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Internal Emotions and External Barriers Hindering Farmers' Adaptive Behavior to Climate Change

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Abstract:

This study aimed to investigate the factors hindering adaptive behaviors to climate change. Although focusing on barriers to adaptation may appear pessimistic, internal psychological distress is a genuine response to threats such as climate change, and—along with external barriers—can reduce adaptability. The study population consisted of farmers in Zanjan Province, Iran. The sample size was determined using Cochran's formula, and stratified sampling was employed. An investigation of the adaptive behaviors adopted by farmers over the past five years showed that strategies such as using drought-tolerant native crop varieties with lower water requirements—drawing on local knowledge and experience—were the most commonly implemented. Inferential results indicated that internal emotions such as eco-anger, followed by external barriers including financial, water, information, and technological constraints, were the most significant obstacles to adopting adaptive behaviors. Additionally, age, work experience, and farm size showed a negative correlation with farmers' adaptive behavior. The study concludes with discussions and recommendations for relevant organizations to address climate change and enhance adaptive responses.

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INTRODUCTION

Climate change and anthropogenic pressures are altering patterns of rainfall, temperature, storms, and drought, intensifying negative impacts on natural systems. The accumulation of atmospheric greenhouse gases is driving a rise in global mean surface temperature at a rate of $0.2^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$ per decade, currently placing temperatures about 1.0°C above pre-industrial levels. Each additional increase of 0.5°C to 1.0°C in global mean temperature significantly raises the frequency of extreme events. Humanity has a limited window to keep global warming below 1.5°C and avoid severe human and environmental disasters.

Iran, the study area, is an arid and semi-arid region in the Middle East with a long history of frequent and severe droughts (Pakmehr et al., 2021). An investigation of surface

temperature, total precipitation, and upward long-wave radiation (ULR) in Iran indicated an anomalous decrease in precipitation events and an anomalous increase in ULR and temperature—confirming the effects of climate change (Mansouri Daneshvar et al., 2019).

Furthermore, an analysis of the natural climate variability in Zanjan Province—the target location of this study—using the Long Ashton Research Station Weather Generator (LARS-WG) model showed that temperature and precipitation in the region have changed over the past 30 years and are projected to continue changing in the future (Khazaei et al., 2019). Climate change is now one of the most pressing challenges facing humanity (Hoegh-Guldberg et al., 2019). Studies show that agriculture accounts for about 80 percent of climate change-related damages (Valizadeh et al., 2021) and, along with forestry

and land use activities, is responsible for 24 percent of total global anthropogenic greenhouse gas emissions (Zhang et al., 2020). At the same time, agriculture—which supports rural livelihoods and food security (Ghanian et al., 2020)—is highly vulnerable to climate change (Ghazali et al., 2021; Wheeler et al., 2021). Therefore, adaptive actions in the agricultural sector are essential to mitigate these interlinked impacts (Mu et al., 2020).

Adaptation refers to the modification of farming actions, procedures, and systems to reduce vulnerability to climate change (Masud et al., 2017). It helps mitigate negative impacts while enhancing potential benefits, leading to improved social and ecological outcomes (Whitney et al., 2017). The literature classifies adaptation strategies into three categories: hard (infrastructure interventions), soft (institutional changes), and ecosystem-based (farm management and conservation) (Whitney & Ban, 2019). However, the strategies adopted vary by geographical region, depending on the nature and extent of climate impacts, as well as individuals' access to resources. For instance, in Pakistan, strategies included early sowing, water harvesting, terracing, and tree planting (Ali et al., 2021). In Botswana's Bobirwa sub-district, households employed strategies such as drought-tolerant crop varieties, early-maturing crops, sequential cropping, altered planting times, and the introduction of new crops. The least used strategies were conservation agriculture and farming in other villages or regions (Mugari et al., 2020).

On-farm technical adaptation, a frequent project objective (Biagini et al., 2014), includes soil conservation, water-saving and harvesting techniques (Chalise et al., 2015), crop diversification (Zhang et al., 2022), precision farming, adjusted planting periods, and agricultural insurance (Ghanian et al., 2020; Hamidianpour et al., 2020). Zhai et al. (2018) found that increasing irrigation and adjusting crop varieties were the most common strategies, while purchasing insurance and exiting agriculture were the least adopted.

