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Climate Change Policies for Sustainable Livestock and Food Security in Sub-Saharan Africa: A Systematic Review

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ABSTRACT

The Sub-Saharan Africa (SSA) region is particularly vulnerable to the dynamics of climate change, due to its widespread dependence on climate-sensitive livestock production, widespread poverty, and low adaptive capacity. The livestock production in the region- pastoral and agro-pastoral systems in the arid and semi-arid areas and mixed crop-livestock production in the sub-humid areas- is under increasing threats due to the increasing temperatures, disrupted rainfall patterns, frequent droughts, and spread of climate-sensitive diseases among animals. These systems play a central role in food security but are highly exposed to climate change. Government and regional bodies have responded by integrating livestock into policy frameworks in line with climate change, including National Adaptation Plans, Climate-smart Agricultural Plans, and National Determined Contributions. This is a systematic review of peer-reviewed journal articles and institutional reports published between 2015 and 2026 to identify the role of climate-change policies that aim to reform livestock systems in shaping sustainability and food security outcomes in SSA. In line with the PRISMA 2020 principles, fifteen articles were identified and analysed through narrative thematic synthesis. Five major themes were identified: adaptation-based policy responses in livestock systems; climate-smart livestock policies; governance and institutional coordination; marginalisation of pastoral and extensive livestock systems; and conditional relations between climate policies and food security. Climate change policies can yield positive outcomes for food security, but if not implemented appropriately, they may undermine equity. The research concludes that geographical diversification, social inclusivity, and coordinated institutional governance of climate-resilient livestock in SSA are necessary.

Keywords: Climate change; Climate change policy; Climate smart agriculture; Livestock systems; Food security; Sub-Saharan Africa; Sustainability

1 INTRODUCTION

Livestock production is an important part of food systems and rural livelihoods in Sub-Saharan Africa. This is crucial in determining dietary quality, household income, employment, and socio-cultural resilience. In many parts of the world, especially in arid and semi-arid climates, livestock plays multipurpose roles in food security, economic stability, and the social security of vulnerable communities. Considered the most important sources of high-quality protein and micronutrients, such as iron, zinc, and vitamin B12, livestock products like milk, meat, and eggs are still lacking in most Sub-Saharan African diets (HLPE, 2017). Additionally, livestock are a source of monetary resources, draught animal power, and cultural capital; therefore, their sustainable management is important to human and ecological health. Sub-Saharan African livestock systems are vulnerable to the effects of climate change. The annual average temperatures across the area have already increased by over 1°C compared with pre-industrial levels, and it is projected that this warming will rise to 1.53 -3°C by the middle of the century and intensify in arid and semi-arid regions (IPCC, 2022). Temperatures above 30°C (86°F) significantly reduce feed consumption, milk production, reproduction, and general productivity (affecting cattle, sheep, and goats) (Nardone et al., 2021). The decrease in rainfall and frequent droughts lead to water and food shortages, where the spread of the transboundary and vector-borne animal diseases increases livestock deaths and negatively affects food security (RojasDowning et al., 2017). These biophysical stress factors, combined with socio-economic vulnerabilities, put communities whose livelihoods depend on livestock in extreme situations, such as food insecurity. In Sub-Saharan Africa, governments and other stakeholders have incorporated livestock systems into climate change policy frameworks, including National Adaptation Plans, climate-smart agriculture, and Nationally Determined Contributions. Policies include adaptation-based

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measures, for example, drought-resistant breeds and warning systems, and mitigation-based strategies, for example, reduced intensity of greenhouse gas emissions. Nonetheless, empirical data on the effectiveness of policies, their coherence, and inclusivity remain fragmented, and many of the interventions fail to reflect the socio-ecological diversity of livestock systems and the needs of smallholder and pastoral communities (Carter et al., 2018). This systematic review aims to fill these gaps by synthesising current empirical and policy-oriented literature to understand the effects of climate-change policies on sustainable livestock production and food security in Sub-Saharan Africa. The objectives of the review are to identify policies systematically regarding climate change that are relevant to livestock systems, evaluate the role of the policies in the production of livestock in a sustainable manner, review the implications of these policies on food security, and identify the main gaps, challenges, and opportunities to enhance the policies. Based on these goals, the main research question is developed: What is the impact of climate change policies on sustainable livestock production and food security outcomes in Sub-Saharan Africa? The study will be useful in informing the design, implementation, and governance of climate-resilient livestock systems in the region by critically analysing peer-reviewed and institutional evidence of the same during 2015-2026.

