the farmer's intention to adopt CAP. Furthermore, the farmer's attitude towards agricultural production and the farmer's belief in climate change also positively moderate the relationship.

Retraction notice: The publisher of the *International Journal of Climate Change Strategies and Management* wishes to retract the article by Syed Hussain Mustafa Gillani, Malkah Noor Kiani, Saifullah Abid (2022), "Farmer's environmental orientation as an antecedent to the intention for adopting conservational agriculture practices: the moderation analysis', published in the *International Journal of Climate Change Strategies and Management* as a part of a special issue, Vol. ahead-of-print, No. ahead-of-print, https://doi.org/10.1108/IJCCSM-09-2021-0106. It has come to our attention that there are concerns that the peer review process was compromised; as a result, the standard of the article does not meet those expected by the journal and the findings cannot be relied upon. There is no evidence that the authors were involved. The authors would like it to be noted that they are not in agreement with this retraction. The publisher of the journal sincerely apologises to the readers.

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Practical implications – Based on findings, this research suggests a need for efforts by the government to encourage farmers to engage themselves in technical support for the adoption of CAP. The educational campaigns and training sessions need to be arranged by the government for this purpose. This may help the farmers to adopt strategies relating to climate change concerning their education, credit access and extension services.

Originality/value – This paper explores the antecedents of farmers' intention for CAP in Pakistan. The empirical evidence previously missing in the body of knowledge will support the governments, researchers and FAO to establish a mechanism for enhancing CAP in developing countries like Pakistan. Further research is recommended to explore the outcomes of farmers' intentions to adopt more CAP to gauge the effectiveness of adaptation strategies

Keywords Conservational agricultural practices, Climate change, Farmer's attitude, Farmers' environmental orientation, Farmer's attitude towards production, Conservative agriculture practices

Paper type Research paper

1. Introduction

Climate change is one of the most severe risks to life on earth's long-term viability. Global warming is a significant contributor to environmental degradation. Increased greenhouse gas emissions in the atmosphere because of fossil fuel burning raise the earth's average temperature and pollute the air (Lewandowsky, 2021). By altering the earth's climatic systems, climate change harms human life and the economy, resulting in floods, famines, droughts and cyclones, among other natural catastrophes (Izaguirre *et al.*, 2021). Reduced agricultural production, greater unpredictability in water supply, increased coastline erosion, saltwater intrusion and an increase in the frequency of severe climatic events are all anticipated to be consequences of climate change in Pakistan (Shah *et al.*, 2021). According to German Watch, Pakistan's geographical location has placed it among the top 10 countries most impacted by climate change over the past two decades.

Agriculture is the country's economic backbone, and it has been affected by climate change. Food availability, access and quality may all be harmed as a result of climate change (Shahzad and Abdulai, 2021). Temperature increases, precipitation patterns changes, extreme weather events and water scarcity can reduce agricultural productivity. According to crop simulation model-based research, wheat, rice and maize yields in Pakistan's dry, semi-arid and rain-fed areas would decrease substantially by the mid-to late century under different Intergovernmental Panel on Climate Change scenarios. The average maximum temperature is expected to increase in future projections. Temperatures in Pakistan's south-eastern region have been shown to exceed thresholds during flowering and ripening, resulting in wheat yield losses (Sardar *et al.*, 2021).

Pakistan benefitted from the green revolution, with wheat, general crops and rice productivity enhanced by approximately 150% (Zulfiqar and Thapa, 2017; Fahad and Wang, 2020). The extensive use of improved cultivars and inorganic fertilisers, as well as a significant dependence on pesticides and agricultural equipment, defined the green revolution (FAO, 2018). The green revolution's wide-ranging agricultural methods can damage soil fertility, greenhouse gas emissions and water quality. Pakistan's agriculture is on an unsustainable path, necessitating intervention through conservative agricultural practices (CAP). Government and non-government sectors encourage CAP (Huong *et al.*, 2017; Mazhar *et al.*, 2021).

The CAP are still in their infancy in terms of adoption (FAO, 2018). Conservative farming methods take much expertise, are not ubiquitous and need skill and drive Kassam *et al.* (2018). It is essential to recognise that conservative farming methods will not achieve their full potential unless the community and other stakeholders support them. Because of the fewer implementation of CAP, this research examined the inner values system of farmers as a decision-maker (Wamsler and Brink, 2018).

