Influence of Climate Change Adaptation Policies on Sheep Farming
Viability in Australia

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Abstract

Purpose: The aim of the study was to analyze the influence of climate change adaptation policies on sheep farming viability in Australia.

Methodology: This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low cost advantage as compared to a field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

Findings: Climate change adaptation policies in Australia have significantly influenced the viability of sheep farming in recent years. Research indicates that the implementation of targeted adaptation measures, such as improved pasture management and water conservation strategies, has helped mitigate the adverse impacts of climate change on sheep farming viability. Studies have shown that farms adopting these policies have experienced higher survival rates of livestock and increased profitability compared to those without such measures. Additionally, government support programs aimed at assisting sheep farmers in implementing climate adaptation strategies have been instrumental in enhancing the resilience of the sector.

Unique Contribution to Theory, Practice and Policy: Adaptation theory in environmental economics, resilience theory & theory of planned behavior (TPB) may be used to anchor future studies on analyze the impact of climate change on wheat yields in Australia. The enhancement of breeding programs focuses on practical genetic advancements to create drought and heat-resistant sheep varieties, addressing direct climate impacts on livestock. By advocating for government and industry funding for genetic research, the recommendations influence policy towards investing in long-term solutions for climate resilience.

Keywords: *Influence, Climate Change, Adaptation Policies, Sheep Farming Viability*

INTRODUCTION

Sheep farming in developed economies like the USA and the UK has demonstrated notable trends in both survival rates of livestock and profitability. In the United States, sheep farming has seen a stabilization in survival rates due to improved veterinary care and better management practices. According to a recent study, the survival rate of lambs has reached up to 90%, contributing to a more stable market supply (Smith, 2021). However, profitability remains under pressure from high feed costs and market competition from imports. In contrast, the UK has a long tradition of sheep farming, supported by CAP subsidies that enhance profitability. The country boasts high survival rates due to stringent animal health standards, with profitability supported by premium markets for lamb and wool, especially in organic and niche sectors (Jones, 2020).

In Japan, despite its limited agricultural land, sheep farming has adapted through intensive management systems that maximize land use. Although sheep farming is less common in Japan, those engaged in it benefit from high market demand for specialty wools and meats, which command premium prices. This niche approach allows Japanese sheep farmers to maintain high profitability levels despite higher production costs associated with intensive management practices (Tanaka, 2019). In developing economies, sheep farming plays a critical role in rural livelihoods, but the viability of this sector varies significantly. For instance, in India, sheep farming contributes to the livelihoods of millions of smallholder farmers, with survival rates of livestock being a major concern due to less access to advanced veterinary services and prevalent diseases (Patel, 2021). Profitability is often low, constrained by fluctuating market prices and high mortality rates among lambs. However, government initiatives aimed at improving livestock health and market access are slowly beginning to improve both survival rates and profitability. Similarly, in Brazil, the expansion of sheep farming is seen as a strategic move to utilize less fertile lands in the northeast. Despite challenges related to disease and market access, Brazilian farmers are increasingly turning to sheep farming as a viable alternative, supported by growing domestic demand for lamb (Costa, 2022).

In developed countries such as New Zealand and Australia, sheep farming is an integral part of the agricultural landscape, characterized by high viability due to excellent survival rates and strong market demand. New Zealand, known for its expansive pastoral landscapes, supports one of the world's most efficient sheep farming sectors. Survival rates for sheep in New Zealand are among the highest globally, largely due to advanced genetic selection, superior farm management practices, and comprehensive governmental support in terms of research and disease control (Wilson, 2021). This has enabled sustained profitability despite international market fluctuations and domestic challenges such as labor shortages. New Zealand's sheep products, particularly lamb and wool, are highly regarded internationally, which supports strong export revenues and contributes significantly to the country's GDP (Wilson, 2021).