Actions to mitigate and adapt to climate change have combined impacts on both present and future socioeconomic conditions. Therefore, understanding the barriers to such actions is critical, although this area has received limited direct attention in existing studies (Warren-Myers et al., 2020). Adaptation efforts are influenced by the structural characteristics of farms, farmers' attitudes, and the barriers they face (Sardaro et al., 2021). These barriers constrain farmers' ability to respond effectively to the adverse effects of climate change (Shrivastava et al., 2019). Understanding these barriers requires a comprehensive view of the adaptation process, including problem recognition, planning, and implementation (Simoes et al., 2017), especially in the context of interconnected climate risks (Fatorić & Biesbroek, 2020). In semi-arid northwestern China, adaptation challenges include limited access to resources and government support, as well as a lack of scientific and effective coping strategies (Mu et al., 2020). Ghanian et al. (2020) found that Iranian farmers' intention to adapt is directly influenced by maladaptation and indirectly affected by economic disincentives and

other barriers. In a qualitative study, Chenani et al. (2021) identified key barriers to adaptation in Iran, including economic, socio-cultural, informational, technological, and market-related constraints. Similarly, Azadi et al. (2019) reported that financial management accounts for 25 percent of farmers' adaptation responses in Iran. Elsewhere, Warren-Myers et al. (2020) classified barriers to climate action into three main categories: lack of reliable, clear, and trusted information; financial constraints; and regulatory issues. Chalise et al. (2015) emphasized the crucial role of governments and other stakeholders in promoting locally-led adaptation initiatives beyond mitigation. Shrivastava (2019) categorized adaptation barriers into technical, institutional, input-related, and socioeconomic types, highlighting that the cost-ineffectiveness of strategies and technical limitations—such as inadequate information, lack of relevant agricultural policies, and untimely input availability—impede farmers' ability to adapt. Zhai et al. (2018) identified major barriers to adaptation among Chinese farmers as shortages of irrigation, land, labor, funds, and information. In Pakistan, Ali et al. (2021) noted that institutional, economic, and social barriers are the most prominent. Other common obstacles hindering farmers' adaptive behaviors include insufficient information, lack of technical expertise, financial constraints, limited land access, and inadequate technology (Chalise et al., 2015; Karkiet et al., 2020; Zhai et al., 2018). Additional barriers identified by Ali et al. (2021) include the absence of certified seeds, water scarcity, lack of market access, and insecure land tenure systems. Sardaro et al. (2021) found that farmers in southern Italy face social, cultural, economic, and cognitive barriers. Psychological factors also play a role. A fixed mindset regarding environmental change may hinder adaptive behavior (Duchi et al., 2020). Integrating psychological barriers into models of pro-environmental behavior change could enhance the effectiveness of interventions (Graves & Roelich, 2021; Xue et al., 2021).

“Climate change has brought about an emerging psychological phenomenon” (Reyes et al., 2021). Psychological barriers are described as dragons of inaction (Lacroix et al., 2019). While a common but oversimplified assumption is that increased information about climate change leads to pro-environmental behavior, this perspective neglects the social-psychological processes triggered by exposure to threatening information (Kapeller & Jäger, 2020) or the experience of threat (Xue et al., 2021). Behavioral intention and action are not only influenced by empowerment (Ghasemiket al., 2021) and positive emotions but are also associated with negative emotions (Lu & Schuldt, 2015; Zhao et al., 2017). Research has shown that climate change induces psychological distress (Hosseini et al., 2017; Yazdanpanah et al., 2021), manifesting in feelings of sadness, anxiety, anger, powerlessness, helplessness, and guilt—emotions that negatively affect daily life and functioning across affective, cognitive, and behavioral dimensions (Hickman et al., 2021). While Pakmehr et al. (2021) found that emotions such as stress, depression, and anger are ineffective in promoting adaptive behavior.