Farmers' intents as decision-makers are investigated to learn more about their choices of agricultural techniques to adopt and the variables that affect adoption intention and probability of subsequent adoption. Adopting conservative farming methods is a highly subjective choice affected significantly by the qualities of the decision-maker (Syed *et al.*, 2022). Farmers are believed to be irrational beings incapable of thinking about anything other than economic value. On the other hand, farmers are decision-makers who have personal preferences for production or environmental stewardship (Bukchin and Kerret, 2018).

Farmers are not a uniform group. They perceive and react differently to agriculture conservation issues, and their attitudes towards environmental problem control differ. As a result, understanding farmers' conservation attitudes and beliefs is critical for identifying and implementing effective agriculture conservation practices. This study, therefore, attempts to seek answers to the following research questions:

RQ1. Do farmers' environmental orientation affect the intention to adopt conservative agriculture practices?

RQ2. Do farmers' attitudes towards agricultural production moderate the association of farmer's orientation and intention to adopt conservative agriculture practices?

RQ3. Do farmers' beliefs in climate change moderate the association of farmers' orientation and intention to adopt conservative agriculture practices?

A dearth of research focuses on farmers as decision-makers and their environmental and production preferences (Hermans *et al.*, 2020; Small *et al.*, 2016). Despite the commitment of Food and Agriculture Organisation (FAO) and the governments of Pakistan, the conservational agricultural practices could not get the attention of farmers. This obvious inconsistency suggests the need for a much richer insight of farmer's intention to adopt conservational practices. It is crucial to shape farmers' intentions to implement conservational agricultural practices (Hermans *et al.*, 2020). Therefore, the significance of this study would be evident with the fact that this study aims to identify the antecedents for farmers' intention to adopt conservational agricultural practices. This study also contributes to the agricultural technology adoption literature to provide better insight of the farmer's intention to adopt conservational agricultural practices.

2. Theoretical perspective and literature review

The adoption theory describes the factors influencing farmers' decisions to engage in conservation agriculture. Two main perspectives may be differentiated in farmers' adoption of agricultural innovations: individualistic and constructivist approaches (Dormon *et al.*, 2004). The rational choice theory aligns with an individualistic perspective because it implies that the farmer makes rational decisions about adopting new technology based on preferences and full information availability. Innovation has been studied through innovation diffusion by farmers' acceptance of agricultural innovation and the resulting societal transformation in the developed world. When understanding adoption, the adopter perception model considers the person's viewpoint. Personal qualities (human values, education and experience); land features; and institutional considerations, such as increasing awareness via expansion, all affect this view (Lynne *et al.*, 1988). Consequently, individualistic perspectives portray innovation adoption as relating to an individual, with little regard for coordination between interdependent actors. Adopting an innovation is viewed as a continuous social process in which new behaviours are acquired in formal and informal contexts through information exchange, observation, imitation or normative action (Bandura, 1977). Furthermore, choices are made based on available knowledge and societal restrictions (De Long *et al.*, 1992). Conservation agriculture adoption may be defined as a farmer willingly adopting new technology (temporary or permanently) and necessitating empirical research.

2.1 Farmers' intention to adopt conservative agriculture practices

As defined by the United Nations' FAO, conservation agriculture is "a farming system that promotes maintenance of a permanent soil cover, minimum soil disturbance and diversification of plant species. It enhances biodiversity and natural biological processes above and below the ground surface, contributing to increased water and nutrient use efficiency and improved and sustained crop production." Conservation agriculture's four guiding principles are permanent residue soil cover, minimal soil disturbance, crop rotations and controlled traffic was added to this list by the FAO to avoid soil compaction and eliminate the need for tillage when zero-till agriculture is practised over a longer period of time (Gupta and Sayre, 2007). According to the FAO: "Conservation Agriculture maintains a permanent or semi-permanent organic soil cover. This can be a growing crop or dead mulch. Its function is to protect the soil physically from sun, rain and wind and feed soil biota. The soil flora and fauna take over the tillage function and soil nutrient balancing. Mechanical tillage disturbs this process. Therefore, zero or minimum tillage and direct seeding are important conservational agriculture elements. A varied crop rotation is also important to avoid disease and pest problems" (Gustafson and Friedrich, 2006).

