PACC
Peatland Agriculture and Climate Change
PACC 2(1): 1–24
ISSN 3048-2690

Institute for Advanced Science, Social and Sustainable Future
MORALITY BEFORE KNOWLEDGE

Understanding farmers' perception on climate change: A global perspective

Nur Afiani[1,*]
[1] *Department of Agricultural Economics, Faculty of Agriculture, Ondokuz Mayis University, Atakum, Samsun 55270, Turkey.*
*Correspondence: afianinur@gmail.com

Received Date: January 21, 2025 Revised Date: February 23, 2025 Accepted Date: February 27, 2025

ABSTRACT

Background: Farmers' understanding of climate change is plays a crucial in shaping adaptation decisions undertaken on their agricultural land. The study aims to determine the factors influencing farmers' perceptions of climate change and how their perceptions pattern from different geographical and climate conditions. **Methods:** A semi-systematic literature review was conducted using peer-reviewed articles published between 2010 and 2025 from major academic databases. The literature review reveals that farmers globally report rising temperature, change in rainfall pattern, and experienced extreme events such as drought and flood. **Findings:** The factors that influence farmers' climate change perception include age, gender, farm experience, education level, access to extension, and access to climate information. Thus, farmers in countries that have access to adequate resources and information would have a better understanding and be more proactive to handling climate change impacts. Another critical finding of the research is that building the right social networks is crucial because social and cultural aspects significantly influence climate change-related perceptions. **Conclusion:** In communities where traditional agricultural practices remain dominant, social interactions and community structures significantly mediate information dissemination and interpretation of climate risks. Therefore, strengthening social networks and improving communication governance are essential to enhance climate literacy and adaptive capacity. **Novelty/Originality of this article:** This study contributes by synthesizing global evidence on perception determinants while integrating social, institutional, and contextual dimensions, offering insights for designing inclusive and context-sensitive climate adaptation policies to support long-term food security.

KEYWORDS: climate change; climate perceptions; factors influencing; farmer's adaptation; social network.

1. Introduction

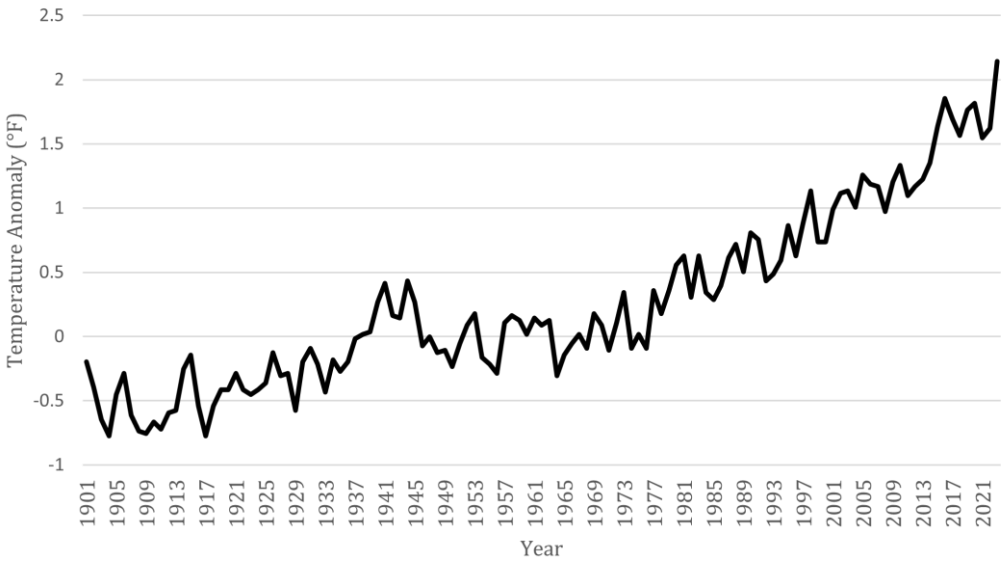
Climate change is among the greatest challenges facing the globe in the 21st century. Its impacts span across the environmental, social, and economic sectors (Aggarwal & Pasricha, 2011; Oti et al., 2021). In the agricultural sector, climate change poses a very serious threat, since this sector is acutely sensitive to changes in weather conditions (Massagony et al., 2023). Projections indicate that climate change is likely to reduce global agricultural production, with a modest decline of around 0.5 % in the medium run and a more substantial fall of approximately 2.3% in the long run. There are also increased food prices expected because of climate change and decreased welfare levels, and the more pronounced fall in welfare in 2050 under the Special Report on Emissions Scenarios (SRES) A1B scenario (Calzadilla et al., 2013).

Cite This Article:
Afiani, N. (2025). Understanding farmers' perception on climate change: A global perspective. *Peatland Agriculture and Climate Change*, *2*(1), 1-24. https://doi.org/10.61511/pacc.v2i1.2025.3272

Copyright: © 2025 by the author. This article is distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

Climate change, particularly that associated with an increase in the number and intensity of extreme events such as unpredictable rainfall patterns and high annual temperatures, will have a significant impact on the agricultural sector and food security on a massive scale. Based on National Oceanic and Atmospheric Administration (NOAA) (2024), since 1901 there has been an increase in precipitation in the world with an average of 0.03 inches per decade (Figure 2). Meanwhile, the average global surface temperature has increased by an average of 0.17°F per decade with 2023 being the warmest year on record (Figure 1). As illustrated in the figure, the global temperature anomaly demonstrates a clear upward trajectory over the past century, with a more pronounced acceleration beginning in the late 20th century. While temperature fluctuations were relatively moderate during the early and mid-1900s, a sustained and steep increase has been evident since the 1980s, highlighting the intensification of global warming in recent decades.

This persistent rise in global temperatures has significant implications for the agricultural sector. Climate change would adversely influence food productivity and threatening farmers' income, as well as access to and availability of food (Anríquez & Toledo, 2019; Firdaus et al., 2019; Murniati & Mutolib, 2020). Consequently, farmers, as the principal stakeholders in this sector, have a crucial role in addressing these changes through efficient adaptation strategies (Roco et al., 2015).



Fig, 1. Global temperature (1901-2023)
(NOAA, 2024)

Additionally, according to the Food and Agriculture Organization of the United Nations (FAO) (2025), the agricultural industry provides employment for over 26% of the world's population. Farmers' comprehension and perception of climate change are therefore crucial since their assessment of the hazards associated with it directly affects their capacity and willingness to adapt. Farmers' perceptions often determine whether they modify planting calendars, diversify crops, or adopt new technologies to mitigate climate risks (Roco et al., 2015; Rahman et al., 2023). Therefore, improving farmers' awareness and understanding is not only essential for sustaining agricultural production but also for achieving global sustainability goals, particularly Sustainable Development Goals (SDG) 2 on Zero Hunger and SDG 13 on Climate Action.

Farmers' perceptions of climate change are shaped not only by their understanding of the phenomenon but also by their direct experiences with weather variability and the accessibility of pertinent information regarding events such as droughts or floods, as well as information disseminated through media or agricultural extension services. In certain countries, particularly in Africa and Asia, awareness of climate change is significant; yet,

farmers frequently perceive climate change primarily as a variation in weather rather than a long-term alteration. This leads certain farmers to delay immediate adaptation measures (Fierros-González & López-Feldman, 2021; Madhuri & Sharma, 2020).

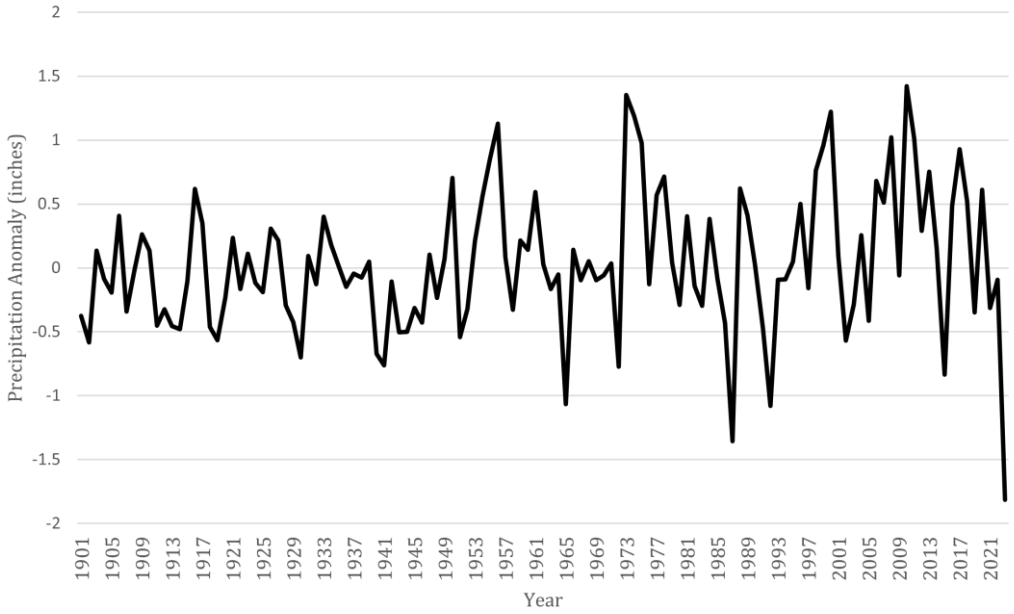


Fig. 2. Global precipitation (1901-2023)
(NOAA, 2024)

Although numerous countries exhibit strong awareness of climate change, a minority remains sceptical or outright denies its existence. This scepticism frequently pertains to beliefs and ideologies jeopardised by climate change solutions, alongside media representations that frequently depict climate change as a contentious topic (Whitmarsh & Capstick, 2018). These disparities in perceptions point to the need for a deeper understanding of how farmers in different regions respond to climate change (Abid et al., 2014). To support efficient and locally appropriate adaptation policies, a wide range of information is needed. In the absence of appropriate policies, the impacts of climate change on the agricultural sector could lead to a decline in global food production, increased food insecurity and large financial losses, especially for smallholder farmers who depend on subsistence agriculture (FAO, 2012).