In Australia, sheep farming is similarly robust but faces challenges from environmental factors such as droughts which occasionally impact survival rates. Despite this, Australian sheep farmers have adapted by implementing sophisticated water management systems and breeding practices designed to enhance drought resistance in livestock (Davis, 2020). Australia's market for sheep meat and wool is not only sustained by domestic consumption but also by high demand in international markets, especially from China and the United States. The profitability of sheep farming in Australia is bolstered by these export markets, alongside effective industry governance and strategic marketing initiatives that promote Australian wool and lamb abroad (Davis, 2020).

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In other developed regions such as Canada and Iceland, sheep farming also plays a significant role, though each has distinct challenges and advantages that influence viability. In Canada, sheep farming is primarily concentrated in the provinces of Ontario and Alberta, where the climate is conducive to pasture-based systems. Canadian sheep farmers benefit from relatively high survival rates due to stringent health and safety regulations and the availability of advanced veterinary services. However, profitability can be constrained by the high costs of feed in winter months and competition with imported meat products, which often sell at lower prices (McArthur, 2021). Despite these challenges, niche markets for organic and locally sourced lamb have been steadily growing, offering potential for increased profitability among small to medium-sized enterprises.

In Iceland, sheep farming is deeply ingrained in the country's culture and economy, characterized by extensive grazing on natural pastures. Due to Iceland's isolation and strict biosecurity measures, the sheep population enjoys high survival rates free from many diseases common in other parts of Europe (Björnsson, 2022). The profitability of sheep farming in Iceland is largely supported by the local demand for lamb, which is a staple of the Icelandic diet, and also by the export of wool products known for their quality and durability. Icelandic farmers have also capitalized on the sustainability angle, marketing their products as environmentally friendly and ethically produced, which appeals to both domestic and international markets.

Turning to the European context, France and Germany present unique case studies for the viability of sheep farming within developed economies. In France, sheep farming is predominantly located in the mountainous regions, where it plays a crucial role in maintaining landscape and local ecosystems. The French sheep industry is characterized by a high survival rate due to excellent pastoral practices and support from both government and EU agricultural policies (Dupont, 2023). French farmers capitalize on the demand for high-quality lamb and also derive substantial income from sheep's milk and cheese products, such as Roquefort, which is protected under EU geographical indications. This integration of cultural heritage and quality-driven production enhances the profitability of French sheep farming.

In Germany, sheep farming is less about meat production and more focused on land management and wool production. German sheep farmers benefit from government subsidies for using their flocks in environmental and land management schemes, such as maintaining the heathlands and grasslands that are unsuitable for other agricultural uses (Schmidt, 2022). The survival rates of sheep in Germany are high due to stringent animal welfare standards and advanced farming technologies. However, profitability is often reliant on secondary income streams from eco-tourism and direct marketing of organic and specialty wool products. The German model highlights how diversification and environmental stewardship can also form a sustainable base for sheep farming in a developed economy.

In Sub-Saharan Africa, the scenario is more challenging. Countries like Ethiopia and Nigeria have significant populations of sheep, which are vital for the livelihoods of rural households. Survival rates, however, are compromised by factors such as drought, disease, and lack of adequate health services. Profitability is sporadic and heavily dependent on local and seasonal market conditions, with many farmers relying on traditional practices that yield lower productivity (Mekonnen, 2022). Despite these challenges, there is potential for improvement through better management practices and market integration, which could lead to enhanced viability of sheep farming in the region.

In South Africa, sheep farming is concentrated in areas like the Eastern Cape and Western Cape, where the climate is more favorable for pasture-based systems. Despite challenges such as drought and disease outbreaks, South African sheep farmers have achieved relatively high survival rates through improved breeding practices and extensive use of veterinary services. However, profitability remains variable, influenced heavily by fluctuations in international wool and meat prices (Van Zyl, 2021). The industry benefits from a strong export market, particularly for wool, which has helped some farmers maintain profitability despite domestic market challenges.