Recent agricultural research goals are to decrease agriculture's negative environmental impact and improve the farm's micronutrient content, essential for agriculture. Climate change impacts agricultural research and investment in the future (Ward *et al.*, 2018). Farmers' acceptance of innovative agricultural technology and practices based on climate change mitigation is critical to agriculture's future (Chandra *et al.*, 2017). Developing nations must embrace innovative agricultural technology and techniques because of their higher dependence on agriculture than industrialised countries and other problems such as food security, poverty and economic development rely on agriculture (Ward *et al.*, 2018; Fahad and Wang, 2019). Technology adoption in agriculture is a well-researched subject, although most conservative agriculture practices (CAP) adoption studies are economic in nature, with just a few research focused on adopting farmers' behaviour. CAP are linked to three broad goals: flexible farming practices, a sustainable income for farmers and reducing greenhouse gas emissions from agricultural practices (FAO, 2018). The list of CAP is long and may seem variable among farmers sometimes (Findlater *et al.*, 2019). No-till or reduced tills/conservative tills are among the oldest and most recommended CAP (FAO, 2018). The benefits of no-till farming are well known, but adoption in developing countries is said to be low (Kassam *et al.*, 2018). Farmers prefer mechanisation (tractors) because they believe it can address labour shortages (Chandra *et al.*, 2017; Ozturk, 2016). No-till can be used in various ways to minimise soil disturbance, including zero till, minimum-till and two tills (Ozturk, 2011; Kassie *et al.*, 2015). Farmers increasingly turn to compost to replace inorganic fertilisers (Kassam *et al.*, 2018; Huong *et al.*, 2019).

However, acceptance is relatively limited in developing nations, with farmers' reluctance to use composting as an obstacle to adoption. Most farmers in emerging countries have never heard of composting, and those who do compost, do it only for their consumption. Composting is not commonly practised because it requires specialised skills, expertise and a workforce to convert non-standard materials into compost, such as manure and green waste (Kassam *et al.*, 2018).

Farmers' intention to practice CAP has been shown to be a significant indicator of their readiness to adopt CAP. To motivate farmers to switch to CAP, it is critical to understand their motivations. The theory of planned behaviour has grown in popularity as a social-psychological model for forecasting behaviour. Numerous authors analysed social behaviour in sustainable agriculture practices using the theory of planned behaviour (Terano *et al.*, 2015).

2.2 Farmer's environmental orientation

Farmers do not share a shared sense of self and have divergent farming preferences (Small *et al.*, 2016). In general, a farmer is regarded as favourable if he is environmentally conscious and uses specialised machines and inorganic fertilisers (Daxini *et al.*, 2018). For the past two decades, intensive agriculturalist strategies have been referred to as productive and environmental oriented, which has resulted in Asia's green revaluation (Kassam *et al.*, 2018). On the other hand, it is vastly different from what it was 30 years ago in today's world. Now, the farmers who engage in extensive environment-oriented farming practices are known to be productive (*Daxini et al.*, 2018). There is widespread agreement that farmers with a higher level of environmental education are more likely to practice conservation agriculture (D'Souza and Mishra, 2018). Additionally, economic considerations are the primary reason for adopting CAP in a number of regions around the globe (Hermans *et al.*, 2020). Farmer environmental orientations can substantially affect their intention to adopt in general, particularly on adopting CAP.

2.3 Farmer's attitude towards agricultural production

Attitude is a fundamental, intrinsic concept in social psychology that has been widely applied in the study of human behaviour (Edison and Geissler, 2003). Attitudes, as a concept, are used to determine whether an object or practice is favourable or unfavourable. In short, it has been defined as an indicator of how strongly a person likes or dislikes an idea, concept or point of view towards others (Olum *et al.*, 2020). What an individual perceives to be true or false influences the formation of attitudes. Attitudes influence an individual's behaviour and are influenced by behaviours and values. In agriculture, an individual farmer's decision-making process allows evaluating and forming favourable or unfavourable beliefs about agricultural practices. Although it may not always be possible to measure the process of belief formation, attitudes can be observed through people's choices, according to foundational theories on attitudes (Olum *et al.*, 2020). Individual small-scale farmers have been observed to behave differently in practice depending on their production needs or household circumstances (Syan *et al.*, 2019). One study that looked at attitudes towards using precision agriculture practices discovered that being confident positively affected processes adoption. Specifically, attitudes of confidence in using precision agriculture technologies, perceptions of net benefits and farm size influenced farm size's intention to adopt agricultural precision technologies (Adrian *et al.*, 2012). According to these studies, economic benefits may not be the primary motivator for producers to adopt precision agricultural technologies. The findings, however, do not conclude that they are generalisable across all technologies. There is a wealth of research on small-scale farmers' attitudes towards agricultural innovations (Ntshangase *et al.*, 2018); however, farmer experiences vary across developing countries. Ntshangase *et al.* (2018) used a cross-sectional study design to investigate the factors influencing the adoption of no-till conservation agriculture. According to the findings of that study, farmers' positive perceptions were positively correlated. When farmers are hesitant to adopt new processes because of lack of information or adequate training, access to extension services can influence a change in their perceptions of their agricultural practices (Morton, 2007). This argument, however, is dependent on the operating socio-cultural environment, which shapes the general belief system in a specific social context. Farmers' strategic responses to external change may be influenced by concerns about profit maximisation and by attitudes and values (Gasson and Errington, 1993). Farmers benefit from their importance on their families, communities, land and water. Regional studies are essential for understanding local populations because

attitudes and perceptions towards new practices do not remain constant across socio-cultural contexts and practices.