Predicting and reducing climate change risks through adaptation and mitigation measures such as changing farming practices requires an understanding of farmers' attitudes towards the issue (Speranza, 2010; Suranny et al., 2022). Therefore, this study aims to provide a comprehensive picture of how farmers from different parts of the world respond to climate change challenges and how these perceptions vary across geographical and climatic contexts. Understanding these perception patterns helps explain why farmers adopt different adaptation strategies across regions and can provide valuable insights for policymakers in designing more effective climate change adaptation policies. Based on these considerations, this study seeks to answer two key questions: how farmers perceive climate change across different geographical contexts and what factors shape these perceptions.

Understanding farmers' perceptions of climate change is crucial to explaining how awareness, experience, and access to resources influence adaptation behavior. Many psychological concepts, such as information, beliefs, attitudes, concern, affect, and perceived risk, have been referred to as perception (Whitmarsh & Capstick, 2018). From a theoretical perspective, farmers' responses to climate risks can be explained through behavioral adaptation theory, which suggests that individuals adjust their behavior when they perceive environmental threats to their livelihoods (Grothmann & Patt, 2005). This perspective emphasizes the role of risk perception, coping appraisal, and adaptive capacity in shaping

farmers' decisions to adopt climate adaptation strategies. However, research on decision-making under uncertainty shows that individuals often underestimate the likelihood that environmental hazards will affect them, which may lead to delayed or inadequate adaptive responses (Grothmann & Patt, 2005). Cognitive studies on decision-making have shown that a number of decision-making biases are active when uncertainty levels are high, including a tendency to be overly optimistic about the risks faced compared to others, or to be overly influenced by salient memories (Jordão et al., 2020; Liu et al., 2018; Folkes, 1988).

This framework assumes that perceptions act as a mediating link between behavioral outcomes (adaptation methods) and external inputs (climate signals and socioeconomic circumstances). Therefore, farmers' reactions to climate events rely on how they understand and internalize these experiences, even while these events produce observable repercussions like drought, flooding, or altered rainfall patterns (Atube et al., 2022; Darabant et al., 2020; Ferdushi et al., 2019). Farmers' understanding of the hazards associated with the interaction between food and climate determines whether adaptation is successful or not. In climate adaptation, perception and knowledge are intertwined and interact: perception is a collection of subjective evaluations and responses to specific events or processes, whereas knowledge is an accumulation of prior knowledge and experience (Soubry et al., 2020).

In this framework, farmers' perceptions are influenced by various interacting factors. Sociodemographic attributes such as age, gender, education, and farming experience play a critical role in determining how individuals interpret climate change. In addition, institutional and information access are other central components in shaping perceptions. Extension workers, farmer organizations, and local cooperatives act as knowledge intermediaries that translate scientific information into applicable advice, thereby strengthening farmers' awareness and adaptive capacity (Makamane et al., 2025; Atube et al., 2021). Conversely, in areas where extension systems are weak or fragmented, farmers tend to rely solely on personal experience, which can lead to misinterpretation of climate signals (Mdiya et al., 2024). The availability of digital and traditional communication channels, including radio programs and mobile phone-based weather alerts, also plays an increasingly important role in shaping how farmers view and act on climate-related information.

The perception process is further mediated by cultural and cognitive factors. Climate anomalies like droughts and floods are frequently explained by spiritual or moral frameworks rather than scientific explanations in many rural communities (González & Feldman, 2021; Karki et al., 2020). The degree to which farmers take climate change seriously and whether they believe that human or supernatural intervention can control it can be influenced by these belief systems. Similarly, farmers' assessments of possible dangers are influenced by psychological factors including risk aversion and optimism bias (Azeem & Alotaibi, 2023). The affective heuristics described by Finucane et al. (2000) suggest that a person's emotions toward an issue often determine their judgment more than factual knowledge. In this context, farmers who experience periodic climate shocks may increase their awareness or become less sensitive to risk, depending on their capacity for adaptation and their social support networks (Ricart et al., 2023). Therefore, perceptions must be understood as a dynamic interaction between cognition, emotion, and collective experience.

Perception formation is also directly influenced by personal experience and environmental exposure (Atube et al., 2022). Climate change is more likely to be noticed by farmers who frequently experience extreme weather events like droughts or floods (Ofuoku, 2011; Huong et al., 2017). However, farmers may draw incorrect inferences if their perceptions are based only on short-term experiences, associating isolated events with broader climate trends. This highlights the importance of combining experiential learning with the dissemination of scientific knowledge to develop more accurate and reliable perceptions. In this context, the diffusion of innovation theory suggests that new knowledge and adaptive practices spread through communication channels and social networks within

farming communities, allowing farmers to learn from extension services, peers, and local institutions (Rogers, 2003).

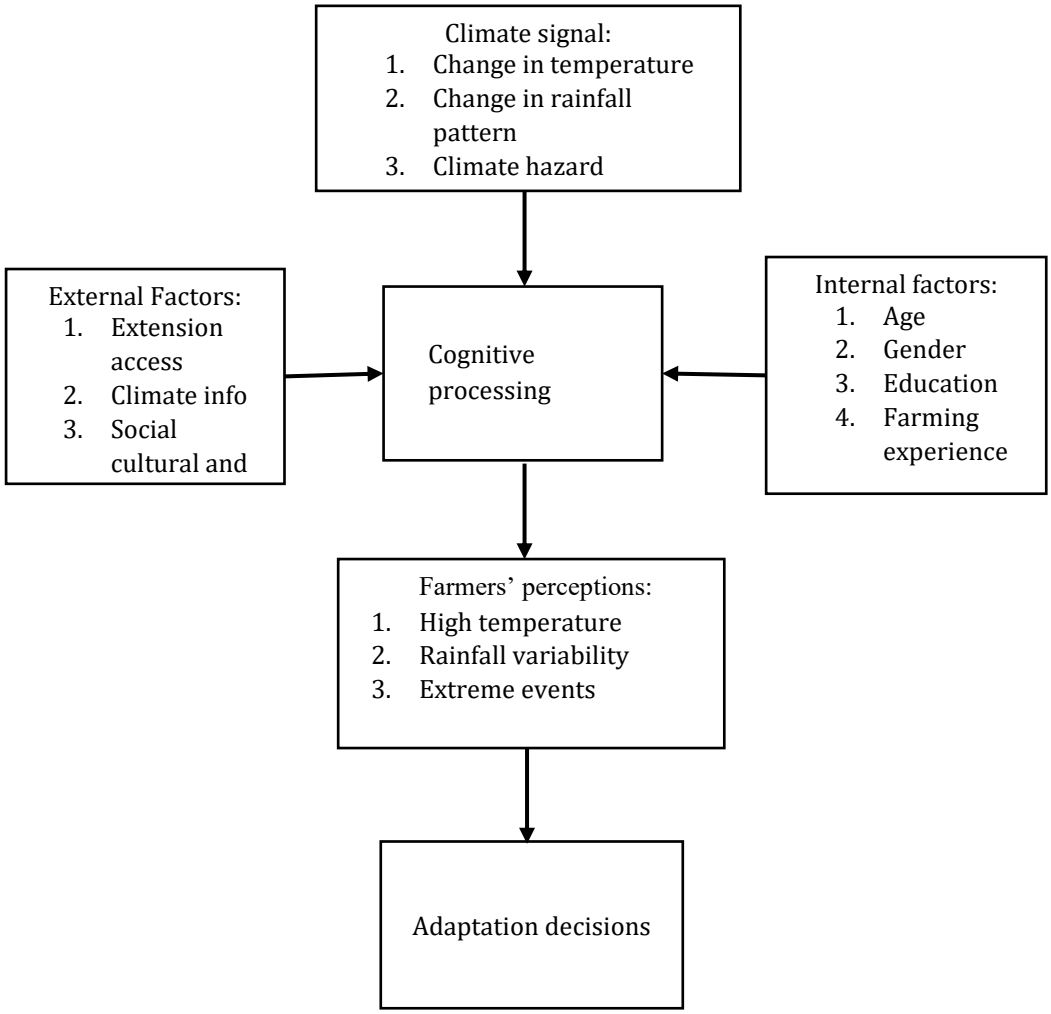


Fig. 3. Conceptual framework of factors influencing farmers' perceptions of climate change and adaptation decisions

As shown in Figure 3, climate signals such as temperature changes, change in rainfall patterns, and climate hazard serve as the initial stimuli observed by farmers. These signals are interpreted through a process of cognitive processing, where individuals assess environmental information based on their knowledge, experiences, and available resources. This interpretation is shaped by internal factors such as socio-demographic characteristics (age, gender, education, and farming experience) as well as external factors including access to extension services, climate information, and socio-cultural beliefs. Through the interaction of these elements, farmers develop perceptions of climate change, which ultimately influence their adaptation decisions in agricultural practices.

Within this framework, farmers' perceptions function as the key mediator linking environmental signals and socio-economic conditions to adaptation outcomes. Proactive adaptation choices including crop diversification, soil conservation, irrigation management, and livelihood diversification are influenced by accurate perception (Roco et al., 2015; Rahman et al., 2023). On the other hand, a narrow or fatalistic perspective frequently leads to inadequate or delayed reactions, which increases susceptibility to climate shocks. As a result, perception is always interacting with knowledge systems, institutional support, and sociocultural contexts rather than functioning independently. Participatory extension programs, financial availability, and supporting legislation can all help farmers convert their perceptions into practical adaptation measures.

