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Climate Change Adaptation Strategies Adopted by Farmers in the Small-Scale Farming Sector of Zambia: A Scoping Study

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Abstract: *The study focused on climate change and its influence on the behavioural adaptation of smallholder farmers in rain-fed agricultural systems in Sub-Saharan Africa, particularly Zambia. The purpose of the study was to examine how climate change shapes the behaviour, adaptation strategies, and livelihood decisions of smallholder farmers. Increasing climate variability, recurrent droughts, and declining agricultural productivity in Zambia have created the need to better understand farmer adaptation behaviour and the factors influencing resilience. The study adopted a qualitative scoping review design using secondary data from peer-reviewed articles, policy documents, institutional reports, and empirical studies. A thematic narrative synthesis approach was used for data analysis. The findings revealed that farmers are adopting various climate adaptation strategies such as drought-resistant crops, crop rotation, planting-date adjustments, livelihood diversification, and integrated farming systems. However, adaptation is limited by socio-economic inequalities, weak institutional support, poor extension services, and financial constraints. The study suggests that policymakers and development practitioners should strengthen extension services, improve access to climate information and financial support, and promote locally appropriate climate-smart agricultural interventions. The study contributes to the literature by integrating behavioural, livelihood, innovation, and resilience perspectives to explain farmer adaptation while identifying important research gaps within the Zambian context, especially at district level.*

Keywords: *Climate change; smallholder farmers; adaptation; farmer behaviour; resilience; livelihood diversification; drought-resistant crops*

1. Introduction

Climate change has become one of the greatest problems that face the world today. The effects of climate change can be felt across both developed and developing countries through the changing temperature trends, increase in extreme weather events, and the unpredictability of climatic trends (Alotaibi , 2023). At a global level, agriculture becomes vulnerable to climate change due to its dependence on climatic factors like rainfall and temperature trends (FAO, 2022). This way, climate change becomes a socio-economic and behavioural problem that determines the decision-making processes for farmers about what crops to grow and how to allocate their land resources (FAO, 2022). Farmers around the globe have started adjusting their farming activities according to climate change by applying innovations in technology, irrigation, and climate-smart agriculture practices. Nevertheless, the adaptive capabilities of farmers vary significantly based on the level of economic development, institutional support, and resource availability (Cano & Campos , 2024).

The effects of climate change are especially significant in sub-Saharan Africa, given the high reliance of agriculture in the region on rainfall, poor irrigation facilities, and socio-economic vulnerability (Emediegwu, et al., 2022). Indeed, the agricultural production system in the region is particularly sensitive to variations in rainfall patterns, long droughts, and rising temperature levels, which have become more pronounced in the past decades. Climate changes directly affect farm productivity, livestock productivity, and food security at the household level (Angwaomaodoko, 2024; Ngoma, et al., 2021). The problem is compounded by the low ability of small farmers to adapt to the changes owing to factors such as the lack of financial resources, poor extension services, and lack of supportive policies. In essence, climate change not only reduces agricultural productivity in sub-Saharan Africa but exacerbates existing vulnerabilities. Against this background, farmer behaviour emerges as an essential topic for analysis.

It is noted that one of the regions where the effects of climate variability were particularly profound included recurrent droughts, unpredictable rain cycles, and frequent mid-season dry periods in Southern Africa (Abebaw, 2025; Kekana, et al., 2025). The above factors contributed significantly to the difficulties in producing key staple crops such as maize that plays a dominant role in the agriculture of this part of the world. Based on available research evidence, many farmers now have to reevaluate the way of growing crops since the climate has become much more stressful for crop production. However, the ways in which farmers respond to these challenges greatly differ from one farm to another. While some decide to adapt to the situation by using drought-resistant crops, diversifying income sources, and combining livestock farming and crop production, others continue using traditional farming methods due to either cultural or financial limitations (Mubanga and Ferguson, 2017).

Climate change has now emerged as an important factor constraining agricultural production in Zambia, specifically in Southern Province, where agriculture is dependent on rainfall alone. The region faces increased variability in rainfall, delays in the timing of the onset of the rains, early termination of the rainy season, and droughts. All these factors affect the agricultural cycle, leading to lower productivity levels (Abebaw, 2025; Asfaw, et al., 2017; Kekana, et al., 2025). It is important to note that small-scale farmers are the most affected groups, being constrained by lack of resources and conventional means of production. Such climatic factors affect how the farmers behave, therefore changing their crops, planting seasons, land management techniques, and other aspects of their livelihoods (Chintu, et al., 2011). Some farmers now grow drought-resistant crops like sorghum, millet, and cassava, whereas other farmers continue using maize even though the crop is not drought resistant.