2.4 Farmer's belief in climate change

Climate change beliefs are a more significant element promoting transformative change (Yoder *et al.*, 2019). Farmers' views of weather-related difficulties were investigated by Below *et al.* (2012) as a potential predictor of adaptation during the past decade, but it was excluded from their final analysis, indicating its relative insignificance. In a survey of 148 Australian farmers, Milne (2008) established a connection between farmers' perceptions of climate change and their preparedness for and management of climatic risks. Hogan (2011) investigated the impact of climate change beliefs in two Australian farmer adaption models and found evidence of climate change. They began by investigating farmers' claims of being able to adapt using a risk management approach (comprising strategies such as financial improvement, diversification, risk management, development of farm plans, training and succession planning). They next looked at farmers' intentions to engage in adaptive activities using a second model (strategies like interest in carbon credits, use of new technologies and adopting sustainable land management practices). Despite finding evidence that farmers who observed physical evidence of climate change were less likely to adopt risk management methods. Farmers who saw physical evidence of climate change were less likely to implement risk management techniques. However, the results may be biased because of Hogan (2011) methodology. While many research studies have shown significant and positive links between climate change beliefs and behavioural changes. As Bostrom *et al.* (2012) point out, just a few studies have looked at how causal reasoning systematically impacts policy choices. This research aims to determine whether there is a link between farmers' belief in climate change and intention to adopt conservative agriculture practices. Although previous research (Park *et al.*, 2012) argues a causal link between climate change belief and intention adaptation, theory indicates that attitudes should influence behaviour; the relationship may be endogenous in some instances (Figure 1).

The summary of essential literature review and similar researches on study variables is illustrated in Table 1.