Reported emotions stimulated by climate change include anxiety (Clayton & Karazsia, 2020; Panu, 2020; Usher et al., 2019), fear (Kleres & Wettergren, 2017; Panu, 2020), depression (Sciberras & Fernando, 2022; Stanley et al., 2021), frustration (Stanley et al., 2021), and anger (Panu, 2020; Stanley et al., 2021). Although “anxiety relating to a multitude of ecological crises, or eco-anxiety, is a subject of growing research significance” (Hogg et al., 2021) and has been extensively studied in mental health research (Reyes et al., 2021), limited attention has been paid to depression, frustration, anger (Antadze, 2020; Stanley et al., 2021), and fear—especially in agriculture and among farmers who work on the frontline with nature. Psychologically, frustration and depression are unlikely to motivate action (Stanley et al., 2021); anxiety is an activating emotion that tends to motivate flight from threat, anger tends to motivate fight (Harmon-Jones, 2003), and fear is a strong inhibitor of collective action (Miller et al., 2009), although it can “motivate action by raising awareness of the threat of climate catastrophe,” often managed by anger (Kleres & Wettergren, 2017). The belief that climate change is unstoppable and beyond human control may increase anxiety (Mayer & Smith, 2019). Clayton and Karazsia (2020) found that climate change anxiety is common, especially among younger adults, and is associated with emotional but not behavioral engagement. The effect of anxiety on behavior largely depends on environmental self-identity, and communities lacking encouragement to adapt may respond with symbolic defense mechanisms, such as adopting a more negative outlook (Uhl, Jonas, & Klackl, 2016). Depression was also found unrelated to behavioral responses (Clayton & Karazsia, 2020). Stanley et al. (2021) found eco-anger to be a key emotional driver predicting greater engagement in personal pro-climate activism, while eco-depressed individuals were more likely to engage in collective climate behavior, and eco-anxious people were less likely to participate. Additionally, people with higher behavioral approach motivation in anger preferred immediate smaller rewards (Zhao et al., 2017), which in agriculture may translate to over-extraction of natural resources to maintain previous crop yields under climate change. Rural communities generally experience diverse concerns about climate change (Austin et al., 2020), but how eco-emotions influence adaptation in agricultural activities remains unclear.

METHODOLOGY

We used a survey to collect quantitative data for this study. A total of 265 structured questionnaires were administered to farmers who had been randomly selected through stratified sampling procedures. The number of samples was calculated based on Cochran’s formula. Nine villages were selected randomly from the Zanjan province and a representative sample was drawn from each village proportionally. Each of the 268 randomly selected farmers was asked about their age and household demography (marital status, family size), and to state their work experience, farm size, having a second job in addition to agriculture, and participation in climate change course. The

farmers were also inquired to report actual practices taken to combat climate change over the last 5 years to determine climate change adaptation. To develop the measure of adaptive behavior on the farm, measures on climate change adaptation consist of Ghanian et al., (2020), Hamidianpour et al, (2020), and Zhai et al, (2018) have been reviewed and 7 items have been used including: “using drought-tolerant native crop varieties”, “using products with lower water requirements”, “adopting new technologies”, “using low-tillage techniques”, “adjusting the periods of planting”, “purchasing agricultural insurance”, “using biological control”.

Respondents were also asked about barriers to adaptive behavior over the past five years, focusing on financial, skilled labor, information, technology, water, and land constraints, based on literature (Ali et al., 2021; Chalise et al., 2015; Karki et al., 2020). Eco-emotions—eco-anger, eco-anxiety, eco-depression, eco-frustration, and eco-fear—were examined using scales adapted from recent studies (Clayton & Karazsia, 2020; Hogg et al., 2021; Stanley et al., 2021). Questionnaire validity was confirmed by subject matter experts, and reliability was tested via a pilot study. Data were collected through face-to-face interviews and analyzed using Smart Partial Least Squares (PLS).