This relationship might be conceptualized as a cyclical process as opposed to a linear one. Farmers' cognitive interpretation is initially influenced by climate cues, which are manifested through noticeable variations in temperature and precipitation. After being filtered by institutional settings, cultural narratives, and sociodemographic traits, this perception results in a certain behavioral outcome, such as adaptation or inaction. The perception process is then influenced by the success or failure of these adaptive measures, which helps farmers make better decisions and understandings in the future. As farmers gain experience and engage with fresh knowledge, perspective changes over time. Agricultural systems' adaptive resilience is based on this dynamic interaction.

2. Methods

Research on farmers' perceptions of climate change builds on various critical perspectives from previous studies to better understand how the perspective patterns of farmers in various countries towards natural phenomena that occur and what are the factors that influence the perspective patterns. This perspective pattern will subsequently affect farmers' adaption methods to climate change. This study consolidates recent studies on farmers' perceptions of climate change from multiple nations to elucidate their viewpoints on the issues. This study employed a semi-systematic literature review approach as described by Snyder (2019). This review aims to synthesize and analyze various empirical studies on farmers' perceptions of climate change, identify common patterns and factors that influence these perceptions, and explore policy implications across different countries. Peer-reviewed journal articles published between 2010 and 2026 were collected from major academic databases, including Scopus, Web of Science, and Google Scholar. These platforms were selected because they provide broad access to peer-reviewed articles, international publications, and multidisciplinary studies relevant to climate change perception and adaptation in agricultural sector.

This research was conducted by analyzing several articles from several selected studies that discuss the patterns of farmers' perceptions of climate change and the factors that influence them. The first stage of this research is to conduct a search using the keywords climate change and farmers' perception, factors influencing perceptions of climate change, agricultural perception of climate risk and collect articles related to it to enhance comprehensive coverage. Secondly, the articles will be sorted based on the focus of the discussion. Articles were included if they focused on farmers' perceptions of climate change, provided empirical evidence, and were published in English-language peer-reviewed journals.

The initial database search generated a broad pool of potentially relevant studies. After removing duplicates and screening titles and abstracts based on relevance to farmers' climate change perception and adaptation behavior, a subset of articles was selected for full-text assessment. It involved identifying duplicates and removing non-academic sources such as non-peer-reviewed reports, news reports, and brief comments. In the next screening stage, titles and abstract were examined to determine whether the articles explicitly discussed farmers' perceptions of climate change. Only articles that focused on perception patterns, behavioral responses, and factor influencing farmers' perceptions were retained. Following the application of the inclusion criteria, 43 peer-reviewed articles were retained for the final analysis.

In this review, the concept of farmers' perception of climate change refers to farmers' subjective understanding and interpretation of climate variability and long-term climatic changes, including perceived changes in temperature, rainfall patterns, and extreme weather events. The review also examines various factors influencing these perceptions, including socio-demographic characteristics (e.g., age, education, farming experience), institutional factors such as access to extension services, and institutional and informational factors (e.g., access to extension services and climate information), and socio-cultural factors, which include cultural beliefs, value systems, gender norms, trust in institutions, and community interactions that shape how farmers interpret climate-related risks. To

enhance analytical clarity, the reviewed studies were also categorized based on their geographic context, including Asia, Africa, Europe, Australian and America, allowing the identification of both global patterns and regional differences in farmers' perceptions of climate change.

The third step of this research is to categorize the articles with respect to author, title of article, study area, methodology, and year of publication. Categorizing articles allows for comparisons between countries and methods, helping to identify global patterns and regional differences in perceptions and the factors that influence them. In addition, this grouping also makes it easier to extract key related variables such as indicators of climate change as perceived by farmers, socio-economic factors that shape perceptions, and policies that can be developed to address these issues. The results of this analysis will provide a summary of information related to farmers' perceptions of climate change and the factors that influence these perceptions.

The reviewed studies cover diverse geographic regions, including Asia (10 studies), Africa (17 studies), Europe (6 studies), Australia (2 studies) and America (6 studies). In addition, one study adopted a cross-regional approach spanning multiple geographic areas, and one article was a systematic review synthesizing findings across countries. However, the majority of studies were concentrated in developing countries, particularly in Asia and Africa, reflecting the higher vulnerability of smallholder farmers in these regions to climate variability. This geographic distribution provides a broad comparative perspective while also indicating a regional concentration of research in climate-sensitive agrarian contexts. To maintain transparency and reliability, the article selection process is documented in a simple table, which can be seen in Table 1.

Table 1. The summary of the title, study area, model and publisher of critically reviewed researches

Authors and year	Title of article	Study area	Method	Publisher
Ofuoku (2011)	Rural Farmers' Perception of Climate Change in Central Agricultural Zone Of Delta State, Nigeria	Nigeria	Linear Regression Model	Indonesian Journal of Agricultural Sclence
Tilahun & Bedemo (2014)	Farmers' Perception and Adaptation to Climate Change: Heckman's Two Stage Sample Selection Model	Ethiopia	Heckman's Two Stage Sample Selection Model	Ethiopian Journal of Environmental Studies & Management
Asrat & Simane (2018)	Farmers' Perception of Climate Change and Adaptation Strategies in the Dabus watershed, North-West Ethiopia	Ethiopia	Heckman's Two Stage Sample Selection Model	Ecological Processes
Kangai et al. (2021)	Determinants of Climate Change Adaptation and Perceptions Among Small-Scale Farmers of Embu County, Eastern Kenya	Kenya	Heckman's Probit Model	African Journal of Environmental Science and Technology
Coster & Adeoti (2021)	Analysis of Perception And Adaptation of Maize–Based Farming Households to Climate Change in Nigeria	Nigeria	Heckman's Two Stage Sample Selection Model	Tropical Agriculture
Omotayo et al. (2020)	Socio-Economic Factors Influencing Perceptions and Adaptability of Rural Rice Farmers to Climate Change, Abuja, Nigeria:	Nigeria	Heckman's Two Stage Sample Selection Model	Russian Journal of Agricultural Science

	Applications of Heckman Two-Stage Model			
Koguia et al. (2021)	Perception of Climatic Change and Farmers' Decision to Adapt in the Sudano-sahelian Zone in Cameroon	Cameroon	Heckman's Two Stage Sample Selection Model	Journal of Humanities and Social Sciences Studies
Bharat et al. (2022)	Farmers' Perception about Climate Change and Response Strategies	India	Regression Analysis	Indian Journal of Extension Education
Elgin-Stuczynski & Batterbury (2014)	Perceptions of Climate Variability and Dairy Farmer Adaptations in Corangamite Shire, Victoria, Australia	Australia	Descriptive Statistics and Qualitative Analysis	International Journal of Climate Change Strategies and Management
Oti et al. (2021)	Awareness And Perception Of Climate Change Among Farmers in Nigeria: Implications for Food Security	Nigeria	Descriptive Statistics	Nigerian Agricultural Journal
Bomers et al. (2024)	Survey of Potato Growers' Perception of Climate Change and Its Impacts on Potato Production in Germany, Switzerland, and Austria	German, Switzerland, Austria	Survey Analysis	Agronomy
Huong et al. (2017)	Farmers' Perception, Awareness and Adaptation to Climate Change: Evidence from Northwest Vietnam	Vietnam	Logit Model	International Journal of Climate Change Strategies and Management
Uddin et al. (2017)	Determinants of Farmers' Perception of Climate Change: A Case Study from the Coastal Region of Bangladesh	Bangladesh	Logit Model	American Journal of Climate Change
Roco et al. (2015)	Farmers' Perception of Climate Change in Mediterranean Chile	Chile	Probit Model	Regional Environmental Change
González & Feldman (2021)	Farmers' Perception of Climate Change: A Review of the Literature for Latin America	Latin America	Systematic review	Frontiers in Environmental Science
Ndambiri et al. (2013)	An Evaluation of Farmers' Perceptions of and Adaptation to The Effects of Climate Change in Kenya	Kenya	Heckman's Two Stage Sample Selection Model	International Journal of Food and Agricultural Economics
Karki et al. (2020)	The experiences and perceptions of farmers about the impacts of climate change and variability on crop production: a review	N/A	Systematic Review	Climate and Development

Hitayezu et al. (2017)	Assessing farmers' perceptions about climate change: A double-hurdle approach.	South Afrika	Probit Model	Climate Risk Management
Ogunleye et al. (2021)	Impacts of farmers' participation in social capital networks on climate change adaptation strategies adoption in Nigeria	Nigeria	Descriptive Statistics, Binary Probit Regression, Multinomial Logit Regression, Endogenous Switching Regression.	Heliyon
Yang et al. (2024)	The role of social capital in the impact of multiple shocks on households' coping strategies in underdeveloped rural areas	China	Individual fixed affect model	Scientific Reports
Teodoro et al. (2021)	Quantifying stakeholder learning in climate change adaptation across multiple relational and participatory networks	USA	Social Network Analysis	Journal of Environmental Management
Woods et al. (2017)	Farmers' Perceptions of Climate Change and Their Likely Responses in Danish Agriculture	Denmark	Descriptive Statistics and Ordered Probit Model	Land Use Policy
Azeem & Alotaibi (2023)	Farmers' beliefs and concerns about climate change, and their adaptation behavior to combat climate change in Saudi Arabia	Saudi Arabia	Non-parametric analysis	PloS One
Mungai et al. (2024)	The role of agricultural extension services in promoting agricultural sustainability: a Central Malawi case study	Malawi	A Comprehensive Survey and Meta Analysis	Cogent Food & Agricultural
Ado et al. (2019)	Farmers' awareness and perception of climate change impacts: case study of Aguie district in Niger.	Niger	Descriptive Statistics and Regression Model	Environment, Development and Sustainability
Shrestha et al. (2022)	Farmers' Perception of Climate Change and Its Impacts on Agriculture.	Nepal	Statistical and Spatial Analysis	Hydrology
Ayanlade et al. (2017)	Comparing smallholder farmers' perception of climate change with meteorological data: A case study from southwestern Nigeria	Nigeria	Cumulative Departure Index (CDI), Rainfall Anomaly Index (RAI), and Structural Equation Model (SEM)	Weather and climate extremes
Balgah et al. (2023)	Impacts of Floods on Agriculture-Dependent Livelihoods in Sub-Saharan Africa: An Assessment from Multiple Geo-Ecological Zones	Sub-Saharan Africa	Mixed-method design and Descriptive-comparative approach	Land