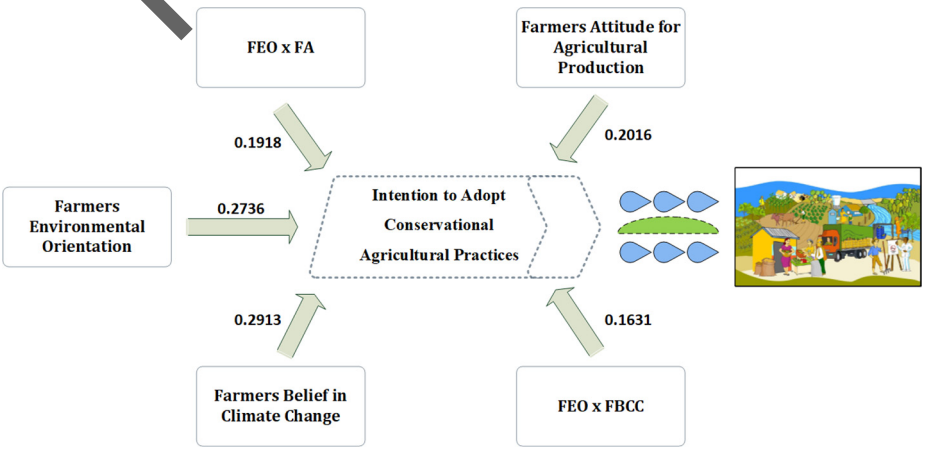

Figure 1.
Statistical diagram of theoretical framework

Table 1. Summary of literature review

Researches on CAP	Methodology adopted	Findings	Future research direction
Hermans *et al.*, 2020	Systematic study	The findings on review of published studies reveal that there exist two distinct approaches on understanding, "what forms the conservational agriculture practices"	Because the adoption rate of CAP are reported low, there is a need to develop improved understanding of farmer CAP adoption and decision-making
Yoder *et al.*, 2019	Systematic study	These findings revealed that CAP adoption researches seldom situates farmers in their institutional contexts	This study recommends that future research may track how knowledge about adoption feedbacks into farmer's perception, beliefs and social norms towards adoption
Findlater *et al.*, 2019	Quantitative survey approach	The findings showed that the implementation of CAP is highly variable among farmers in South Africa	There is a serious risk of misunderstanding of concept of CAP at farmer's level of South Africa, which is also a serious concern for CAP researchers
Olum *et al.*, 2020	Systematic study	The findings revealed that the determinants of farmer's willingness to accept CAP can be grouped into sociodemographic, biophysical, technological, institutional and behavioural factors	A number of consistent factors have been identified through this review that needs to be empirically explored in relation to the adoption of CAP practices
Syan *et al.*, 2019	Quantitative survey approach	The results of the study confirmed that perceived usefulness, self-efficacy and extension services play a significant role, whereas social capital, facilitating conditions and compatibility have no significant impact on the decisions to implement CAP	Future study can be further extended to examine the effect of sociocultural and other attitudinal factors on farmers' intention towards CAP
Ward *et al.*, 2018	Observational and experimental analysis	This study finds a find strong evidence of interrelated decisions, particularly among mulching crop residues and practicing zero tillage, suggesting that mulching residues and intercropping or rotating with legumes introduces a multiplier effect on the adoption of zero tillage	This study suggests that there is a range of factors that are correlated with CAP adoption, thus needs to be empirically explored
Chandra *et al.*, 2017	Systematic Analysis	The findings of study suggests that climate-smart agriculture such as conservational agriculture practices is a fairly new concept framed around three pillars at global, developed and developing countries level	Study suggests that the new researches are required to understand the differences in both developing and developed countries
Kassam *et al.*, 2018	Survey approach	The findings suggest that CAP was practised globally, corresponding to about 12.5% of the total global cropland. In 2008/2009, the spread of CAP was reported to an increase of some 69% globally. In 2015/2016, CAP adoption was reported by 78 countries, an increase in adoption by 42 more countries since 2008/2009, respectively. The largest extents of adoption are in South and North America, followed by Australia and New Zealand, Asia, Russia and Ukraine, Europe and Africa	This study suggests that CAP is the future sustainable agriculture. Thus, more empirical research on CAP are suggested for new researches
Daxini *et al.*, 2018	Quantitative survey approach	The results showed that the farmer's attitudes, subjective norms (social pressure), perceived behavioural control (ease/difficulty) and perceived resources are significant and positively associated with farmers' intentions to adopt CAP	Future research are suggested to empirically explore the other possible factors that may affect the intention of farmers. Furthermore, the actual adoption level of farmers may also be explored in future research

3. Methodology

3.1 Construct measures

The questionnaire has been adapted from several research studies to measure constructs. The dependent variable "Intention to adopt conversational agricultural practices" refers to the farmer's preference for innovative agricultural practices, as explained by the study of Venkatesh (2003). A six-items research instrument is adopted to measure this construct (Venkatesh *et al.*, 2003). The independent variable "farmer's environmental orientation" is a unidimensional construct and is measured with a five-item research instrument adapted from the study of McCann *et al.* (1997).

The moderating variable "farmer's attitude towards agriculture production" is operationalised with four sub-constructs of commerce, tradition, environment and technology (12-items instrument) adopted from the study of Wheeler *et al.* (2013). The moderating variable "farmer's belief in climate change" is measured with the three sub-constructs adopted (three-item instrument) from the study of Khanal *et al.* (2018).

3.2 Sampling and data collection

The research work has been carried out in Pakistan's two most agricultural producing provinces, i.e. Punjab and Sindh. The unit of analysis of this research work is the farming household head, as the head makes the agriculture production-related decisions of the farming household. The selection of the unit of analysis has been finalised in two phases. In the first phase, a list of all the districts falling in Punjab and Sindh has been prepared. In the second phase, the districts with non-farming households were exempted from the list. The union councils and wards (chak) of the farming households have been contacted to identify households involved in farming. The list of farming's household heads was developed and a sample of 500 households was selected using a simple random sampling strategy. The research instrument was translated into the local languages, i.e. Urdu, Punjabi and Sindhi. Only 473 respondents participated in the survey process.

4. Data analysis and empirical results

The descriptive statistics computing the mean standard deviation of all constructs are illustrated in Table 2. The results refer that the mean scores of participants' farmer's intention to adopt conversation agriculture practices and farmers' environmental orientation carry a high score ranging between 4 and 5. Similarly, the farmer's belief of climate change and the three subconstructs of farmer's attitude (commerce, tradition and environment) possess the highest score of 5. However, the fourth sub-construct of the farmer's attitude (technology) possesses an average score ranging between 3 and 4.