RESULTS

The average age of respondents was 41.2 years, with about one-third married and an average family size of around five. The mean agricultural experience was 22 years. Among them, 64.2% were engaged solely in agriculture, while 35.8% reported secondary jobs such as service work, handicrafts, and beekeeping. The average farm size was nearly 5 hectares.

Adaptive behavior over the past five years was measured using seven Likert-scale items (1 = very low to 5 = very high) and is presented in Fig. 1 based on mean scores. The most common adaptation strategies were using drought-tolerant native crop varieties, products with lower water requirements, and adjusting planting periods—reflecting reliance on local knowledge. Strategies requiring new scientific knowledge, timely information, appropriate technology, and financial capital were less adopted, indicating gaps in these conditions. Low to moderate use was reported for low-tillage techniques and purchasing agricultural insurance. The least used strategies were biological control and adopting new technologies (Figure 1).

As shown in Table 1, a Pearson product-moment correlation coefficient was computed to assess the relationship between farmers’ contextual variables and adaptive behavior. Results indicate a significant negative correlation between adaptive behavior and age ($r = -0.218$), farm size ($r = -0.299$), and work experience ($r = -0.323$) at the $p < 0.01$ level. Additionally, the number of climate change courses attended by respondents showed a significant positive correlation with adaptive behavior ($r = 0.297$, $p < 0.01$).

The estimated PLS structural model provided a satisfactory fit to data, based on the statistical goodness of-fit indices

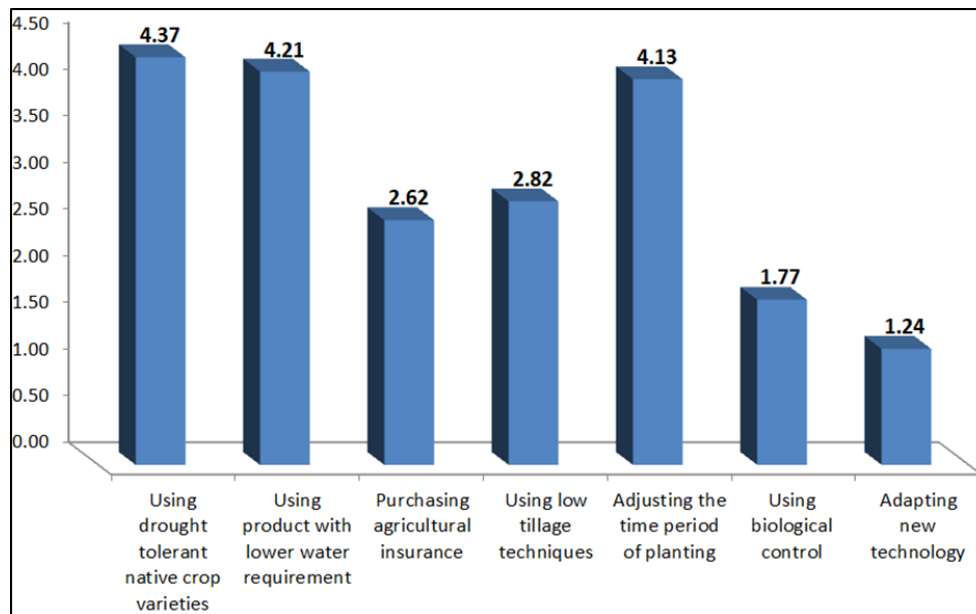


Figure 1. Adaptive Behavior of Farmers on the Farm during 5 Past Years Measured Using Likert-type Scaling from Very low (1) to Very high (5).

Table 1. Pearson Correlation of Contextual Variables with Farmers' Adaptive Behavior.