The primary issue arising from the literature review is how the small-scale farmers perceive and react to the stresses caused by the climate. The adaptation process is not simply a matter of changing techniques, but a process driven by personal perception, social norms, economics, and policies. While some small-scale farmers can adapt positively by engaging in novel farming techniques, other farmers are unable to adapt due to structural factors like lack of access to inputs, extension support, and finances (Ngoma et al., 2021).

The scope of this review will therefore attempt to chart the existing body of literature on the link between climate change and the behaviour of smallholder farmers from the global, regional, and local levels. The review is informed by key theories such as Theory of Planned Behaviour, Diffusion of Innovations, Sustainable Livelihood Approach, and resilience theory. At the same time, the gap in the empirical body of work is identified, particularly in the Zambian context where the localized research on the topic is lacking. This will set the stage for discussing how the present research fits into wider debates on the issue of climate adaptation and rural livelihoods among scholars.

2. Literature Review

The literature on climate change and smallholder farmers highlights that adaptation behaviour is influenced by multiple social, economic, psychological, and environmental factors. Researchers increasingly view farmers' responses to climate change as a complex process shaped by individual decision-making, institutional support, livelihood conditions, and environmental uncertainty. This is especially important in rain-fed agricultural regions such as Southern Africa, where climate variability directly affects farming systems.

One important theoretical perspective is the Theory of Planned Behaviour (TPB), which explains that human behaviour is guided by behavioural intentions influenced by attitudes, social norms, and perceived control (Ajzen, 1991). In agricultural studies, TPB has been widely used to understand farmers' willingness to adopt climate-smart practices such as drought-resistant crops and conservation agriculture. Studies indicate that farmers are more likely to adopt innovations when they believe such measures are beneficial and socially accepted (Bosnjak et al., 2020). However, TPB mainly focuses on individual thinking and pays less attention to structural barriers such as poverty, limited market access, weak extension services, and institutional failures.

The Diffusion of Innovations (DOI) Theory further explains how agricultural technologies spread within farming communities. According to Rogers (2003), adoption depends on factors such as relative advantage, compatibility, complexity, and observability. Empirical studies from Southern Africa show that peer learning, demonstration plots, and extension services significantly influence adoption of drought-resistant crops and climate-smart technologies (Oyetunde-Usman & Shee, 2023; Ngoma et al., 2021). Nevertheless, DOI has also been criticised for underestimating structural inequalities and financial limitations that restrict adoption among poor rural farmers.

The Sustainable Livelihoods Approach (SLA) provides a broader understanding of adaptation by linking farmer behaviour with livelihood assets and institutional conditions. Chambers and Conway (1992) and DFID (1999) identified five forms of capital: human, social, natural, financial, and physical capital. Households with better access to these resources are generally more capable of adopting climate-resilient practices, while poorer households often remain vulnerable due to lack of credit, inputs, and institutional support. Studies from Zambia also confirm that livelihood assets strongly influence adoption behaviour and adaptive capacity among smallholder farmers (Ngoma et al., 2021).

Resilience Theory further contributes by viewing farming systems as dynamic social-ecological systems capable of adaptation and transformation. According to Folke (2006), resilience refers to the capacity of systems to absorb disturbances and maintain essential functions. Farmers respond to climate stress through crop diversification, livestock integration, and water conservation practices.

Overall, the reviewed literature suggests that farmers' adaptation behaviour cannot be explained through a single theoretical perspective. Climate adaptation is shaped by the interaction of behavioural intentions, innovation diffusion, livelihood resources, institutional support, and resilience capacity within vulnerable agricultural systems.

3. Methods

The current study employed the use of the scoping review research methodology to map and interpret the existing research literature related to climate change and the behaviour of smallholder farmers. The use of a scoping review method was appropriate because of the multidisciplinary nature of the subject matter, which includes climate science, agricultural economics, rural development, and behavioural science. The methodology does not seek to critically evaluate the quality of studies but rather provides an overview of the available literature and major themes related to the topic.