The K-R20 and Cronbach's alpha coefficients are the most frequently reported internal consistency estimates. Either one provides a reasonable underestimate (that is, a conservative or safe estimate) of a set of test results' reliability. The K-R20, on the other hand, can be used only if the test items are scored dichotomously (i.e. right or wrong). Cronbach's alpha can also be used to determine the reliability of test items that are scored dichotomously. However, alpha has the advantage over K-R20; in that, it can be used with weighted items (as in an item scored 0 points for a functionally and grammatically incorrect answer, 1 point for a functionally incorrect but grammatically correct answer, 2 points for a functionally correct but grammatically incorrect answer and 3 points for a functionally and grammatically correct answer). As a result, Cronbach's alpha is more adaptable than K-R20 and is frequently the most appropriate reliability estimate for language test development and research projects (Brown, 2002). Therefore, Cronbach's alpha is used for reliability

Construct	Sub-constructs	Item no	Sample mean	SD	Min values	Max values	Reliability
Intention to adopt CAP		1	4.05	0.49	1.00	5.00	
		2	4.37	0.68	1.00	5.00	
		3	4.13	0.69	1.00	5.00	
		4	4.89	0.73	1.00	5.00	
		5	4.37	0.76	1.00	5.00	
		6	4.21	0.81	1.00	5.00	
	Sub-total	*6*					*0.748*
Farmer's environmental orientation		7	4.69	0.48	1.00	5.00	
		8	4.54	0.59	1.00	5.00	
		9	4.5	0.4	1.00	5.00	
		10	4.58	0.69	1.00	5.00	
	Sub-total	*4*					*0.814*
Farmer's attitude towards agriculture production	Commerce	11	5.00	0.1	1.00	5.00	0.714
		12	5.00	0.1	1.00	5.00	
		13	5.00	0.1	1.00	5.00	
		14	5.00	0.1	1.00	5.00	
	Tradition	15	5.00	0.1	1.00	5.00	0.815
		16	5.00	0.1	1.00	5.00	
		17	5.00	0.1	1.00	5.00	
		18	5.00	0.1	1.00	5.00	
	Environment	19	5.00	0.1	1.00	5.00	0.781
		20	5.00	0.1	1.00	5.00	
	Technology	21	3.11	0.48	1.00	5.00	0.679
		22	3.75	0.94	1.00	5.00	
	Sub-total	*12*					*0.872*
Farmer's Belief in climate change	Climate information	23	5.0	0.1	1.00	5.00	
	Climate belief	24	5.0	0.1	1.00	5.00	
	Adaptation belief	25	5.0	0.1	1.00	5.00	
	Sub-total	*3*					*0.728*
	Total	*25*					*0.784*

Table 2. Descriptive statistics and reliability analysis

analysis. The reliability analysis showed that the Cronbach's alpha values of all the research measures also lie in acceptable ranges, i.e. above 0.6.

Before conducting the hypothesis testing, the correlation of the study variables were tested as depicted in Table 3. The results revealed that there exists a positive correlation of

Variables	1	2	3	4
(1) Intention to adopt CAP	1			
(2) Farmer's Environmental Orientation	0.751"	1		
	0.000			
(3) Farmer's attitude towards agricultural production	0.541"	0.767"	1	
	0.000	0.068		
(4) Farmer's belief in climate change	0.781"	0.667	0.328"	1
	0.000	0.091	0.000	

Table 3. Correlation matrix of study variables

dependent variable (intention to adopt conservational agriculture practices) with the farmer's environmental orientation, farmer's attitude towards agricultural production and farmer's belief in climate change with the correlation values of 0.751, 0.541 and 0.781 with *p*-value of 0.000 (that is less than 0.05), respectively. The results also revealed that the variables farmer attitude towards agricultural production and farmer's belief in climate does not correlate with independent variable farmer's environmental orientation with the *p*-values 0.068 and 0.091 (that are greater than 0.05), respectively. Thus, this satisfies the criteria of moderation effect.

Numerous articles in the research literature have discussed various design, analysis and interpretation issues that arise when testing hypotheses about the mechanisms and contingencies of effects, colloquially referred to as mediation and moderation analysis (Hayes and Rockwood, 2017). Moderation analysis is used when determining whether the magnitude of a variable's effect on an outcome variable depends on a third variable or set of variables (Hayes, 2012).