Variable	R-value
Age	-0.218**
Farm size	-0.299**
Work experience	-0.323**
Number of courses participate	0.297**

Note: * $p < 0.05$; ** $p < 0.01$

consist of the NFI (0.902) which significantly pass the cut off value (0.9) and SRMR (0.041) with a value less than 0.08 shows a strong fit (Fig. 2). The result according to the hypothesized structural model demonstrated that; among the eco-emotions variables the impact of eco-anger ($\beta = -0.210$, $t = 3.544$, $p < 0.001$) and eco fear ($\beta = .2938$, $t = 4.282$, $p < 0.001$) on farmers' adaptive behavior to climate change were significantly different from zero, where the impact for eco-anger was negative and for eco-fear was positive on farmers' adaptive behavior to climate change (Table 2). While the result showed that the effect of eco-anxiety ($\beta = 0.042$, $t = 0.724$, $p > 0.05$); eco-depression ($\beta = -0.028$, $t = 0.377$, $p > 0.05$); and eco-frustration ($\beta = -0.003$, $t = 0.045$, $p > 0.05$) were not significant on farmers' adaptive behavior to climate change (Table 2). Furthermore, the result revealed that among the constraint variables the impact of financial constraint ($\beta = -0.192$, $t = 2.409$, $p < 0.05$); information constraint ($\beta = -0.160$, $t = 2.170$, $p < 0.05$); technology constraint ($\beta = -.155$, $t = 2.141$, $p < 0.05$); and water constraint ($\beta = -.188$, $t = 2.337$, $p < 0.05$) on farmers' adaptive behavior to climate change were negative and significantly different from zero at the 0.05 level. Whereas the result showed that the impact of land constraint ($\beta = -0.026$, $t = 0.416$, $p < 0.05$) and skilled workers constraint ($\beta = 0.003$, $t = 0.044$, $p > 0.05$) were not significant (Table 2).

The general equation of the proposed structural model takes the form (Equation 1):

$$Y_1 = b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_6 X_6 + b_7 X_7 + b_8 X_8 + b_9 X_9 + b_{10} X_{10} + b_{11} X_{11} + \varepsilon \quad (\text{Equation})$$

Where

b_x = Slope (estimates of coefficients)

Y_1 = Adaptive Behavior

X_1 = Eco Anger

X_2 = Eco Anxiety

X_3 = Eco Depression

X_4 = Eco Fear

X_5 = Eco Frustration

X_6 = Financial Constraint

X_7 = Information Constraint

X_8 = Land Constraint

X_9 = Skilled Workers Constraint

X_{10} = Technology Constraint

X_{11} = Water Constraint

ε = model error of estimate

Therefore, the prediction equation of the model is presented as follows;

$$Y_1 = -0.21 X_1 + 0.042 X_2 - 0.028 X_3 + 2.93 X_4 - 0.003 X_5 - 0.192 X_6 - 0.160 X_7 - 0.026 X_8 + 0.003 X_9 - 0.155 X_{10} - 0.188 X_{11} + \varepsilon$$

Moreover, the result based on the estimated structural model showed that approximately 37% of farmers' adaptive

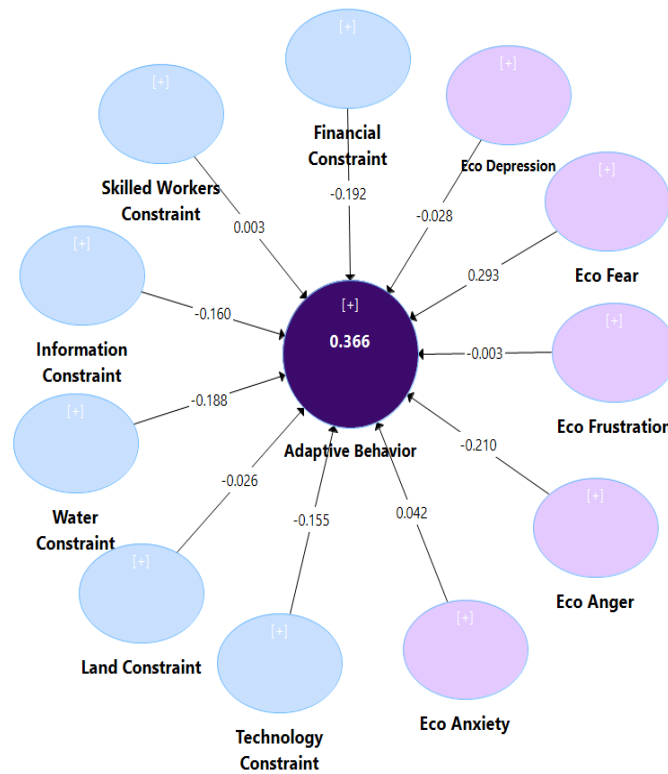


Figure 2. Hinders of Farmers’ Adaptive Behavior to Climate Change.