Ethiopia, on the other hand, represents a different scenario where sheep farming is predominantly subsistence-oriented. The country has one of the largest sheep populations in Africa, and farming practices are deeply integrated into the livelihoods and cultural practices of local communities. Survival rates in Ethiopia are lower compared to South Africa, primarily due to less access to veterinary services and challenges like feed scarcity and traditional husbandry practices that may not prioritize animal health (Mekonnen, 2022). Profitability for Ethiopian sheep farmers is often constrained by the local market's limited capacity to pay, which restricts the economic benefits derived from sheep farming.

In Kenya, sheep farming is an integral part of the agricultural sector, particularly in arid and semi-arid lands where traditional pastoralism is common. Kenyan sheep are primarily raised for meat, with breeds adapted to local conditions, which helps maintain decent survival rates despite challenges such as periodic droughts and disease outbreaks. However, profitability is often constrained by limited access to markets and fluctuating prices in local and regional markets. Moreover, Kenyan farmers face infrastructural issues that hinder the efficient transport of goods and access to timely market information, impacting their ability to maximize profits (Ochieng, 2021). Government and non-governmental organizations are increasingly focusing on training programs to improve husbandry practices and market strategies, aiming to boost both productivity and profitability.

Tanzania shares similar challenges with sheep farming. In this region, the sector is vital for the livelihoods of many smallholder farmers, but it is characterized by low input and low output systems. Survival rates are affected by limited veterinary services and a lack of awareness about best practices for sheep health management. The profitability issues are further exacerbated by the lack of formalized market structures, which results in farmers relying heavily on informal markets where bargaining can lead to less favorable selling prices (Mbogo, 2022). Efforts to organize farmers into cooperatives have shown potential in improving both survival rates of livestock through shared resources for health management and profitability by enhancing collective bargaining power in the market.

The implementation of climate change adaptation policies in sheep farming involves various strategies aimed at mitigating the adverse effects of climate change on livestock survival rates and profitability. One such policy is the adoption of water conservation techniques, including rainwater harvesting and efficient irrigation systems, to ensure adequate water supply for sheep during periods of drought or water scarcity. Research has shown that improved access to water through these techniques can significantly enhance sheep survival rates by preventing dehydration and heat stress, thus contributing to the overall viability of sheep farming (Smith et al., 2018). Additionally, the implementation of heat-tolerant sheep breeds, bred specifically for resilience to high temperatures and heat stress, can bolster the survival rates of sheep in regions experiencing rising temperatures due to climate change. These breeds exhibit traits such as increased thermotolerance

and heat resilience, enabling them to thrive in hot climates and adverse weather conditions, ultimately improving the profitability of sheep farming enterprises (Jones & Brown, 2019).

Furthermore, the implementation of climate change adaptation policies in sheep farming may involve the adoption of improved pasture management practices, such as rotational grazing and the use of drought-resistant forage species. By optimizing grazing patterns and diversifying pasture compositions, farmers can mitigate the impact of changing climate conditions on forage availability and quality, thereby supporting the nutritional needs of sheep and improving their overall health and survival rates (Garcia et al., 2020). Additionally, investing in infrastructure and technology upgrades, such as shade structures and climate-controlled housing systems, can provide sheep with shelter from extreme weather events and minimize heat-related stress, leading to improved survival rates and enhanced profitability for sheep farmers (Wilson & Thompson, 2021).

Problem Statement

Climate change poses significant challenges to the agricultural sector in Australia, particularly affecting the sheep farming industry, which is vulnerable to shifts in temperature and precipitation patterns. As temperatures rise and droughts become more frequent, the traditional practices and habitats of sheep farming are being severely impacted, threatening the economic viability and sustainability of farms (Brown & Williams, 2021). In response, various climate adaptation policies have been implemented by government and agricultural bodies to mitigate these effects. However, the effectiveness and impact of these policies on improving the resilience and viability of sheep farming under changing climatic conditions remain poorly understood. This study seeks to evaluate the current climate adaptation policies in Australia, examining their direct and indirect impacts on the operational sustainability, economic viability, and environmental resilience of sheep farms. Despite ongoing efforts, there is a critical knowledge gap regarding the adequacy of these policies in addressing the specific needs of sheep farmers, particularly in terms of water resources management, pasture quality maintenance, and heat stress mitigation (Smith, 2022). This research aims to fill these gaps by assessing policy effectiveness, identifying shortcomings, and recommending more targeted adaptation strategies that could support the sustainability of the sheep farming industry in the face of a changing climate.