Eitzinger et al. (2018)	Risk perception and decision-making: do farmers consider risks from climate change?	Swiss	Exploratory Multivariate Analysis Model	Climatic Change
Foguesatto et al. (2019)	Farmers' typologies regarding environmental values and climate change: Evidence from southern Brazil	Brazil	Exploratory Factor Analysis (EFA) and T*wo-Step Cluster Analysis*	Journal of Cleaner Production
Foguesatto et al. (2021)	What shapes farmers' perception of climate change? A case study of southern Brazil	Brazil	Binary Logistic Regression Mode	Environment, Development and Sustainability
Hagos et al. (2025)	Access to and Level of Climate Information Use: Implications for Adoption of Adaptation and CSA Practices.	Ethiopia	Endogenous Probit Model	Environmental Management
He et al. (2022)	Brief communication: Western Europe flood in 2021–mapping agriculture flood exposure from synthetic aperture radar (SAR)	Western Europe	Threshold-based change detection model	Natural Hazard and Earth System Sciences
Leng et al. (2019)	Crop yield sensitivity of global major agricultural countries to droughts and the projected changes in the future	23 major food-producing countries	Fixed-effect panel regression	Science of the Total Environment
Mitter et al. (2019)	Exploring Farmers' Climate Change Perceptions and Adaptation Intentions: Empirical Evidence from Austria	Austria	Structural Equation Model	Environmental Management
Molua et al. (2014)	Climate change perception and farmers' adoption of sustainable land management for robust adaptation in Cameroon	Cameroon	Binary Logit Model	Journal of Agricultural Science
Kumar et al. (2023)	Farmers' Perception towards Climate Change and its Effect on Agriculture in Kolar District of Karnataka, India	India	Descriptive statistics, regression analysis, and Garret's ranking technique	International Journal of Environment and Climate Change
Andrista et al. (2025)	Responses to climate change: Perceptions and adaptation among small-scale farmers in Indonesia	Indonesia	Descriptive statistics and logistic regression model	Journal of Environmental Management
Chintakindi et al. (2026)	Farmers' perception of climate change and determinants influencing adaptive readiness in Chhattisgarh State, India	India	Ex post facto research design	Journal of Scientific Research and Report
De Pascale et al. (2023)	How Mediterranean winegrowers perceive climate change	Italy	Quantitative survey method with non-parametric statistical analysis.	AIMS Agriculture and Food

Gassi & Ateş (2024)	Perceptions of climate change and adaptation measures among wheat and barley producers	Türkiye	Descriptive statistics and multiple correspondence analysis	Journal of Agriculture Faculty of Ege University
Petersen-Rockney (2022)	Social risk perceptions of climate change: A case study of farmers and agricultural advisors in northern California	USA	Qualitative case study	Global Environmental Change
Freebairn (2021)	Adaptation to Climate Change by Australian Farmers	Australia	Conceptual analysis	Climate

3. Results and Discussion

3.1 Farmers' perceptions of climate change in different countries

Based on literature review, farmers believe that climate change is occuring (Azeem & Alotaibi, 2023; Rahman et al., 2023; Omotayo et al., 2020; Uddin et al., 2017; Woods et al., 2017). They also believe that there is sufficient evidence to support the occurrence of climate change. Although climate change is perceived as a serious menace to life, farmers' perceptions of climate change vary from person to person (Rahman et al., 2023). The perception of climate change by agricultural producers is a complex process that integrates several psychological components, such as information, beliefs, attitudes, and worries about the reality and nature of climate change (Whitmarsh & Capstick, 2018). Woods et al. (2017) in their research on a number of farmers in Denmark also explained that farmers' perceptions of climate change also include how they perceive climate change, evaluate related risks, and identify the barriers they face in adapting to the impacts of climate change. In the face of uncertain external pressures, they would prefer to make small, adaptable changes to their current farming system rather than larger, less reversible ones, and they are more driven to take action by short-term economic benefits than by long-term environmental effects.

Evidence from multiple empirical studies also indicate that almost all farmers in the study countries responded observed a rise in temperature over the past few years (Table 2). This is in line with data from NOAA (2024) which shows a global temperature increase of 0.17°F per decade. A study by Gassi & Ateş (2025) on wheat and barley producers in Türkiye found that many farmers perceived a decline in crop yields and associated this trend with increasing temperatures and drought conditions. Some farmers also noted that it is difficult to predict rainfall at this time. They also realized that there have been several delays in the onset of the rainy season (Ofuoku, 2011; Oti et al., 2021; Uddin et al., 2017). In some African countries, such as Nigeria most farmers are aware of an increase in rainfall intensity (Omotayo et al., 2020; Oti et al., 2021). Meanwhile, in many Asian countries, European countries, Australia and parts of Latin America there has been a decrease in annual rainfall (Bomers et al., 2024; Elgin-Stuczynski & Batterbury, 2014; Huong et al., 2017; Roco et al., 2015; Uddin et al., 2017; Freebairn, 2021; Gassi & Ateş, 2024).

However, in other regions farmers do not necessarily perceive a clear increase or decrease in total rainfall but instead observe greater variability in rainfall patterns. For example, a study De Pascale et al. (2023) found that Mediterranean winegrowers frequently reported irregular rainfall patterns, including unpredictable timing of precipitation, higher rainfall intensity during short periods, and longer dry intervals between rainfall events. Such variability in rainfall distribution contributes to farmers' perceptions of increasing climate uncertainty and affects agricultural management decisions. In some case, farmers' perception of climate change, particularly in relation to changes in temperature and rainfall, contradict with meteorogical data (Ayanlade et al., 2017; Shrestha et al., 2022). This phenomenon may be partially result from increasing of extreme weather events that

directly threaten farmers' livelihoods. In addition, these changes in temperature and unpredictable weather patterns have led to an increase in pest and disease attacks, changes in planting seasons, and competition from weeds, resulting in an uncontrollable decline in crop productivity (Kumar et al., 2023).

Table 2. Farmers' perception of climate change

Region	Increase in temperature	Rainfall change	Extreme events	References
Africa	Observed increase	Increase in rainfall intensity and delayed rainy season	Flooding and drought	Omotayo et al. (2020); Oti et al. (2021)
South America	Observed increase	Decrease in rainfall	Increased drought	Roco et al. (2015)
Asia	Observed increase	Decrease and unpredictable rainfall	Flooding and drought	Uddin et al. (2017); Huong et al. (2017); Gassi & Ateş (2025)
Europe	Observed increase	Decrease and unpredictable rainfall	Increased drought	Bomers et al. (2024); De Pascale et al. (2023)
Australia	Observed increase	Decrease in rainfall	Increased drought and bush fires	Elgin-Stuczynski & Batterbury, (2014); Freebairn, (2021)

In Table 2 farmers' perceptions of climate change are also characterized by extreme events experienced by farmers. Several farmers in Africa and South America reported an increase in droughts affecting their fields over the last decade (Omotayo et al., 2020; Oti et al., 2021; Roco et al., 2015; Uddin et al., 2017). Farmers in Germany, Switzerland, and Austria have mentioned that drought is their prime concern, and its impact has been most intense in the last ten years (Bomers et al., 2024). The increased frequency of droughts has exerted significant pressure on agricultural productivity. For instance, Leng & Hall (2019) analyzed data from ten major wheat, corn, rice, and soybean producing countries and found that extreme drought events (SPI ≤ -2.0) increase the probability of yield declines for these crops. Moreover, studies conducted in Asia and the Mediterranean region confirm that current droughts count as one of the biggest climate pressures affecting farming systems. Spinoni et al. (2020) revealed that how droughts have increased in both frequency and severity across Europe and parts of Asia over the last three decades. This trend has led to big drops in soil moisture levels. It also raises the risks for crops that depend entirely on rainfall.

In addition to drought, the farmers in these countries have also witnessed increased frequency of flooding in their agricultural lands (Oti et al., 2021). This perception is consistent with the Intergovernmental Panel on Climate Change (IPCC) (2023) report, which states that heavy rainfall events that trigger flooding are expected to increase in many regions around the world, posing greater risks to low-lying agricultural areas and farming communities in river basins. For example, studies in Sub-Saharan Africa have shown that in some geo-ecological zones, more than 88% of farming households report crop damage from flooding, leading to soil erosion and a significant decline in land fertility (Balgah et al., 2023). In Western Europe, during the severe floods of July 2021, about 57% of the flooded area was agricultural land, which is estimated to have led to a significant decline in agricultural productivity (He et al., 2021). In addition, the increased risk of flooding in Europe and Asia has resulted in significant crop losses and long-term soil degradation, which in turn reduces the capacity of agricultural systems to recover quickly after extreme events (Kundzewicz et al., 2019). Similarly, studies in Australia also highlight the growing influence of climate variability and extreme weather events on agricultural systems. Rising temperatures and changes in rainfall patterns are expected to intensify the occurrence of extreme climatic conditions, including droughts, bushfires, and heavy rainfall events that may contribute to flooding in some regions, posing additional challenges for farmers' livelihoods and agricultural productivity (Freebairn, 2021).