Table 2. The Result of Hypothesized Path Model.

Path	Estimate	t- Statistics	p-value
Eco Anger (X ₁) → adaptive behavior	-0.210	3.544	0.000
Eco Anxiety (X ₂) → adaptive behavior	0.042	0.724	0.469
Eco Depression (X ₃) → adaptive behavior	-0.028	0.377	0.706
Eco Fear (X ₄) → adaptive behavior	0.293	4.282	0.000
Eco Frustration (X ₅) → adaptive behavior	-0.003	0.045	0.964
Financial Constraint (X ₆) → adaptive behavior	-0.192	2.409	0.016
Information Constraint (X ₇) → adaptive behavior	-0.160	2.170	0.030
Land Constraint (X ₈) → adaptive behavior	-0.026	0.416	0.678
Skilled Workers Constraint (X ₉) → adaptive behavior	0.003	0.044	0.965
Technology Constraint (X ₁₀) → adaptive behavior	-0.155	2.141	0.033
Water Constraint (X ₁₁) → adaptive behavior	-0.188	2.337	0.020

behavior to climate change had explained by proposed variables (Fig. 2).

DISCUSSION AND CONCLUSIONS

Climate change in addition to causing environmental disasters has different effects on human physical and mental health which psychological effects are still not well understood (Reyes et al., 2021) and can play a major role in intensifying or reducing environmental effects (Graves & Roelich, 2021; Xue et al., 2021). Considering that the whole target population of this study has been

exposed to and experienced climate change (Khazaei et al., 2019) we concentrate on the emotions in response to climate change which according to Stanley et al. (2021) are discrete in meaning and imply reasonably different action. The study results showed that eco-fear and eco-anger significantly influence the adaptability of farmers but in a different way. Individuals who feel fear try harder and focus on goal-pursuit to avoid future negative events and to eliminate danger, taking adaptive action which is consistent with the study results of Kleres and Wettergren (2017) that showed how fear stimulates behaviour by

raising awareness of climate change. The negative impact of eco-anger, though meaningful, acted as a restrictive to adaptive behavior in line with Harmon-Jones (2003) that declare anger motivates a person to fight. It can be argued that environmental anger, instead of leading the individual to more adaptive behaviors, leads them to maladaptive behaviors and more extraction from natural resources to achieve pre-climate change crop yield on the farm consistent with a study that discuss people in anger moods preferred immediate reward (Zhao et al., 2017). The results of this study did not reveal a significant relationship between eco-depression and eco-frustration with adaptive behavior, aligning with the findings of Pakmehr et al. (2021) and the psychological view that frustration and depression are generally ineffective motivators for action (Clayton & Karazsia, 2020; Stanley et al., 2021). However, the negative standardized beta coefficients for both variables suggest they may act as barriers to adaptation and warrant attention from mental health professionals. Eco-anxiety also showed no significant effect on adaptive behavior, indicating that the level of anxiety experienced by farmers was not high enough to drive behavioral change. The positive beta value of eco-anxiety suggests that while farmers may feel some anxiety, they remain inclined toward adaptation. This contrasts with Kapeller and Jäger (2020) and Uhl et al. (2016), who suggested that anxiety could trigger symbolic defense mechanisms rather than proactive responses. There are growing concerns about climate change (Simoes et al., 2017), particularly in agriculture, which is both highly vulnerable and a contributor to anthropogenic climate change (Karki et al., 2020). Effective mitigation in this sector depends on farmers' ability to implement adaptive strategies, yet various constraints limit this capacity. The study results show that financial constraints are the most significant external barrier to adaptation, confirming findings across diverse contexts, including Iran (Ghanian et al., 2020; Chenani et al., 2021), Australia (Warren-Myers et al., 2020), India (Shrivastava et al., 2019), China (Mu et al., 2020), Pakistan (Ali et al., 2021), Nepal (Chalise et al., 2015), and Italy (Sardaro et al., 2021). The persistence of financial barriers in global research from 2015 onward highlights that, despite academic recognition, no effective operational solutions have been implemented. Expecting farmers, who ensure food security and often lack substantial land and capital, to bear this burden is unrealistic. Additionally, top-down adaptation models have proven ineffective (Chalise et al., 2015), and locally-driven models struggle without external support. Therefore, international legal frameworks paired with community-driven strategies are essential.