For hypotheses testing, the regression-based Haye's process approach has been used. The results are shown in Table 4. It has been found that the farmer's environmental orientation explains 67.86% of farmer's intentions to adopt conservative agriculture practices, farmers' attitudes and farmers' beliefs in climate change with the *p*-value = 0.000 < 0.05. The results also show that farmers' environmental orientation possesses the significant positive effect of 0.2736 on the farmer's intention to adopt CAP with the *p*-value = 0.000 < 0.05 and *t*-values = 8.82 > 2. Similarly, it has also been found that the farmer's attitude and farmer's belief in climate change also possess the positive significant moderation effect of 0.2016 and 0.2913 on the association of farmer's environmental orientation and intention to adopt CAP with the *p*-value = 0.000, 0.000 and *t*-values = 7.2 and 8.56, respectively. The farmer's attitude jointly with the farmer's environmental orientation also casts a synergizing moderating significant effect of 0.1918 with the *p*-value = 0.000 and *t*-values = 4.26 on the farmer's intention to adopt conservative agriculture practices. The results also reflect that the farmer's belief of climate change jointly with the farmer's environmental orientation also casts a positive synergizing moderating effect of 0.1631 with the *p*-value = 0.000 and *t*-values = 2.71 on the farmer's intention to adopt conservative agriculture practices.

"The *P* value is defined as the probability under the assumption of no effect or no difference (null hypothesis) of obtaining a result equal to or more extreme than what was observed. The P stands for probability and measures how likely any observed difference between groups is due to chance. Being a probability, P can take any value between 0 and 1.

Table 4.
Moderation effect of farmer's attitude and famer's climate change belief on intention to adopt conservative agriculture practices

Antecedent	Intention to adopt conservative agriculture practices Coef.	SE	*t*	*p*
Constant	2.548	0.747	3.41	0.000
Farmer's environmental orientation	0.2736	0.031	8.82	0.000
Farmer's attitude	0.2016	0.028	7.2	0.000
Farmer's belief of climate change	0.2913	0.034	8.56	0.000
Interaction_1 (FEO × FA)	0.1918	0.045	4.26	0.000
Interaction_2 (FEO × FBCC)	0.1631	0.060	2.71	0.001

Notes: $R^2 = 0.6786$, $F(4, 479) = 76.02$, $p = 0.000$

Values close to 0 indicate that the observed difference is unlikely to be due to chance, whereas a P value close to 1 suggests no difference between the groups other than due to chance" (Dahiru, 2008).

Thus, the results revealed that Farmers' environmental orientation positively effects on the intention to adopt conservational agricultural practices. Furthermore, this positive effect relation is significantly moderated by the farmers' attitude for production and belief in climate change. Thus, it can be represented in terms of regression equation as:

$$\mathrm{CAP} = \beta_0 + \beta_1 \mathrm{FEO} + \beta_2 \mathrm{FA} + \beta_3 (\mathrm{FEO} \times \mathrm{FA}) + \beta_4 \mathrm{FBCC} + \beta_3 (\mathrm{FEO} \times \mathrm{FBCC}) + e$$

$$\mathrm{CAP} = 2.548 + 0.2736\,\mathrm{FEO} + 0.2016\,\mathrm{FA} + 0.1918\,(\mathrm{FEO} \times \mathrm{FA}) + 0.2913\,\mathrm{FBCC} + 0.1631\,(\mathrm{FEO} \times \mathrm{FBCC}) + 0.747\,e$$

where CAP = conservational agricultural practices, FEO = farmer's environmental orientation, FA = farmer's attitude towards CAP, FBCC = the farmer's belief of climate change and e = error term.

5. Discussion

Based on the findings of this study, which reveal that if we need to enhance farmers' intention for conservational agricultural practices, there is a need to further strengthen the environmental orientational programs at a mass level for the farmers, particularly in developing countries where minor importance is given to such programs. These findings are also supported by existing literature (Findlater *et al.*, 2019; Olum *et al.*, 2020). As the developing countries already have budgetary and financial constraints, FAO may support such educational campaigns to empower farmers (Kassam *et al.*, 2018). Government programs aimed at raising national awareness about soil erosion have successfully reached this sample. The farmers who took part in the discussion had a good grasp of the problem. The fact that farmers across the country are so concerned about soil erosion shows how well-informed they are. When it comes to agricultural chemical use, raising awareness and supporting alternative practices are especially important. The farmers who took part in the survey expressed some concern about agricultural chemicals in their answers. These findings are also supported by existing literature that evidence the influential role of farmer's feedback and resources on intention to adopt CAP practices (Daxini *et al.*, 2018; Yoder *et al.*, 2019).

Peterson (1991) predicted that conservation would take on a fundamentally dysfunctional outlook. Farmers see themselves as stewards of the land, but they frequently jeopardise its well-being for the sake of their livelihood (Syan *et al.*, 2019). Even though the farmers who took part in this study are not necessarily representative of all nation's farmers as a whole, it is clear from the findings that the dichotomy of paradigms described above is nuanced. Farmer participants were concerned about both the economy and the land's health. This study further confirms the findings of Napier *et al.* (1988) and Buttel *et al.* (1981), which point to the importance of economics in farming decisions. Farmers are usually proud of their goods and frustrated by the insufficient financial reward for their efforts. They are reliant on an economic system over which they have no influence. Their farms' long-term productivity is also a significant concern for them.