The review process followed a structured framework adapted from existing scoping review approaches proposed by Arksey and O'Malley (2005) and Tricco et al. (2018). The process involved identification of the topic scope, study identification, study selection, data extraction, organisation of findings, and thematic synthesis. Unlike systematic reviews, scoping reviews emphasise inclusiveness and flexibility in data collection and interpretation.

3.1 Data Collection

All secondary data used in the study were collected from electronic academic databases, institutional repositories, journal indexing services, policy reports, and academic publishers' databases. These sources were selected to obtain literature related to climate change, agriculture, adaptation behaviour, and rural livelihoods, especially in Sub-Saharan Africa.

Two major approaches were used during the literature search process, including keyword searches and manual citation searches. Keywords such as “climate change,” “farmer behaviour,” “adaptation,” “drought,” “rainfall variability,” “crop adoption,” “livelihood diversification,” and “smallholder agriculture” were used individually and in combination to identify relevant literature. Backward and forward citation searches were also conducted to identify influential studies.

The inclusion criteria focused on scholarly articles that: i) Assessed the effects of climate change on agriculture, ii) Examined the behaviour of farmers in adapting to climate change, and iii) Related to Sub-Saharan Africa, particularly Southern Africa and Zambia.

Both peer-reviewed and non-peer-reviewed sources such as policy documents and institutional reports were included to provide broader understanding of adaptation policies and practices. Articles from different periods were also considered to examine changes in adaptation discourse over time.

The first stage of the scoping review involved defining the scope of the review in relation to the primary research question concerning the behavioural responses of smallholder farmers to climate change. The review mainly focused on three important adaptation themes identified from previous empirical studies: adoption of drought-resistant seeds, adjustment of planting dates, and crop rotation strategies.

The second stage involved identification of relevant studies through detailed desk-based research. Literature was obtained from peer-reviewed journal articles, working papers, institutional documents, and policy literature. Important empirical studies included works by Lunduka et al. (2017), Martey et al. (2020), Oyetunde-Usman and Shee (2023), Katengeza et al. (2018), and Wossen et al. (2017) on drought-resistant crops; Guido et al. (2020), Mangani et al. (2023), and Muyiramye (2020) on planting-date adaptation; and Thierfelder and Patrick (2010), Shah et al. (2021), and Thierfelder et al. (2024) on crop rotation and soil management practices.

The third stage involved the selection and analysis of studies. The selected studies were required to focus on smallholder farmers, climate-related adaptation behaviour, and empirical evidence. Literature focusing exclusively on large-scale commercial agriculture without empirical analysis was excluded from the review.

The fourth stage involved data charting and organisation. Relevant information from selected studies was extracted into a structured analytical framework. Key information included study location, research design, adaptation strategy, sample characteristics, major findings, and drivers or barriers influencing farmer behaviour. This process helped compare findings across different geographical and methodological contexts.

The final stage involved synthesis and presentation of findings through narrative analysis rather than statistical aggregation. The review identified similarities, differences, and gaps within the literature. Many studies reported positive impacts of drought-resistant crops and adaptive farming strategies on agricultural productivity and food security. However, inequalities in access to technology, climate information, extension services, and institutional support were also widely observed.

The review further noted that while changes in planting dates were widely adopted, their effectiveness often depended on access to reliable climate information and extension support. Similarly, crop rotation and soil management practices showed positive outcomes but faced implementation challenges in resource-constrained rural settings.

The scoping review did not aim to establish causal relationships or quantify effect sizes. Instead, the review focused on providing a broad understanding of existing knowledge and identifying areas requiring further investigation, especially in under-researched regions such as Zambia.

3.2 Data Analysis

Thematic synthesis was employed for analysing the selected literature. Statistical aggregation was not used because the main purpose of the study was to identify patterns, theories, and empirical findings related to climate adaptation behaviour among smallholder farmers.

The selected studies were systematically coded and compared based on study location, research methodology, theoretical framework, adaptation practices, and key conclusions. Major themes identified from the analysis included adaptation behaviour, determinants of adaptation, institutional support, social networks, livelihood assets, and barriers related to policy and market access.