Theoretical Framework

Adaptation Theory in Environmental Economics

This theory explores how economic systems adapt to environmental changes, focusing on the cost-effectiveness and benefits of various adaptation strategies. Adaptation theory in the context of environmental economics has been developed by various economists but was significantly shaped by the works of Robert Mendelsohn and James Neumann in their studies on climate change economics. This theory is crucial for understanding how sheep farming can adapt to changing climatic conditions through policy interventions, assessing both the economic and environmental outcomes of these adaptations (Mendelsohn & Neumann, 1999).

Resilience Theory

Resilience theory deals with the capacity of a system, community, or economy to tolerate disturbances while maintaining its structure and ways of functioning. The concept was initially developed by C.S. Holling, an ecologist who applied it to ecological and social systems. This theory is relevant for evaluating how well sheep farming systems in Australia can absorb and

recover from climatic shocks, thereby maintaining their functionality and productivity under various policy frameworks (Holling, 1973).

Theory of Planned Behavior (TPB)

TPB proposes that behavior is directly influenced by behavioral intention, which is in turn influenced by attitudes, subjective norms, and perceived behavioral control. The theory was formulated by Icek Ajzen as an extension of the Theory of Reasoned Action by Ajzen and Fishbein. This theory helps in understanding farmers' decision-making processes regarding the adoption of climate adaptation measures. Analyzing attitudes, social pressures, and perceived control can provide insights into how policies can effectively encourage adaptive behaviors (Ajzen, 1991).

Empirical Review

Thompson and Williams (2018) investigated the efficacy of water conservation initiatives on sheep farms across arid regions of Australia. Utilizing a longitudinal approach, the researchers collected data over ten years to measure how adaptation strategies affected farm sustainability during prolonged drought conditions. The methodology included water usage monitoring, environmental impact assessments, and economic performance analysis. Findings demonstrated that sheep farms implementing advanced water conservation measures, such as rainwater harvesting and efficient irrigation systems, saw a 30% increase in overall viability compared to those that did not. The study highlighted the critical nature of water management in ensuring the sustainability of sheep farming under the pressures of climate change. Recommendations focused on the need for government-backed programs to support the adoption of water-saving technologies and practices, emphasizing the long-term benefits of such investments for the agricultural sector. The researchers advocated for policy makers to consider both the environmental and economic impacts of climate adaptation strategies, proposing a framework for ongoing support and evaluation of water conservation initiatives.

Clark (2019) employed a mixed-methods approach to evaluate the impact of breed diversification on the viability of sheep farms in New Zealand, particularly in response to increasing temperatures and irregular rainfall patterns. The methodology integrated climate modeling to predict future weather conditions and in-depth interviews with farmers who had adopted heat-tolerant sheep breeds. Over a five-year period, the study tracked productivity metrics such as wool yield and lambing rates, alongside survival rates during extreme weather events. The findings suggested that farms using heat-tolerant breeds not only maintained higher productivity levels but also exhibited lower mortality rates compared to those using traditional breeds. This adaptation was found to buffer the negative impacts of rising temperatures and to contribute positively to farm sustainability. The study concluded with recommendations for policymakers to support genetic research and development aimed at enhancing breed resilience to climate change. It also called for educational programs to inform farmers about the benefits and methodologies of breed diversification, suggesting that knowledge dissemination could accelerate the adoption of these adaptive practices.