3.2 Factors influencing farmers' perception of climate change

In general, cultural and socio-demographic factors influence farmers' perceptions of climate change (Ahmed et al., 2021; González & Feldman, 2021; Karki et al., 2020). However, these cultural and socio-demographic factors have different influences depending on the geographical location of the land. For example, research generally shows that age influences farmers' perceptions of climate change. The older the farmer, the higher the level of perception of climate change (Asrat & Simane, 2018; Koguia et al., 2021; Omotayo et al., 2020). However, Koguia et al. (2021) in their research on farmers in Cameroon showed that farmers older than 50 years tend to be more pessimistic about climate change. Older farmers typically possess extensive agricultural experience, which has exposed them to a greater number of climate-related events. As a result, they may demonstrate heightened risk awareness; however, this experience can also contribute to adaptation fatigue and increase the perceived difficulty of implementing new practices over time (Molua, 2014). Furthermore, diminished physical capabilities or limited resources in old age, combined with resistance to adopting new technologies or methods, may undermine confidence in the effectiveness of adaptation (Mitter et al., 2019).

Gender also plays an important role in shaping farmers' perceptions of climate change (Kangai et al., 2021; Koguia et al., 2021; Ofuoku, 2011; Andrista et al., 2025). Kougia et al. (2021) in their research showed that male farmers have more perceptions of climate change due to psychological factors related to risk assessment and decision making. Andrista et al., (2025) also found that male farmers tend to be more actively involved in land management practices compared to female farmers, which influences how they perceive environmental changes and implement adaptation strategies. This difference is often associated with the division of labor and access to agricultural resources within farming households. This is shown from previous research which explains that men generally tend to assess risk in a lower or less problematic way than women who are generally more cautious (Finucane et al., 2000). In addition, cultural factors, social roles, and responsibilities that men often carry in agriculture may also encourage men to view climate challenges as something that can be overcome or better managed, creating a more optimistic perception (Koguia et al., 2021).

Table 3. Factors influencing farmers' perception of climate change

Factor	General influence on perception	Region	References
Age	Older farmers generally show higher perception of climate change.	Africa, Asia, Europe	Asrat & Simane (2018); Koguia et al. (2021); Omotayo et al. (2020); Mitter et al. (2019)
Gender	Male farmers often report higher perception of climate change.	Africa, Asia	Kangai et al. (2021); Koguia et al. (2021); Ofuoku (2011); Andrista et al. (2025)
Education	Higher education increases climate change awareness.	Africa, Asia	Asrat & Simane (2018); Bharat et al. (2022); Kangai et al. (2021); Ofuoku (2011)
Farming Experience	Longer farming experience improves climate change perception.	Africa, Europe	Coster & Adeoti (2020); Ofuoku (2011); Omotayo et al. (2020); Woods et al. (2017)
Access to Extension Services	Extension services improve climate change awareness.	Africa, Asia, America	Tilahun & Bedemo (2014); Coster & Adeoti (2020); Omotayo et al. (2020); Foguesatto et al. (2021)
Access to Climate Information	Climate information access strengthens climate change perception.	Africa, Asia, Australia, Europe, America	Bharat et al. (2022); Kangai et al. (2021); Omotayo et al. (2020); Tilahun & Bedemo (2014); Freebairn (2021); Foguesatto et al. (2021)

Education is also a factor that influences farmers' perception of climate change (Asrat & Simane, 2018; Bharat et al., 2022; Kangai et al., 2021; Ofuoku, 2011; Omotayo et al., 2020). Farmers who have a higher level of education will open up opportunities for access to broader knowledge, including environmental information and climate change (Kangai et al., 2021; Ndambiri et al., 2013). Furthermore, Ofuoku (2011) also stated that the longer farmers are educated, the higher the likelihood of an increased appreciation of climate change. Education allows the gaining of formal sources and improves analysis and problem-solving skills thus making those farmers who have undergone education more inclined to know about viable adaptation options before making any decisions and their cost and benefit (Bharat et al., 2022). Additionally, education is normally related to the readiness for innovation and involvement in social networks or farmer organizations which are one of the factors increasing the possibility to receive training and new technology (Asrat & Simane, 2018).

Farming experience is also one of the factors that influence farmers' perception of climate change (Coster & Adeoti, 2020; Ofuoku, 2011; Omotayo et al., 2020). Farmers who have longer experience tend to be more familiar with climate patterns and changes that occur over a long period of time. By experiencing diverse environmental conditions over decades, these farmers are better equipped to identify subtle anomalies that impact agricultural yields, ultimately facilitating the selection of appropriate adaptation measures (Coster & Adeoti, 2020). This is further supported by Woods et al. (2017), who argue that direct, personal experience with extreme weather events acts as a primary catalyst for risk recognition.

In addition to farming experience, access to extension services also affects farmers' perception of climate change (Coster & Adeoti, 2020; Omotayo et al., 2020; Tilahun & Bedemo, 2014; Chintakindi et al., 2026). Extension services play an important role in providing information, knowledge and guidance on climate change and more adaptive agricultural practices (Mungai et al., 2024). Extension services can also provide farmers with access to the latest technologies and innovations in agriculture to face the challenges of climate change. However, these services must be adapted to local environmental conditions and grounded in regional agro-ecological knowledge (Ado et al., 2019). Interaction with experts helps farmers understand the weather anomalies they experience and connect them to broader climate phenomena (Foguesatto et al., 2021).

Reliable climate information, particularly when delivered through extension services and communication networks, significantly influences farmers' perceptions and responses to climate risks (Bharat et al., 2022; Kangai et al., 2021; Koguia et al., 2021; Foguesatto et al., 2021; Omotayo et al., 2020; Tilahun & Bedemo, 2014). In Australia, farmers' perceptions and responses to climate change are influenced not only by observed changes in temperature and rainfall but also by economic and institutional factors. Technological development, fluctuations in agricultural product prices, and access to climate information and policy support can shape how farmers interpret climate risks and adjust their production decisions (Freebairn, 2021). Facilitated access to information can enhance farmers' knowledge and understanding, offering insights into suitable climate-smart agricultural adaptation techniques and solutions to address climate change (Hagos et al., 2025; Andrista et al., 2025; Chintakindi et al., 2026). In addition, access to this information can also improve understanding of the risks that may occur due to climate change, such as more frequent floods or droughts (Eitzinger et al., 2018). With a better understanding, farmers can take more effective prevention and protection measures.

3.3 Socio cultural dimension and cognitive barriers

Besides socio-demographic considerations, social and cultural elements can significantly affect farmers' perceptions of climate change. In rural regions or indigenous tribes, farmers frequently perceive climate change as a result of human actions or as divine retribution for immoral conduct (González & Feldman, 2021). Cultural and religious perspectives might shape farmers' perceptions of climate change, often attributing it to

spiritual influences or divine will, particularly in some African and Asian countries. In addition, in economically developed countries such as the United States, Germany, and China, behavioral factors, political ideology, and the politicization of climate change significantly shape public perceptions (Karki et al, 2020). Farmers who view climate change as a consequence of human actions are more inclined to implement adaptation strategies, whereas those who regard it as a natural or spiritual occurrence may exhibit reduced engagement in such measures.

Perceptions are also shaped by cognitive habits (Bazgir et al., 2023). According to Whitmarsh & Capstick (2018), farmers frequently use availability heuristics, evaluating climate change based on recent exceptional events rather than long-term trends. Their perception of progressive change may be distorted by this short-term attention, which may result in reactive adaptation as opposed to proactive adaptation. Furthermore, risk perceptions are influenced by social norms in different ways depending on gender. Research indicates that women are more likely to be concerned and cautious about climate hazards, but males are more likely to perceive them as less serious and more controllable (Finucane et al., 2000; Koguia et al., 2021; Hitayezu et al., 2017). Designing inclusive climate communication and training programs requires an understanding of these gender variations. Egalitarian values are also positively associated with the likelihood of recognizing climate risks. This is consistent with research by Hitayezu et al. (2017), which revealed that farmers with social views that emphasize equality are more sensitive to environmental issues and collective risks.

Research by Foguesatto & Machado (2021) in southern Brazil shows that ecocentric and anthropocentric values have a significant positive impact on farmers' perceptions of climate change. Anthropocentric farmers are more focused on their personal interests, whereas ecosentric farmers care about the environment. Anthropocentric ideals need not be detrimental to nature, despite what may seem contradictory (Foguesatto et al., 2019). As a result, self-interest influences how farmers perceive climate change and may encourage the adoption of mitigation or adaptation strategies.

Beyond individual values, local social and cultural values are also reflected in the degree of trust individuals place in governmental and institutional bodies (Foguesatto & Machado, 2021). Farmers who exhibit a high reliance on government support or subsidies often demonstrate lower awareness of climate change. This pattern indicates that dependence on external assistance may diminish individuals' sense of personal responsibility for adaptation. Furthermore, social networks serve as collective learning spaces that bridge the gap between individual opinions and community level responses. Research by Petersen-Rockney (2022) highlights that farmers' perceptions of climate change risks are strongly influenced by social interactions and the exchange of knowledge within agricultural communities. In a case study involving farmers and agricultural advisors in northern California, the study found that farmers' understanding of climate risks is shaped not only by personal experiences but also by communication with advisors and peer networks. Through these interactions, farmers can exchange information, discuss climate-related anomalies, and learn about potential coping strategies. Previous studies also show that farmers who participate in local groups or cooperatives are more likely to share experiences and adaptation practices related to climate variability (Ogunleye et al., 2021; Yang et al., 2024). Peer learning is facilitated and the idea that climate change is a shared problem rather than an abstract phenomenon is strengthened by these exchanges (Teodoro et al., 2021). Hence, strengthening local knowledge-sharing networks and community-based organizations can help raise awareness and encourage proactive adaptation in rural communities.