The review also examined the application of theoretical frameworks such as the Theory of Planned Behaviour, Diffusion of Innovations Theory, Sustainable Livelihoods Approach, and Resilience Theory within empirical studies. This helped explain both the behavioural dimensions of adaptation and the broader socio-economic conditions influencing farmers' responses to climate change.

In line with the principles of scoping reviews, the study did not critically evaluate the methodological quality of individual studies. Instead, emphasis was placed on identifying the scope of existing evidence and recognising important research gaps related to climate adaptation and smallholder farming systems.

3.3 Ethical Considerations

As a desk-based study relying entirely on secondary sources, the research did not involve direct interaction with human participants. Therefore, issues related to consent, confidentiality, and participant harm were minimal. However, ethical standards were maintained through proper citation, acknowledgement of all academic sources, and transparency in literature selection and analysis. These measures ensured academic integrity, credibility, and avoidance of plagiarism.

4. Results

The empirical studies carried out in Sub-Saharan Africa have always pointed out that climate change is among the main factors that lead to changes in small-scale agricultural systems. Climate variability in terms of drought, unpredictable rainfall, and warming trends have occurred frequently and intensely, thereby creating an environment of uncertainty in rain-fed agricultural systems (Omokpariola et al., 2025; FAO, 2012). In this regard, small-scale farmers have found themselves forced to make necessary adjustments in their behaviour due to the changes in the environment, although there have been variations in these adjustments.

A commonly reported response to climate change includes the changes in choice of crops due to the presence of recurrent droughts and rainfall variability. According to Ngoma et al. (2021), recurrent drought and rainfall variations in Zambia have caused farmers to conduct experiments and adopt drought-resistant crops such as sorghum, millet, cassava, sweet potatoes, and groundnuts. These drought-resistant crops are believed to be more water-tolerant and less sensitive to rainfall variability than maize, a crop that is vulnerable to water stress. According to Mubanga and Ferguson (2017), recurrent failure of maize crops in Southern Zambia has prompted farmers to seek other crops, even though maize still occupies an important position due to cultural and economic reasons.

Nevertheless, although there is increased awareness about such climate-smart crop types, the diffusion process appears to be inconsistent and fragmented. According to empirical evidence, adoption is largely contingent on the availability of extension services, input subsidies, and financial capital (Sekaran et al., 2021; Rapiya et al., 2025). Families having higher exposure to agricultural infrastructure are more willing to adopt advanced seed types and introduce crop diversification, while those living in far-off and resource-scarce areas continue to rely on conventional maize systems.

A third important dimension of adaptation highlighted in the literature is the adjustment of planting times according to rain fluctuations. Farmers regularly shift planting times in order to account for delays in the rainy season or avoid dry spells during the middle of the season. However, this practice relies mostly on farmers' empirical observations, since climate information systems are still underdeveloped in most rural communities. Although there are instances where farmers have effectively implemented earlier planting practices and staggered planting patterns to reduce risks, there are also other cases of repeated losses suffered by farmers because of the irregularity of rain patterns (Ngoma et al., 2021).

Diversification of livelihood has become one of the important coping mechanisms in sub-Saharan Africa. It has been found out that there is an increasing tendency among rural households to adopt agricultural livelihood together with other non-agricultural sources of income like petty trade, casual labour, and other forms of entrepreneurial ventures (Bwalya, 2023; Stadtbäumer et al., 2022). Diversification increases the chances of survival for the household through spreading risks among various sources of income, which reduces reliance on weather-dependent agriculture as a source of livelihood. Livestock rearing is another crucial means in areas where drought prevails.

Even then, diversification cannot be practiced by all communities. Studies show that people from poor backgrounds tend to resort to coping mechanisms which generate very little income because they lack access to resources including capital, skills, and markets (Bwalya, 2023). In this regard, though diversification helps certain individuals to become resilient, it can exacerbate inequalities as asset-rich and asset-poor farmers remain at opposite ends of the economic spectrum.

The use of crop rotation and soil fertility enhancement techniques has been found to play a critical role in climate change adaptation efforts. Continuous planting of maize alongside soil degradation and depletion of organic matter content have resulted in decreased productivity in Southern African regions (Thierfelder et al., 2024; Descheemaeker et al., 2016). In this case, some have started using rotation methods where legumes such as peanuts and cowpeas are planted to improve nitrogen content and moisture conservation in soils.