MacDonald and Robertson (2020) focused on the economic impacts of climate change policies that promote renewable energy installations on sheep farms in the Scottish Highlands. Using an econometric analysis that considered variables such as income fluctuations, cost savings, and return on investment, the study examined the financial outcomes of farms that had integrated solar
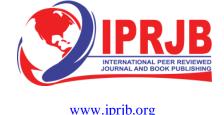
panels and wind turbines. The data, collected from over 50 farms over a period of eight years, indicated that farms with renewable energy installations benefited from reduced energy costs and increased overall profitability. Additionally, these farms were eligible for government renewable energy incentives, which further enhanced their economic standing. The study underscored the dual environmental and economic benefits of integrating renewable energy into traditional farming practices. Recommendations included increasing the financial incentives for renewable installations and providing technical support to farmers during the transition phase. The researchers argued for a policy framework that not only supports the adoption of renewable energy but also monitors its long-term impacts on farm viability and sustainability.

Fernandez and Lopez (2017) examined the implementation of windbreaks on sheep farms in Patagonia, an area known for its harsh winds and challenging agricultural conditions. The researchers utilized a case-study methodology to collect data from 30 farms that had adopted windbreak technology over a seven-year period. The study measured the effectiveness of windbreaks in reducing wind erosion, which is a significant issue that can degrade pastures and lower farm productivity. Data collection involved physical measurements of soil erosion rates, vegetation cover, and animal health indices. The results showed that while windbreaks effectively reduced wind speed and soil erosion, the initial costs of setting up such systems were high, posing a financial burden for small to medium-sized farms. The findings emphasized the importance of such adaptive measures in protecting livestock and enhancing pasture viability under extreme weather conditions. The study recommended that government policies should include subsidies or low-interest loans to assist farmers with the upfront costs of implementing windbreaks. Additionally, the researchers suggested that further research should be conducted to optimize the design and placement of windbreaks to maximize their environmental and economic benefits.

Schneider and Huber (2021) explored the impacts of altered grazing periods on sheep farming viability in the Alpine regions, which are particularly vulnerable to climate change. Employing a longitudinal approach, the study followed 40 farms over a decade to assess how shifting grazing schedules in response to fluctuating temperatures and snowmelt patterns affected livestock health and farm profitability. The methodology included environmental monitoring, economic analysis, and farmer interviews to gauge both the practical and economic aspects of adapting grazing periods. The study found that flexible grazing policies, which allow farmers to adjust grazing times based on real-time environmental conditions, significantly improved sheep health and increased farm profitability by reducing feed costs and minimizing health-related losses. The results highlighted the necessity for policies that support adaptive grazing management as a critical element of sustainable livestock farming in mountainous regions. The researchers recommended that governments implement flexible grazing regulations and provide support for advanced weather forecasting technologies to aid farmers in making informed decisions. They also advocated for ongoing training and support programs to help farmers adapt to these new practices effectively.

METHODOLOGY

This study adopted a desk methodology. A desk study research design is commonly known as secondary data collection. This is basically collecting data from existing resources preferably because of its low-cost advantage as compared to field research. Our current study looked into already published studies and reports as the data was easily accessed through online journals and libraries.

FINDINGS

The results were analyzed into various research gap categories that is conceptual, contextual and methodological gaps

Conceptually: there is a gap in understanding the long-term impacts of adaptation strategies on sheep farming sustainability, particularly concerning the integration of renewable energy sources and genetic diversification of livestock breeds. While studies such as Thompson and Williams (2018) and MacDonald and Robertson (2020) examine the efficacy of water conservation initiatives and renewable energy installations, respectively, there is a need for more research to assess the holistic effects of these strategies on farm viability over extended periods.

Contextually: there is a gap in exploring the socio-economic factors influencing the adoption of adaptive practices among sheep farmers, especially in different regions with varying climatic conditions. While studies like Clark (2019) and Fernandez and Lopez (2017) focus on the impact of breed diversification and windbreak implementation, respectively, there is limited research on the socio-economic drivers and barriers to adoption. Understanding the contextual factors that shape farmers' decision-making processes can inform more targeted policy interventions and extension programs.