3.4 Policy and institutional implication

A farmer's likelihood of adapting in the future is influenced by their perceptions of climate change, including their belief in global climate change and their concern over its possible effects. Farmers are more likely to seize the opportunities presented by climate

change when they believe it (Woods et al., 2017). These findings collectively indicate that improving farmers' perceptions of climate change requires not only educational interventions, but also structural reforms in communication and governance. Access to extension services and climate information systems has been identified as one of the strongest determinants of perception (Tilahun & Bedemo, 2014; Coster & Adeoti, 2020). However, these systems remain fragmented and underfunded in many regions, particularly in developing countries. As a result, farmers lack access to accurate climate information and mitigation measures to cope with climate change. Policymakers should also focus on developing decentralized and participatory extension programs that translate climate science into locally relevant information. The IPCC (2023) asserts that local knowledge and climate literacy have a major impact on how success community-level adaptation efforts work. Farmers are more likely to use more successful adaptation tactics including crop diversification, integrated water management, and soil conservation techniques when they have access to reliable information and are able to accurately interpret climatic patterns (FAO, 2022).

Including climate-smart agriculture (CSA) concepts in extension curricula is one possible strategy. CSA places a strong emphasis on context-appropriate technologies that can both increase productivity and lessen the effects of climate change, such as integrated pest management, crop rotation, and precision irrigation (Grigorieva et al., 2023; Chen, 2025). However, farmers' perception and confidence in the information offered are crucial to the success of such programs. Therefore, to make sure that climate messages are in line with local experiences and belief systems, communication strategies should make use of participatory techniques, such farmer field schools and demonstration plots (Abdullah et al., 2023).The function of institutional credibility and trust is another important policy aspect. If climatic information comes from reliable sources, such cooperatives, local leaders, or seasoned extension agents, farmers are more likely to believe it (Arbuckle et al., 2015). Building local institutions' ability to function as reliable middlemen in the climate communication chain should thus be a top priority for governments and non-governmental organizations. Ams long as internet availability and digital literacy are sufficiently encouraged, digital tools like WhatsApp extension groups and weather forecasts that are accessible via mobile devices can further enhance the flow of information. The development of institution to enhance farmers' access to climate change knowledge may contribute to increase their levels of adaptation (Ado et al., 2019). Furthermore, policy intervention strategies should aim to enhance farmers' self-efficacy to foster confidence in their adaptive capacities, rather than solely providing information about risks (Mitter et al., 2019).

3.5 Limitations and contextual considerations

Although this review provides a comprehensive synthesis of existing studies on farmers' perceptions of climate change, several limitations should be acknowledged. First, the geographical distribution of the reviewed studies is uneven, with a strong concentration in Sub-Saharan Africa and South Asia, while relatively fewer studies originate from Europe and the Americas. This imbalance may influence the overall interpretation of global perception patterns, as institutional capacity, climate exposure, and socio-economic conditions vary significantly across regions.

Second, the methodological approaches of the reviewed studies differ considerably. While this semi-systematic review identifies key factors influencing farmers' perceptions of climate change, the reviewed studies exhibit considerable methodological variation, including differences in research design, data collection methods, and measurement scales used to assess perception. The studies range from qualitative interviews and case studies to quantitative surveys employing different Likert-scale instruments. Given this diversity, a narrative synthesis approach was applied to integrate findings and highlight broader patterns across regions. The findings also indicate the need for more standardized reporting of climate perception indicators in future research, which would facilitate stronger quantitative synthesis and cross-study comparisons.

Finally, socio-cultural contexts can shape how farmers interpret climate signals. In several rural communities, climate anomalies may be explained through cultural or spiritual beliefs rather than scientific explanations, potentially influencing farmers' perception of climate risks and their willingness to adopt adaptation strategies. These contextual differences highlight the importance of considering regional and cultural dimensions when designing climate adaptation policies and agricultural extension programs.

4. Conclusions

This study highlights the importance of farmers' perceptions of climate change, particularly in relation to better and sustainable agricultural practices. Based on the results of the literature review, this study shows that farmers' perceptions of climate change can be seen from their views on temperature changes, changes in rainfall patterns, and extreme events such as droughts and floods. These perceptions are influenced by a combination of socio-demographic, institutional, and socio-cultural factors. The results of this study have important implications for developing policies and strategies for climate change adaptation in agriculture. The finding highlight that access to education and information significantly shapes farmers' perceptions of climate change. This indicates the necessity to enhance access to information and knowledge resources for farmers, particularly in regions with inadequate infrastructure. Particular attention should be given to areas with poor infrastructure and restricted access to information where misinformation may prevail, and where farmers are exposed to particularly low levels of household adaptation. Also different views on particular issues recognized among regions, well occupations, and age groups indicate the requirements of specific, regional based social inclusive policies. These variations in perceptions across geographical and sociodemographic conditions underscore the need for context-specific policy strategies.

In addition, age and farming experience also influence farmers' perceptions of climate change. This can be a reference for extension programs and interventions in the agricultural sector to be tailored to the sociodemographic characteristic. Formulating strategies that overlook these distinctions may result in suboptimal adaptation policies. It is also essential to cultivate and enhance social networks among farmers, governmental bodies, and local community organizations to facilitate the rapid and effective dissemination of climate change-related information. Governments and financial institutions also need to provide low-interest financing or credit facilities that make it easier for farmers to invest in adaptation technologies and practices. This is important so that farmers have the ability to change their farming methods according to the changing needs of the climate.

This study focuses on synthesizing existing evidence regarding farmers' perceptions of climate change and the factors influencing these perceptions. Future research is expected to further discuss farmers' perceptions related to the risks and impacts of climate change, as well as the effectiveness of climate change strategies implemented. In addition, a longitudinal approach to analyzing how farmers' perceptions change over time and across different climatic stresses is needed. This review also provides a comparative perspective by synthesizing studies from different geographical regions, including Africa, Asia, Europe, and the Americas. However, comparative analyses across different geographical and climatic regions would also be valuable to identify contextual differences in perception patterns and adaptation responses. In addition, future studies should evaluate the effectiveness of policy interventions, extension services, and climate information programs in improving farmers' adaptive capacity and resilience. Such research would provide stronger empirical evidence to support the development of more targeted and effective climate adaptation policies in the agricultural sector.

Acknowledgement

The author wishes to thank everyone who provided encouragement and inspiration during the preparation of this manuscript.

Author Contribution
N.A. conceptualized the study, wrote, reviewed, and edited the article.

Funding
This research received no external funding.

Ethical Review Board Statement
Not available.

Informed Consent Statement
Not available.

Data Availability Statement
Not available.

Conflicts of Interest
The author declares no conflict of interest.

Declaration of Generative AI Use
During the preparation of this work, the author used SciSummary to assist in conceptual clarification and summarizing relevant literature. In addition, the author also used Grammarly to assist in improving grammar, clarity, and academic tone of the manuscript. After using this tool, the author reviewed and edited the content as needed and took full responsibility for the content of the publication.

Open Access
©2025. The author. This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third-party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit: http://creativecommons.org/licenses/by/4.0/

References
Abdullah, S., Sarwoprasodjo, S., & Hapsari, D. R. (2023). Participatory communication to strengthen farmers' empowerment and adaptation in facing the impacts of climate change. *HABITAT*, *34*(3), 245-255. https://doi.org/10.21776/ub.habitat.2023.034.3.22

Abid, M., Scheffran, J., Schneider, U. A., & Ashfaq, M. (2014). Farmers' perceptions of and adaptation strategies to climate change and their determinants. *Earth System Dynamics*, *5*, 1359–1406. https://doi.org/10.5194/esdd-5-1359-2014

Ado, A. M., Leshan, J., Savadogo, P., Bo, L., & Shah, A. A. (2019). Farmers' awareness and perception of climate change impacts: Case study of Aguie district in Niger. *Environment, Development and Sustainability*, *21*(6), 2963–2977. https://doi.org/10.1007/s10668-018-0173-4

Aggarwal, D., & Pasricha, J. S. (2011). Climate change and its impacts on Indian agriculture. *The International Journal of Climate Change: Impacts and Responses*, *2*(3), 163–172. https://doi.org/10.18848/1835-7156/CGP/v02i03/37060

Ahmed, Z., Guha, G. S., Shew, A. M., & Alam, G. M. M. (2021). Climate change risk perceptions and agricultural adaptation strategies in vulnerable riverine char islands of

Bangladesh. *Land Use Policy*, *103*, 105295. https://doi.org/10.1016/j.landusepol.2021.105295

Andrista, S., Utami, N. P., Hukom, V., Nielsen, M., & Nielsen, R. (2025). Responses to climate change: Perceptions and adaptation among small-scale farmers in Indonesia. *Journal of Environmental Management*, *377*, 124593. https://doi.org/10.1016/j.jenvman.2025.124593

Anríquez, G., & Toledo, G. (2019). De-climatizing food security: Lessons from climate change micro-simulations in Peru. *PLOS ONE*, *14*(9), e0222483. https://doi.org/10.1371/journal.pone.0222483

Arbuckle, J. G., Jr., Morton, L. W., & Hobbs, J. (2015). Understanding farmer perspectives on climate change adaptation and mitigation: The roles of trust in sources of climate information, climate change beliefs, and perceived risk. *Environment and Behavior*, *47*(2), 205–234. https://doi.org/10.1177/0013916513503832

Asrat, P., & Simane, B. (2018). Farmers' perception of climate change and adaptation strategies in the Dabus Watershed, North-West Ethiopia. *Ecological Processes*, *7*(1), 7. https://doi.org/10.1186/s13717-018-0118-8

Atube, F., Malinga, G. M., Nyeko, M., Okello, D. M., Alarakol, S. P., & Okello-Uma, I. (2021). Determinants of smallholder farmers' adaptation strategies to the effects of climate change: Evidence from northern Uganda. *Agriculture & Food Security*, *10*(1), 1. https://doi.org/10.1186/s40066-020-00279-1

Atube, F., Malinga, G. M., Nyeko, M., Okello, D. M., Mugonola, B., Omony, G. W., & Okello-Uma, I. (2022). Farmers' perceptions of climate change, long-term variability and trends in rainfall in Apac district, northern Uganda. *CABI Agriculture and Bioscience*, *3*(1), 16. https://doi.org/10.1186/s43170-022-00116-4