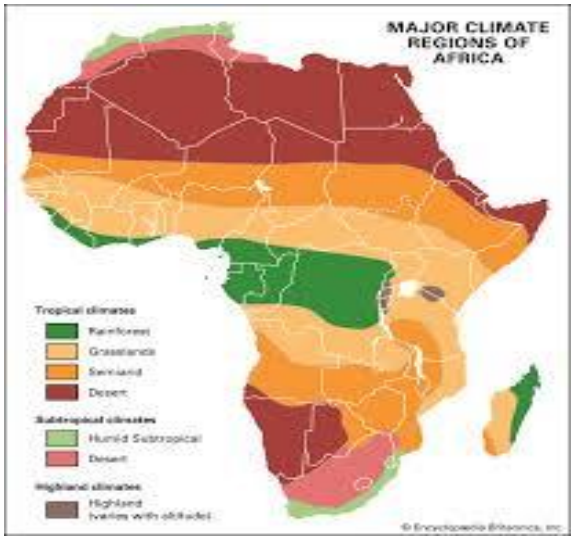


Figure 1: Major Climate Regions of Africa

Source: Britannica (2026)

2 LITERATURE REVIEW

2.1 FOOD SECURITY, CLIMATE CHANGE AND LIVESTOCK SYSTEMS

It is widely believed that the nexus between climate change, livestock systems, and food security in Sub-Saharan Africa is multifaceted, multi-scaled, and context specific. Although Baker (2023) focuses more on the biophysical mechanisms of climate change affecting livestock, including heat stress, water scarcity, and disease dynamics, HLPE (2017) goes a step further by connecting these disturbances to the four pillars of food security. Nonetheless, one major weakness of the current research is that most of them assume climate effects are mainly exogenous shocks, contrary to being mediated by institutional and policy space. Conversely, Herrero et al. (2016) and Bashiru and Oseni (2025) reorient the discussion by framing policy as a key factor in system resilience, positing that adaptive capacity is primarily influenced by governance systems rather than environmental factors. This distinction puts into sharp relief a major theoretical debate: early literature is dominated by biophysical models, whereas more recent studies take a political economy and systems approach, and acknowledge that climate risks are mediated through socio-economic and institutional conditions. This paper develops the latter point of view, placing climate policy as a mediating variable between the environmental stressor and the food system outcomes.

2.2 GOVERNANCE FRAMEWORK OF CLIMATE POLICY

Climate change policy is now conceptualised as a multi-level governance system that informs the transformation of the livestock system. Newell et al. (2019) emphasised the importance of global climate agreements and national commitments (for example, NDCs), while IPCC (2019) and FAO (2017) highlighted their translation into sectoral interventions. However, policy coherence is becoming a controversial issue. Thornton et al. (2015) state that climate policies frequently do not align with the objectives of agricultural development and, as a result, trade-offs between emissions reduction and the protection of livelihoods. On the contrary, Loboguerrero et al. (2020) promote the integrated solutions concept, as policy coordination can create co-benefits across climate, agriculture, and nutrition. Most importantly, a significant part of the literature presupposes that policy integration is possible; however, empirical research in Sub-Saharan Africa indicates institutional fragmentation and poor implementation capacity. This policy-practice gap has not been investigated seriously, especially in livestock-based economies.