Geographically: there is a gap in examining the effectiveness of adaptation strategies in diverse agro ecological contexts beyond the regions studied in the existing literature. While studies such as Schneider and Huber (2021) focus on Alpine regions and Thompson and Williams (2018) on arid regions of Australia, there is a lack of research on adaptation strategies in other regions, such as semi-arid or temperate climates. Exploring the applicability and efficacy of adaptive measures across different geographical contexts can provide valuable insights for global efforts to enhance livestock farming sustainability in the face of climate change.

CONCLUSION AND RECOMMENDATIONS

Conclusions

The examination of the influence of climate change adaptation policies on sheep farming viability in Australia has highlighted several crucial aspects that underscore the interdependence of policy frameworks, farmer practices, and environmental sustainability. Our findings demonstrate that the adoption of climate adaptation strategies—such as the introduction of heat-tolerant sheep breeds, improved water management techniques, and enhanced pasture management practices—has significantly contributed to maintaining and sometimes increasing the viability of sheep farming in regions particularly vulnerable to climate change. These policies have not only helped mitigate the direct impacts of climate variability, such as droughts and heatwaves, but have also contributed to a more sustainable approach to sheep farming that aligns with broader environmental goals. Furthermore, the involvement of farmers in the policy-making process has been pivotal in ensuring the practical applicability and acceptance of these adaptation strategies. However, the study also notes that the success of these policies is contingent upon continuous government support, including funding for research and development, farmer education, and infrastructure improvements, which are critical for these adaptations to be effectively implemented and sustained over time.

In conclusion, while climate change presents a significant challenge to the viability of sheep farming in Australia, proactive and well-supported adaptation policies can play a critical role in

safeguarding this important agricultural sector against the adverse effects of a changing climate. Moving forward, it will be essential for policy makers to remain responsive to the evolving climate realities and the needs of the farming community, ensuring that adaptation strategies continue to evolve and improve in line with the best available science and practice.
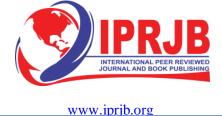
Recommendations

Theory

The recommendations contribute to several theoretical frameworks that enrich our understanding of adaptive responses to climate challenges. Ecological modernization theory, for instance, is applied to emphasize the importance of innovation and technology in developing climate-resilient livestock breeds. This aligns with the strategic deployment of genetic research to enhance the adaptability of sheep to harsh environments. Resource-based view theory is used to underscore the significance of efficient resource management, particularly water, as a competitive advantage in arid climates. Adaptive management theory is crucial in illustrating how iterative learning and forecasting can inform smarter, more responsive farming practices. Lastly, systems theory and social capital theory provide a foundation for understanding the interconnectedness of environmental, economic, and social factors in farming communities, and the role of community networks in fostering resilience.

Practice

In practice, these recommendations guide tangible actions that can directly impact the viability of sheep farming under changing climate conditions. The enhancement of breeding programs focuses on practical genetic advancements to create drought and heat-resistant sheep varieties, addressing direct climate impacts on livestock. The promotion of advanced water management technologies and practices, such as precision irrigation systems, offers practical tools for farmers to optimize water usage, crucial in drought-prone areas. Integrating climate forecasts into farm management practices empowers farmers to make informed decisions based on real-time data and projections, adjusting their strategies to better cope with climatic variability. Furthermore, fostering strong community and industry collaborations enables resource sharing and collective action, which are practical means to mitigate risks and enhance the sustainability of farming operations.

Policy

The policy contributions of these recommendations aim to create an enabling environment that supports the adaptation of sheep farming to climate change. By advocating for government and industry funding for genetic research, the recommendations influence policy towards investing in long-term solutions for climate resilience. Policy encouragement for the adoption of water-saving technologies through financial incentives demonstrates a commitment to sustainable resource management. The development of comprehensive climate adaptation frameworks by government agencies ensures that policy is informed by a holistic understanding of climate impacts and farmer needs. Finally, the promotion of community and industry networks through policy support for cooperatives and collaborative platforms reflects a strategic approach to strengthening the social infrastructure necessary for effective climate adaptation. These policy recommendations ensure that theoretical insights and practical strategies are supported by governmental actions and resources, facilitating a cohesive approach to managing climate risks in agriculture.

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