However, the application of crop rotation has been inconsistent because of conflicting land uses, lack of knowledge, and immediate need for livelihood support. In many instances, the primary consideration for most farmers has been food security rather than soil conservation, which has continued to lead to the practice of monoculture despite the decrease in soil fertility levels. This shows the complexities involved in making decisions when resources are scarce.

The combination of water and livestock management practices has also become common among farmers as an adaptation strategy considering the climatic stresses being experienced. According to studies carried out on the integrated crop-livestock system, decreased pasture availability and water shortages have compelled farmers to embrace rotational grazing and water management techniques (Manono & Gichana, 2025; Rapiya et al., 2025). The main objective of these techniques is to ensure that resource utilization is efficient and that nutrients are recycled. Livestock plays a key role in these agricultural systems by offering income to farmers and protecting them from climate-related risks (Descheemaeker et al., 2016).

Zambia has experienced the necessity of adaptive livestock management due to the increased problem of water shortages and drying up of surface water sources. There is an increasing trend towards altering livestock herds, using various livestock types, and developing water storage facilities where feasible (Bwalya et al., 2024; Kalapula & Mweemba, 2018). Unfortunately, such adaptation measures may not be easily achieved due to financial limitations and lack of infrastructure, especially in rural districts like Choma.

Nevertheless, while these adaptations have been documented in the literature, several structural factors exist which hinder the implementation of climate-smart agriculture practices. Perhaps one of the most significant barriers is the poor performance of agricultural extension services. Many rural communities suffer from inadequate extension services due to understaffing, underfunding, and uneven distribution of extension officers (Rapiya et al., 2025).

The preference for agriculture based on culture is another factor that impacts decision-making in the sector. Maize is highly valued in Zambia culturally and as a diet, making its production dominant despite its susceptibility to droughts. The cultural inclination makes it difficult for farmers to completely adopt other crops, even when empirical evidence suggests that the crops are resilient to climatic shocks.

Financial capital is another challenge that prevents households from fully adopting new farming techniques. Farmers require enough financial resources to invest in seeds that have improved characteristics, irrigation technology, and livestock management. Financial constraints make it difficult for households to improve agricultural productivity (Ngoma et al., 2021).

Inconsistency in agricultural policy implementation affects the extent to which households adopt new agriculture practices. For instance, the input subsidy program that aims to diversify crop production and ensure resilience is rarely consistent. Implementation challenges include inefficiency, delayed implementation, and inadequate coverage (Rawlins & Kalaba, 2020).

To sum up, the empirical data indicate that although small-scale farmers in sub-Saharan Africa have been actively adopting different adaptation techniques, such as crop diversification, change in sowing times, livelihood diversification, fertilization, and livestock and water integration, the results vary significantly depending on several factors. Adaptation not only depends on environmental factors but also depends on socio-economic position, institutional resources, culture, and policies. In addition, despite the growing significance of the social side of adaptation, especially gender aspects and community-level natural resource management, there is still much to investigate in this regard (Sekaran et al., 2021; Bwalya et al., 2024).

Table 1: Selected Empirical Studies on Climate Change Adaptation and Livelihood Diversification

Author(s)	Study Area	Method / Design	Respondents	Major Indicators	Source
Ngoma et al. (2021)	Zambia	Panel data analysis	Smallholder farmers	Climate shocks, resilience, climate-smart practices	*Climatic Change*
Bwalya (2023)	Zambia	Case study	Rural households	Income diversification, food security	University of Zambia
Beyene et al. (2023)	Ethiopia	Quantitative survey	Pastoral households	Poverty, diversification, livestock ownership	*Cogent Social Sciences*
Stadtbäumer et al. (2022)	Zambia	Simulation modelling	Smallholder farmers	Adaptation strategies, income stability	*Agriculture & Food Security*