Ayanlade, A., Radeny, M., & Morton, J. F. (2017). Comparing smallholder farmers' perception of climate change with meteorological data: A case study from southwestern Nigeria. *Weather and Climate Extremes*, *15*, 24–33. https://doi.org/10.1016/j.wace.2016.12.001

Azeem, M. I., & Alhafi Alotaibi, B. (2023). Farmers' beliefs and concerns about climate change, and their adaptation behavior to combat climate change in Saudi Arabia. *PLOS ONE*, *18*(1), e0280838. https://doi.org/10.1371/journal.pone.0280838

Balgah, R. A., Ngwa, K. A., Buchenrieder, G. R., & Kimengsi, J. N. (2023). Impacts of floods on agriculture-dependent livelihoods in Sub-Saharan Africa: An assessment from multiple geo-ecological zones. *Land*, *12*(2), 334. https://doi.org/10.3390/land12020334

Bazgir, B., Shamseddini, A., Hogg, J. A., Ghadiri, F., Bahmani, M., & Diekfuss, J. A. (2023). Is cognitive control of perception and action via attentional focus moderated by motor imagery? *BMC Psychology*, *11*(1), 12. https://doi.org/10.1186/s40359-023-01047-z

Bharat, Chapke, R. R., & Kammar, S. (2022). Farmers' perception about climate change and response strategies. *Indian Journal of Extension Education*, *58*(1), 7–11. https://doi.org/10.48165/ijee.2022.58102

Bomers, S., Ribarits, A., Kamptner, A., Tripolt, T., von Gehren, P., Prat, N., & Söllinger, J. (2024). Survey of potato growers' perception of climate change and its impacts on potato production in Germany, Switzerland, and Austria. *Agronomy*, *14*(7), 1399. https://doi.org/10.3390/agronomy14071399

Calzadilla, A., Rehdanz, K., Betts, R., Falloon, P., Wiltshire, A., & Tol, R. S. J. (2013). Climate change impacts on global agriculture. *Climatic Change*, *120*(1–2), 357–374. https://doi.org/10.1007/s10584-013-0822-4

Chen, X. (2025). The role of modern agricultural technologies in improving agricultural productivity and land use efficiency. *Frontiers in Plant Science*, *16*, 1675657. https://doi.org/10.3389/fpls.2025.1675657

Chintakindi, S., Sengar, R. S., Shraddha, C., Rawat, S., & Patel, A. (2026). Farmers' perception of climate change and determinants influencing adaptive readiness in Chhattisgarh State, India. *Journal of Scientific Research and Reports*, *32*(3), 4027. https://doi.org/10.9734/jsrr/2026/v32i34027

Coster, A. S., & Adeoti, A. I. (2020). Analysis of perception and adaptation of maize-based farming households to climate change in Nigeria. *Tropical Agriculture*, *97*(4), 268–280. https://journals.sta.uwi.edu/ojs/index.php/ta/article/view/7263

Darabant, A., Habermann, B., Sisay, K., Abatne, G., Hailu, M. T., & Schulte, A. (2020). Farmers' perceptions and matching climate records jointly explain adaptation responses in four communities around Lake Tana, Ethiopia. *Climatic Change*, *163*(1), 481–497. https://doi.org/10.1007/s10584-020-02889-x

De Pascale, A., Giannetto, C., Zirilli, A., Alibrandi, A., & Lanfranchi, M. (2023). How Mediterranean winegrowers perceive climate change. *AIMS Agriculture and Food*, *8*(2), 440–460. https://doi.org/10.3934/agrfood.2023023

Eitzinger, A., Binder, C. R., & Meyer, M. A. (2018). Risk perception and decision-making: Do farmers consider risks from climate change? *Climatic Change*, *151*(3), 507–524. https://doi.org/10.1007/s10584-018-2320-1

Elgin-Stuczynski, I. R., & Batterbury, S. (2014). Perceptions of climate variability and dairy farmer adaptations in Corangamite Shire, Victoria, Australia. *International Journal of Climate Change Strategies and Management*, *6*(1), 85–107. https://doi.org/10.1108/IJCCSM-03-2013-0039

Ferdushi, K. F., Ismail, M. T., & Kamil, A. A. (2019). Perceptions, knowledge and adaptation about climate change: A study on farmers of haor areas after a flash flood in Bangladesh. *Climate*, *7*(7), 85. https://doi.org/10.3390/cli7070085

Fierros-González, I., & López-Feldman, A. (2021). Farmers' perception of climate change: A review of the literature for Latin America. *Frontiers in Environmental Science*, *9*, 672399. https://doi.org/10.3389/fenvs.2021.672399

Finucane, M. L., Alhakami, A., Slovic, P., & Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, *13*(1), 1–17. https://doi.org/10.1002/(SICI)1099-0771(200001/03)13:1

Firdaus, R. B. R., Gunaratne, M. S., Rahmat, S. R., & Kamsi, N. S. (2019). Does climate change only affect food availability? What else matters? *Cogent Food & Agriculture*, *5*(1), 1707607. https://doi.org/10.1080/23311932.2019.1707607

Foguesatto, C. R., Borges, J. A. R., & Machado, J. A. D. (2019). Farmers' typologies regarding environmental values and climate change: Evidence from southern Brazil. *Journal of Cleaner Production*, *232*, 400–407. https://doi.org/10.1016/j.jclepro.2019.05.275

Foguesatto, C. R., & Machado, J. A. D. (2021). What shapes farmers' perception of climate change? A case study of southern Brazil. *Environment, Development and Sustainability*, *23*(2), 1525–1538. https://doi.org/10.1007/s10668-020-00634-z

Folkes, V. S. (1988). The availability heuristic and perceived risk. *Journal of Consumer Research*, *15*(1), 13–23. https://doi.org/10.1086/209141

Food and Agriculture Organization. (2012). *Climate change adaptation and mitigation challenges and opportunities in the food sector*. http://www.fao.org/foodclimate

Food and Agriculture Organization. (2022). *FAO strategy on climate change 2022–2031*. https://openknowledge.fao.org/items/7b9bf435-b12b-4abf-94c0-4806d3b97109

Food and Agriculture Organization. (2025). *FAOSTAT: Employment indicators: Agriculture*. https://www.fao.org/faostat/en/#data/OEA

Freebairn, J. (2021). Adaptation to climate change by Australian farmers. *Climate*, *9*(9), 141. https://doi.org/10.3390/cli9090141

Gassi, K. R., & Çelik Ateş, H. (2025). Perceptions of climate change and adaptation measures among wheat and barley producers. *Journal of Agriculture Faculty of Ege University*, *62*(1), 63–75. https://doi.org/10.20289/zfdergi.1499619

González, I. F., & Feldman, A. L. (2021). Farmers' perception of climate change: A review of the literature for Latin America. *Frontiers in Environmental Science*, *9*, 672399. https://doi.org/10.3389/fenvs.2021.672399

Grigorieva, E., Livenets, A., & Stelmakh, E. (2023). Adaptation of agriculture to climate change: A scoping review. *Climate*, *11*(10), 202. https://doi.org/10.3390/cli11100202

Grothmann, T., & Patt, A. (2005). Adaptive capacity and human cognition: The process of individual adaptation to climate change. *Global Environmental Change*, *15*(3), 199–213. https://doi.org/10.1016/j.gloenvcha.2005.01.002

Hagos, T., Tadesse, T., Berhe, M., & Kassa, B. (2025). Access to and level of climate information use: Implications for adoption of adaptation and CSA practices. *Environmental Management*, *75*(5), 1267–1280. https://doi.org/10.1007/s00267-025-02133-1

He, K., Yang, Q., Shen, X., & Anagnostou, E. N. (2022). Brief communication: Western Europe flood in 2021–mapping agriculture flood exposure from synthetic aperture radar (SAR). *Natural Hazards and Earth System Sciences*, *22*(9), 2921–2927. https://doi.org/10.5194/nhess-22-2921-2022

Hitayezu, P., Wale, E., & Ortmann, G. (2017). Assessing farmers' perceptions about climate change: A double-hurdle approach. *Climate Risk Management*, *17*, 123–138. https://doi.org/10.1016/j.crm.2017.07.001

Huong, N. T. L., Shun Bo, Y., & Fahad, S. (2017). Farmers' perception, awareness and adaptation to climate change: Evidence from northwest Vietnam. *International Journal of Climate Change Strategies and Management*, *9*(4), 555–576. https://doi.org/10.1108/IJCCSM-02-2017-0032

Intergovernmental Panel on Climate Change (IPCC). (2023). *Climate change 2023: Synthesis report*. https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf

Jordão, A. R., Costa, R., Dias, Á. L., Pereira, L., & Santos, J. P. (2020). Bounded rationality in decision making: An analysis of the decision-making biases. *Business: Theory and Practice*, *21*(2), 654–665. https://doi.org/10.3846/btp.2020.11154

Kangai, R., Chitechi, E. W., Koske, J., Waswa, B., & Ngare, I. (2021). Determinants of climate change adaptation and perceptions among small-scale farmers of Embu County, Eastern Kenya. *African Journal of Environmental Science and Technology*, *15*(4), 167–178. https://doi.org/10.5897/ajest2020.2943

Karki, S., Burton, P., & Mackey, B. (2020). The experiences and perceptions of farmers about the impacts of climate change and variability on crop production: A review. *Climate and Development*, *12*(1), 80–95. https://doi.org/10.1080/17565529.2019.1603096

Koguia, W. N., Nonga, N., Madi, A., Leblois, A., Nemkenang Koguia, W., Fidoline, Tene, M., & Laure, G. (2021). Perception of climatic change and farmers' decision to adapt in the Sudano-Sahelian zone in Cameroon. *Journal of Humanities and Social Sciences Studies*, *3*(10), 22–33. https://doi.org/10.32996/jhsss.2021.3.10.3