6. Conclusion and policy recommendations

This study concludes that the farms with a wider variety of crops may be enticed to adopt more sustainable practices. Evidence indicates that larger firms can afford to experiment with new (and possibly more sustainable) agricultural practices because they have the financial resources to do so (Esseks *et al.*, 1990). There's also the argument that larger farms

are more concerned with making money now than long-term investments (Buttel *et al.*, 1981). Accordingly, farm structure may have an impact on farmers' willingness to implement more environmentally friendly farming practices. Future studies are encouraged to investigate empirically in this manner. This study demonstrates the caution that researchers should exercise when developing instruments to measure sustainability. To begin, farmers in our sample routinely test their soil for contaminants. Soil fertility may be more critical than previously thought. On the other hand, the informal interviews revealed that the majority of farmers have their soil tested by chemical fertiliser dealerships, which offer testing along with chemical products as an incentive to buy them. When soil quality is prioritised, plant growth indicators can be used to gauge progress, and farmers are doing everything they can to avoid degrading the soil; they may be less concerned about soil monitoring. They might think soil testing is pointless. As more research is conducted, it will be possible to add to this body of knowledge by including more people from different backgrounds and perspectives. Given modern agriculture's numerous and severe environmental consequences, it is critical that farmers who farm sustainably keep up their practices and encourage more farmers to practice conservation. Further research should look at more than just farmers' intentions to adopt more CAP to gauge the effectiveness of adaptation strategies.

According to the findings, this research study suggests some policy implications. There is a need for efforts at the governmental level to encourage farmers to engage themselves in technical support for the adoption of conservational agriculture practices. The educational campaigns and training sessions need to be arranged by the government for this purpose. This may help the farmers to adopt strategies relating to climate change concerning their education, credit access and extension services. Understanding the farmer's beliefs about climate change, their acceptance of climate change and their ability to adapt is crucial in assessing their commitment to using conservation agriculture, which could help increase farm productivity. Pakistan is actively enacting programs to ensure that it can respond to the changing climate. Adaptation plans for agriculture should include local and national programs as well as the adjustments that farmers are making to their farms.

This study also possesses some limitations that pave the way for future research. This research study has empirically explored the farmer's intention to adopt conservational agriculture practices. However, the actual adoption rate of farmers has not been tested by this research work. It is therefore suggested that future research may explore the future behaviour of farmers concerning the farmer's intention to adopt conservational agricultural practices. Furthermore, this research study also recommends the need for longitudinal studies on the decision-making behaviours of farmers and other factors that may encourage them towards more sustainable agricultural practices.

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Appendix

Annexure – Research Instrument

Dear participants!
Please respond to all the statements as
strongly disagree (1), disagree (2), neutral (3), agree (4), strongly agree (5)

Intention to Adopt conservational agricultural practices

1. I think that no-till use will have better farm production.
2. I think that manure use requires more effort to use in my farm
3. I think the use of crop residue on farms projects a positive impression of me on my fellow farmers.
4. I think I will have the necessary support to use the legume on my farm
5. I think I will have the soil quality test for better farm production
6. I intend to adopt the above practices (conservative agriculture) in next season

Farmer's Environmental Orientation

7. Farmer's decision can have an important effect on the environment.
8. Agricultural pollution is a serious environmental problem for us.
9. Soil erosion can be a serious problem for our farm.
10. Pollution from agricultural chemicals is a serious problem in Pakistan.

Farmer's Attitude towards agriculture production

11. Financial gain is the only reason for my involvement in farming.
12. Rupees is what farming is all about.
13. A maximum annual return from my property is my most important aim
14. I view my farm as first and foremost a business enterprise Tradition
15. I could never imagine living anywhere other than this area
16. I want to continue farming as long as I am able.
17. Farming is the only occupation I can imagine doing.
18. My life would be worse if I moved from this farm.

Environment

19. Managing environmental problems on my farm is a very high priority.
20. I am willing to do something about the environmental effects of my farming practices.

Technology

21. Knowing about new technology that becomes available is important to me.
22. I am open to new ideas and alternatives about farming.

Farmer's Belief of Climate Change

Climate Information

23. I regularly receive information on climate change.

Climate Belief

24. I believe that the climate has changed in our local area.

Adaptation Belief

25. I believe adaptation minimizes negative climate change impacts on agricultural production.

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