Research Poster

Barriers to the Adoption of Climate-Smart Agriculture Among Producers in the United States: A Sociological Prospect

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Introduction

The agriculture, livestock, and seafood sectors in the United States are critical contributors to the national economy and food security. In 2023, agriculture, food, and related industries contributed approximately $1.54 trillion to the U.S. gross domestic product, accounting for 5.5% of the nation's economy (USDA Economic Research Service, 2024). However, these sectors face increasing challenges from climate change, including extreme weather, declining soil health, and water scarcity (Forster et al., 2024). Climate-smart agriculture (CSA) offers a technique that enhances productivity, strengthen resilience and reduce greenhouse gas emissions (Intergovernmental Panel on Climate Change [IPCC], 2023). Despite these benefits, CSA adoption remains limited in United States (Johnson et al., 2023), reducing agricultures ability to adapt climate change and improve long term sustainability (Berthold et al., 2021). As a result, a better understanding of the systemic barriers to CSA adoption is critical for developing solutions to promote sustainable agricultural practices across diverse farming systems (Smith & Olesen, 2010). Despite growing research on CSA, few studies have synthesized how sociological barriers to CSA adoption have evolved over time in the United States, particularly within agricultural education, Extension, and communication systems. Addressing this gap can support future efforts to increase CSA adoption and strengthen agricultural resilience.

Theoretical Framework

This study is based on Rogers' diffusion of innovations (DOI) and the theory of planned behavior (TPB). DOI explains how innovations spread through communication channels and social systems (Rogers et al. 2014); while TPB highlights that adoptions decisions are influenced by attitudes, subjective norms, and perceived behavioral control (Worthington et al., 2021). Although, CSA is acknowledged as effective responses to environmental concerns such as climate change, pests, droughts, natural disasters, and food poverty (Lipper et al., 2014), its adoption remains limited (Rosário et al., 2022). Rather than directly measuring producers' attitudes or behavioral intentions, these frameworks guided the qualitative analysis by informing the coding framework and interpretation of historical documents. DOI constructs (e.g., communication channels, innovation characteristics, and social systems) and TPB constructs (e.g., attitudes, subjective norms, and perceived behavioral control) served as sensitizing concepts during thematic analysis. These frameworks provided a structured lens for examining how historical extension materials communicated and promoted CSA practices, while establishing a foundation for future research that directly investigates producers' perceptions and adoption decisions through interviews or surveys.

Methodology

This study used a historical research methodology (Berg, 2001) and qualitative content analysis (Elo & Kyngäs, 2008) to understand barriers to CSA adoption among U.S. producers. Data were collected from both primary (Extension bulletins, technical reports, and agricultural policy documents) and secondary sources (USDA publications and peer-reviewed journal articles published between 2012 and 2024). Peer-reviewed studies were identified through Scopus and Web

of Science using the search terms “farmers”, “adoption behavior”, “factors influencing”, and “CSA practices or technologies”. Only English-language studies focused on U.S. producers were included. A total of nineteen documents were sampled and reviewed for this study. Data were analyzed using qualitative content analysis (Schreier, 2012). Document were coded using a coding framework informed by the diffusion of innovations (DOI) and theory of planned behavior (TPB), while allowing additional themes to emerge. Similar codes were grouped into broader categories (e.g., economic, sociological, behavioral, educational/communication, and policy-related) using a constant comparative approach. Documents were then organized into historical (early 1990s-2011) and contemporary (2012-2024) periods, and themes were compared across these periods to identify changes in barriers and supports to CSA adoption over time.

Results

Analysis of historical documents (early 1990s-2011) and contemporary peer-reviewed literature (2012-2024) revealed changes in the barriers influencing CSA adoption among U.S. producers. Historical documents identified limited access to reliable information, inadequate institutional support, and uncertainty regarding the economic benefits of CSA practices as key barriers to adoption. In contrast, contemporary literature indicated that although Extension programs and educational initiatives have improved awareness and access to information, socioeconomic disparities, inconsistent policy incentives, and ineffective communication strategies continue to constrain CSA adoption. Contemporary documents also identified persistent policy and governance challenges, including inconsistent implementation of climate-related policies, limited incentives for CSA practices, continued support for conventional agricultural systems, and information management barriers such as limited data sharing, inconsistent data quality, and misinformation.

Conclusions, Recommendations, and Implementation

This study identified key social, technological, and information related barriers to CSA adoption among U.S. producers. These findings are consistent with previous research showing that limited access to information, financial resources, and technical support remain major barriers to CSA adoption (Rosário et al., 2022). Guided by the diffusion of innovations theory, the findings suggested that communication channels, Extension outreach, and local support influenced the diffusion of CSA practices. The theory of planned behavior highlighted the importance of improving producers perceived behavioral control through education, technical assistance, and access to resources. Although private funding was identified as an important source of financial support (McNunn et al., 2020), government assistance appeared to be underutilized. These findings suggested increasing Extension outreach, strengthening local advisory services, and expanding access to policy incentives and financial assistance could support greater CSA adoption and contribute to a more resilient and sustainable agricultural system.

Due to the scope and limitations of this study, further research should examine how information quality, trust, communication channels, Extension programs, and policy incentives influence producers' adoption decisions. Future studies using interviews or surveys could further examine the DOI and TPB constructs identified in this historical analysis to better understand producers' attitudes, social influences, and decision-making processes regarding CSA adoption.

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