Kumar, H. H. S., Murthy, D. S., Ajayakumar, S., K. M., & Sri, K. K. (2023). Farmers' perception towards climate change and its effect on agriculture in Kolar District of Karnataka, India. *International Journal of Environment and Climate Change*, *13*(11), 2676–2683. https://doi.org/10.9734/IJECC/2023/v13i113436

Kundzewicz, Z. W., Kanae, S., Seneviratne, S. I., Handmer, J., Nicholls, N., Peduzzi, P., & Sherstyukov, B. (2014). Flood risk and climate change: Global and regional perspectives. *Hydrological Sciences Journal*, *59*(1), 1–28. https://doi.org/10.1080/02626667.2013.857411

Leng, G., & Hall, J. (2019). Crop yield sensitivity of global major agricultural countries to droughts and the projected changes in the future. *Science of the Total Environment*, *654*, 811–821. https://doi.org/10.1016/j.scitotenv.2018.10.434

Liu, H., Jiang, C., Liu, Y., Hertogh, M., & Lyu, X. (2018). Optimism bias evaluation and decision-making risk forecast on bridge project cost based on reference class forecasting: Evidence from China. *Sustainability*, *10*(11), 3981. https://doi.org/10.3390/su10113981

Madhuri, & Sharma, U. (2020). How do farmers perceive climate change? A systematic review. *Climatic Change*, *162*(3), 991–1010. https://doi.org/10.1007/s10584-020-02814-2

Makamane, A., Loki, O., Swanepoel, J., Zenda, M., & Van Niekerk, J. (2025). Farmers' perceptions on the capacity of extension practitioners on climate change in the Eastern Cape Province of South Africa. *Frontiers in Climate*, *7*, 1534254. https://doi.org/10.3389/fclim.2025.1534254

Massagony, A., Tam Ho, T., & Shimada, K. (2023). Climate change impact and adaptation policy effectiveness on rice production in Indonesia. *International Journal of Environmental Studies*, *80*(5), 1373–1390. https://doi.org/10.1080/00207233.2022.2099110

Mdiya, L., Aliber, M., Mdoda, L., Van Niekerk, J., Swanepoel, J., & Ngarava, S. (2024). Empowering resilience: The impact of farmer field schools on smallholder livestock farmers' climate change perceptions in Raymond Local Municipality. *Sustainability*, *16*(20), 8784. https://doi.org/10.3390/su16208784

Mitter, H., Larcher, M., Schönhart, M., Stöttinger, M., & Schmid, E. (2019). Exploring farmers' climate change perceptions and adaptation intentions: Empirical evidence from Austria. *Environmental Management*, *63*(6), 804–821. https://doi.org/10.1007/s00267-019-01158-7

Molua, E. L. (2014). Climate change perception and farmers' adoption of sustainable land management for robust adaptation in Cameroon. *Journal of Agricultural Science*, *6*(12), 202–215. https://doi.org/10.5539/jas.v6n12p202

Mungai, L. M., Messina, J. P., Zulu, L. C., Chikowo, R., & Snapp, S. S. (2024). The role of agricultural extension services in promoting agricultural sustainability: A Central Malawi case study. *Cogent Food & Agriculture*, *10*(1), 2423249. https://doi.org/10.1080/23311932.2024.2423249

Murniati, K., & Mutolib, A. (2020). The impact of climate change on the household food security of upland rice farmers in Sidomulyo, Lampung Province, Indonesia. *Biodiversitas*, *21*(8), 3487–3493. https://doi.org/10.13057/biodiv/d210809

Ndambiri, H. K., Ritho, C. N., & Mbogoh, S. G. (2013). An evaluation of farmers' perceptions of and adaptation to the effects of climate change in Kenya. *International Journal of Food and Agricultural Economics*, *1*(1), 75–96. https://erepository.uonbi.ac.ke/handle/11295/89570

National Oceanic and Atmospheric Administration (NOAA). (2024). *Climate at a glance*. https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance

Ofuoku, A. U. (2011). Rural farmers'perception of climate change in central agricultural zone of Delta State, Nigeria. *Indonesian Journal of Agricultural Science*, *12*(2), 63-69. https://doi.org/10.21082/ijas.v12n2.2011.63-69

Ogunleye, A., Kehinde, A., Mishra, A., & Ogundeji, A. (2021). Impacts of farmers' participation in social capital networks on climate change adaptation strategies adoption in Nigeria. *Heliyon*, *7*(12), e08624. https://doi.org/10.1016/j.heliyon.2021.e08624

Omotayo, A. O., Olugbenga, O. A., & Olarotimi, O. N. (2020). Socio-economic factors influencing perceptions and adaptability of rural rice farmers to climate change, Abuja, Nigeria: Applications of Heckman two-stage model. *Russian Journal of Agricultural and Socio-Economic Sciences*, *104*(8), 45–56. https://doi.org/10.18551/rjoas.2020-08.06

Oti, O. G., Okoye, C. U., & Obasi, I. O. (2021). Awareness and perception of climate change among farmers in Nigeria: Implications for food security. *Nigerian Agricultural Journal*, *52*(2), 164–173. https://www.ajol.info/index.php/naj/article/view/218413

Petersen-Rockney, M. (2022). Social risk perceptions of climate change: A case study of farmers and agricultural advisors in northern California. *Global Environmental Change*, *75*, 102557. https://doi.org/10.1016/j.gloenvcha.2022.102557

Rahman, M. S., Zulfiqar, F., Ullah, H., Himanshu, S. K., & Datta, A. (2023). Farmers' perceptions, determinants of adoption, and impact on food security: Case of climate change adaptation measures in coastal Bangladesh. *Climate Policy*, *23*(10), 1257–1270. https://doi.org/10.1080/14693062.2023.2212638

Ricart, S., Gandolfi, C., & Castelletti, A. (2023). Climate change awareness, perceived impacts, and adaptation from farmers' experience and behavior: A triple-loop review. *Regional Environmental Change*, *23*(3), 82. https://doi.org/10.1007/s10113-023-02078-3

Roco, L., Engler, A., Bravo-Ureta, B. E., & Jara-Rojas, R. (2015). Farmers' perception of climate change in Mediterranean Chile. *Regional Environmental Change*, *15*(5), 867–879. https://doi.org/10.1007/s10113-014-0669-x

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.

Shrestha, R., Rakhal, B., Adhikari, T. R., Ghimire, G. R., Talchabhadel, R., Tamang, D., KC, R., & Sharma, S. (2022). Farmers' perception of climate change and its impacts on agriculture. *Hydrology*, *9*(12), 212. https://doi.org/10.3390/hydrology9120212

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339. https://doi.org/10.1016/j.jbusres.2019.07.039

Soubry, B., Sherren, K., & Thornton, T. F. (2020). Are we taking farmers seriously? A review of the literature on farmer perceptions and climate change, 2007–2018. *Journal of Rural Studies*, *74*, 210–222. https://doi.org/10.1016/j.jrurstud.2019.09.005

Speranza, C. I. (2010). *Resilient adaptation to climate change in African agriculture*. Deutsches Institut für Entwicklungspolitik. https://hdl.handle.net/10419/199179

Spinoni, J., Barbosa, P., De Jager, A., McCormick, N., Naumann, G., Vogt, J. V., Magni, D., Masante, D., & Mazzeschi, M. (2019). A new global database of meteorological drought events from 1951 to 2016. *Journal of Hydrology: Regional Studies*, *22*, 100593. https://doi.org/10.1016/j.ejrh.2019.100593

Suranny, L. E., Gravitiani, E., & Rahardjo, M. (2022). Impact of climate change on the agriculture sector and its adaptation strategies. *IOP Conference Series: Earth and Environmental Science*, *1016*(1), 012038. https://doi.org/10.1088/1755-1315/1016/1/012038

Teodoro, J. D., Prell, C., & Sun, L. (2021). Quantifying stakeholder learning in climate change adaptation across multiple relational and participatory networks. *Journal of Environmental Management*, *278*, 111508. https://doi.org/10.1016/j.jenvman.2020.111508

Tilahun, U., & Bedemo, A. (2014). Farmers' perception and adaptation to climate change: Heckman's two stage sample selection model. *Ethiopian Journal of Environmental Studies and Management*, *7*(2), 832–839. https://doi.org/10.4314/ejesm.v7i2.3s

Uddin, M. N., Bokelmann, W., & Dunn, E. S. (2017). Determinants of farmers' perception of climate change: A case study from the coastal region of Bangladesh. *American Journal of Climate Change*, *6*(1), 151–165. https://doi.org/10.4236/ajcc.2017.61009

Whitmarsh, L., & Capstick, S. (2018). Perceptions of climate change. In S. Clayton & C. Manning (Eds.), *Psychology and climate change: Human perceptions, impacts, and responses* (pp. 13–33). Elsevier. https://doi.org/10.1016/B978-0-12-813130-5.00002-3

Woods, B. A., Nielsen, H. Ø., Pedersen, A. B., & Kristofersson, D. (2017). Farmers' perceptions of climate change and their likely responses in Danish agriculture. *Land Use Policy*, *65*, 109–120. https://doi.org/10.1016/j.landusepol.2017.04.007

Yang, Y., Huang, Y., Huang, J., & Nie, F. (2024). The role of social capital in the impact of multiple shocks on households' coping strategies in underdeveloped rural areas. *Scientific Reports*, *14*(1), 14218. https://doi.org/10.1038/s41598-024-65206-x

Biographies of Author

Nur Afiani, Department of Agricultural Economics, Faculty of Agriculture, Ondokuz Mayis University, Atakum, Samsun 55270, Turkey.

- Email: afianinur@gmail.com
- ORCID: 0009-0008-7517-1425
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A