The next critical external barrier to adaptive behavior was water constraints, consistent with Ali et al. (2021), which can only be mitigated through advanced precision agriculture or water harvesting methods. However, the implementation of such technologies is inherently linked to financial capacity, a limitation already identified. This aligns with the study's descriptive results, which showed minimal adoption of precision technologies among farmers as a climate change adaptation strategy. The third significant

constraint, information access, also negatively affected adaptive behavior. As noted by Shrivastava et al. (2019) and Chenani et al. (2021), this barrier can be addressed through effective extension services that deliver timely and relevant information. Technological constraints were another significant limiting factor, further emphasizing the systemic nature of the challenges—technology access requires both capital and knowledge. Contrary to previous studies (Chalise et al., 2015; Karki et al., 2020), land constraints were not a significant factor in this study. A possible explanation is that farmers may lack awareness of the reciprocal relationship between soil health and climate change. Climate factors influence soil formation and biological activity, while soil processes affect greenhouse gas levels. Properties such as temperature, gas composition, organic matter, and salinity are all climate-sensitive. It is, therefore, essential for extension agents to raise awareness and provide training in these areas. Unlike the findings of Zhai et al. (2018), this study's respondents did not perceive a lack of skilled labor as a barrier, indicating either sufficient access to labor or that labor quality is not currently a limiting factor for adaptation in the region studied.

In the context of a threat like climate change, standardized beta results demonstrated that internal emotions—specifically eco-fear and eco-anger—were stronger predictors of adaptive behavior than external barriers such as financial, water, information, and technology constraints. These findings imply several key points:

First, internal emotions are more influential than external factors in shaping adaptive responses. Second, since eco-fear positively and eco-anger negatively influence adaptation, targeted psychological interventions to manage eco-anger are essential. Third, financial constraints remain a core external barrier, closely linked to other limitations, particularly access to water-related technologies. Fourth, individual attributes such as age, work experience, and land size negatively correlate with adaptive behavior, reinforcing findings by Zhai et al. (2018). This suggests that younger and small-scale farmers are more inclined to adopt climate adaptation strategies, whereas older and larger-scale farmers are more resistant. This poses a significant challenge for societies with aging farming populations and concentrated land ownership, signaling an urgent need for tailored policies and support systems.

This study recommends educational interventions as a key strategy, grounded in the observed positive correlation between participation in climate change training and the implementation of adaptive behaviors. To enhance farmers' adaptive capacity, it is essential to design programs that both promote technical knowledge and address psychological barriers such as frustration, depression, and anger. Managing these eco-emotions through targeted training can redirect emotional responses toward constructive, adaptive actions. A successful green transition demands psychological insight to ease climate-related stress and foster practical, locally-driven adaptation strategies. Removing external barriers—especially financial and informational—is critical. Collaborative models involving

local communities, supported by higher-level institutions, are recommended to replace ineffective top-down approaches. Such a structure not only reduces emotional distress but also strengthens community bonds with the environment. Given the global nature of climate threats, mitigation efforts must extend beyond national boundaries. International organizations should establish enforceable protection frameworks mandating adaptive behaviors and holding governments accountable for implementation to effectively address anthropogenic climate change.

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CONFLICTS OF INTERESTS

The author declares no conflict of interest with respect to the authorship or the publication of this article.

AUTHOR CONTRIBUTIONS

The study conception and design, material preparation, data collection, analysis, the manuscript preparation, were performed by Roya Karami.

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