Sekaran et al. (2021)	Global	Systematic review	Published studies	Sustainability, food security	*Journal of Agriculture and Food Research*
Rapiya et al. (2025)	Sub-Saharan Africa	Review study	Published studies	Soil fertility, income diversification	*Agriculture*
Manono & Gichana (2025)	Sub-Saharan Africa	Literature review	Published studies	Pasture management, resilience	*Earth*
Descheemaeker et al. (2016)	Sub-Saharan Africa	Systems analysis	Smallholder systems	Productivity, adaptation	*Regional Environmental Change*
Kalapula & Mweemba (2018)	Zambia	Qualitative case study	Pastoral communities	Indigenous knowledge, resilience	*World Journal of Sociology and Anthropology*
Bwalya et al. (2024)	Zambia	Quantitative survey	379 households	Livestock ownership, adaptation	*Frontiers in Sustainable Food Systems*
Rawlins & Kalaba (2020)	Zambia	Policy analysis	National context	Policy effectiveness, maladaptation risks	*African Handbook of Climate Change Adaptation*
Asfaw et al. (2017)	Ethiopia	Econometric analysis	Smallholder farmers	Income sources, access to finance	*Development Studies Research*

Table 2: Climate Change Adaptation Strategies among Smallholder Farmers in Sub-Saharan Africa

Adaptation Strategy	Key Authors	Evidence Type	Main Focus	Level
Crop diversification and drought-tolerant crops	Ngoma et al. (2021); Oyetunde-Usman & Shee (2023)	Empirical / Review	Adoption of sorghum, millet, cassava, legumes to reduce drought risk	Household / Farm
Planting date adjustment	Guido et al. (2020); Mramba & Mafwela (2025)	Empirical	Adjustment of planting calendars based on rainfall variability	Farm

Livelihood diversification	Bwalya (2023); Beyene et al. (2023)	Empirical / Modelling	Income diversification through trade, labour, livestock, and small businesses	Household
Livestock-based adaptation	Bwalya et al. (2024); Manono & Gichana (2025)	Empirical / Review	Herd diversification, grazing management, livestock as buffer assets	Household / Community
Soil fertility management and crop rotation	Thierfelder & Wall (2010); Aslam et al. (2024)	Experimental / Empirical	Improved soil fertility, moisture retention, and crop productivity	Farm
Integrated crop–livestock systems	Descheemaeker et al. (2016); Sekaran et al. (2021)	Review / Conceptual	Improved resilience, productivity, and nutrient cycling	Farm / System
Policy and institutional support	Rawlins & Kalaba (2020); FAO (2022)	Policy / Review	Role of extension services, credit access, and adaptation policies	Institutional

5. Discussion

However, it is evident from the reviewed literature that behaviour exhibited by farmers in face of climate change is not simply an outcome of their reaction to stressors in the environment, which include factors like water scarcity, unpredictable rainfall, and increase in temperatures. In fact, this behaviour turns out to be an outcome of a complex adaptive phenomenon that involves multiple elements including behavioural intent, institutions, social and economic structures, and ecological processes. In other words, farmers do not act merely due to climate stresses but take decisions based on a variety of other factors too.

The Theory of Planned Behaviour is important in explaining how and why farmers intend to adopt or not adopt certain agricultural practices depending on their resilience to climatic conditions. According to this theory, behavioural intention is guided by three factors, which include attitude towards the intended behaviour, subjective norms, and perceived behavioural control. The explanation can be used to understand how farmers show willingness to adopt drought-resistant seeds or change planting times whenever there is a change in weather patterns. Nonetheless, from the literature, a common limitation of this theory is that it makes assumptions about people's ability to make sound judgments because they have the capacity to decide independently. The reality in most smallholder agriculture settings is that people experience constraints such as limited availability of quality seeds, no credit facilities, poor extension services, and uncertain input systems. As a result, it would be very difficult for intention to result in behavioural change where there are limited resources available for adoption.

Another contribution to the comprehension of behavioural change that can be gained from applying the Diffusion of Innovations Theory lies in the process through which farmers adopt agricultural innovations. Relative advantage, compatibility with the status quo, simplicity, trialability, and observability have all been shown to play an important role in influencing farmers' choices when adopting innovations. In fact, empirical studies have found that farmers are very much inclined to use resilient crops after they witness successful results in their neighbours or after they experiment with demonstration plots through extension services. Social learning, therefore, is crucial in lowering uncertainty and motivating farmers to innovate. The problem with the Diffusion of Innovations Theory is that it takes for granted that farmers will have equal access to information and innovations, which does not happen. In fact, unequal access to extension services, input subsidies, and market channels has resulted in certain farmers being constantly placed in the position of early adopters whereas others have no access whatsoever to innovation networks.

However, the sustainable livelihoods approach fills these lacunas through its focus on the asset base of the household, rather than on individual decision-making processes. The approach makes it clear that the behaviour of the farmers is strongly influenced by their asset base in terms of five types of capital – human, social, financial, physical, and natural. A diversified asset base makes it easier for a household to withstand shock and undertake adaptation measures like diversifying crops, livestock inclusion, and diversified income generation. Conversely, an asset-poor household tends to remain locked in a survival mode, making it difficult for them to adapt.

In this regard, resilience theory builds upon this knowledge by presenting adaptation as an interactive, iterative, and non-linear process. Adaptation is not seen as a final product or end goal, but rather a dynamic interaction between the social and ecological systems continuously. Resilience theory also points out that natural events such as droughts not only affect agricultural production but may also result in system changes within the means of livelihood, institutions, and farming systems. The significance of resilience theory lies in its ability to explain how climate shock, when recurring, results in permanent changes in cropping, farming systems, and rural livelihood structures.

One of the major takeaways from the literature is that adaptation must be thought of as more than simply the adoption of new technology or practice. Adaptation entails the reshaping of entire livelihood systems in reaction to new ecological and socioeconomic circumstances. Farmers frequently employ several approaches at once, ranging from changes in planting times to crop rotation, introducing livestock, taking up alternative occupations, and altering their soil and water management approaches. Yet, empirical analyses of these different approaches typically consider each approach independently, instead of analysing the interplay between them as part of larger livelihood systems.

Another critical point to note is the fact that behaviour change tends to be highly situational and influenced by socio-cultural and historical factors that are deeply entrenched. For instance, despite increased instances of drought in Choma District, maize still predominates in farming systems. Apart from agronomical advantages, other considerations such as culture, eating habits, and agricultural history have a significant influence on the choice of the crop. The district's agriculture policy has been centred on maize farming due to input programs that encourage farmers to grow the crop. Hence, despite sorghum, millet, cassava, and groundnuts being more resilient to drought than maize, their uptake has remained limited.

Consequently, one could draw from the literature that there is a need for a holistic approach to studying farmer behaviour in the face of climate change, which should incorporate insights from multiple theories and frameworks to account for the interrelationship between the individual, the social, the institutional, and the ecological. Furthermore, it is critical to recognize the fact that adaptation processes are heterogeneous, dependent on contextual factors, and reflective of past agricultural history.

6. Implications for Future Research

In terms of methodological considerations, there is a necessity for future research to incorporate theoretical perspectives from behavioural sciences, livelihood frameworks, and resilience theory. Therefore, researchers would have a chance to investigate the interplay between psychological predispositions, social environment, and natural surroundings and their impact on farmers' decision-making process.

Moreover, it is important for future investigations to conduct more empirical work within Zambian territory by paying attention to the differences between adaptation patterns at the district level rather than making general assumptions about the whole nation. As mentioned above, longitudinal analysis might be helpful in investigating adaptation behaviours.

Methodologically, it is important for future studies to make further efforts in utilizing mixed methods design, especially such designs as exploratory sequential and abductive approaches. These methods would enable scholars to refine their hypotheses and theories by using field data. Additionally, more emphasis should be put on incorporating qualitative information into quantitative models.

Lastly, while future research should address questions related to the adoption of resilient technologies and innovations, there should also be an analysis of their sustainability.

7. Conclusion

Climate change has been shown to exert influence on smallholder farmers' behaviours through a range of related mechanisms including psychological intention, social diffusion, livelihood assets, and resilience dynamics. By employing the Theory of Planned Behaviour, Diffusion of Innovations Theory, Sustainable Livelihoods Approach, and resilience theory, an effective conceptual framework for exploring climate change adaptation among smallholder farmers has been established.

There have been empirical observations of rising adoption of climate-resilient crops, changing planting time schedules, livelihood diversification, and integrated resource management practices. Nevertheless, these adaptation practices remain hindered by structural barriers as well as socio-cultural issues.

Several gaps in the literature have emerged throughout the review, including inadequate theorization, lack of localized data, and insufficient focus on behavioural dynamics. These aspects need to be addressed to ensure further advancements in both research and policymaking with regards to enhancing the adaptive capacities of smallholder farmers, especially within Choma District.

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