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2.3 Differentiating Livestock Systems as Policy Contexts

One of the key improvements in literature is that livestock systems are now identified as heterogeneous and context-specific policy arenas. FAO & ILRI (2011) and Herrero et al. (2016) define systems as agro-ecological and production features, whereas Descheemaeker et al. (2020) attribute policy effectiveness to the consensus between interventions and system differences. Nevertheless, there is a critical gap between the operationalisation of these classifications in policy. Although research is recognising heterogeneity, most national climate policies continue to assume homogenous approaches to policy, usually leaning towards commercially oriented systems. This generates structural injustices, with less policy focus given to pastoral and smallholder systems, even though they are vital to food security. Thus, the literature demonstrates a lack of analytical awareness of diversity within systems and in practical policy formulation, and more system-sensitive governance frameworks are required.

2.4 Governance and Policy Framing of Emissions

Many studies have discussed the role of livestock emissions in global greenhouse gas emissions, although IPCC (2019) and Hristov et al. (2018) have singled out enteric fermentation, including manure management, as the major contributors. A key controversy in literature concerns the proper mitigation strategy. On one hand, Herrero et al. (2016) and Kebreab et al. (2023) support reducing emissions intensity and further elaborate that an absolute reduction in emissions may harm food production in low-income environments. On the other hand, global mitigation frameworks tend to focus on aggregate emissions reductions, creating a tension between global and local policies. Furthermore, technological solutions such as feed additives (for example, 3-NOP, seaweed) are often presented as scalable options. However, researchers such as Roque et al. (2021) warn against excessive dependence on these innovations, highlighting cost and scalability challenges as well as regulatory obstacles, particularly in developing countries. These concerns indicate that existing literature might be excessively focused on technical mitigation options while underestimating socio-economic and institutional barriers to adoption.

2.5 Policy and System Resilience to Adaptation

In Sub-Saharan Africa, high climate vulnerability calls for adaptation policies with a more direct effect. The key adaptation strategies are identified by Thornton et al. (2009) and Godber and Wall (2014), and their positive impact on livelihood stability and food security is emphasised by Nyong et al. (2021). The adaptation literature, however, is more inclined to believe that the interventions are available and being practised. In practice, IPCC (2019) notes long-standing obstacles, such as inadequate infrastructure, ineffective extension systems, and insufficient funding. Furthermore, adaptation policies are not usually considered alongside mitigation, although there is growing recognition that combined strategies are more effective. This disintegration is indicative of a wider problem in climate governance where silos among sectors make it difficult to implement comprehensive policy responses.

2.6 Sustainable Livestock Production as Policy Outcome

The concept of livestock system sustainability is currently presented more as a policy construct than a technical one. According to Kadam et al. (2024) and IPCC (2019), sustainability is a multidimensional concept that connects the environmental, economic, and social aspects. Although Loboguerrero et al. (2020) and Ortiz et al. (2023) highlight the advantages of integrated approaches, few empirical studies have examined their effectiveness in practice in Sub-Saharan Africa. Many studies are conceptual/model-based, lacking real-world validation. These raise doubts on the scalability and contextual relevance of proposed sustainability pathways.

2.7 Food Security as a Limitation and an End

Food security is at the centre of the climate policy debate but is marred by controversy. IPCC (2019) describes it as both a limitation and a result, and FAO (2017) and Jayne et al. (2024) highlight how livestock are vital for sustaining nutrition and livelihoods. One conflict arises between international sustainability objectives and local food security. Policies implemented to reduce livestock emissions can either raise food prices or decrease the availability of animal-source foods, especially with vulnerable populations. The recent literature on nutrition-sensitive climate policy has tried to solve this by focusing on emissions reductions that do not undermine food availability or the quality of the diet. Nevertheless, there are few empirical applications of this approach, which is a sign of a lack of alignment between theory and practice.

2.8 Policy Tools, Governance Capacity and Equity

Climate policies use a combination of knowledge-based, regulatory and economic tools. Nevertheless, their performances rely on the ability to govern and the coordination of institutions (FAO, 2017). Equity is a focal point in a growing literature. As Rufino et al. (2017) and Descheemaeker et al. (2020) show, even poorly designed policies may disproportionately affect smallholders and pastoralists, exacerbating existing inequalities. Although this

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has been realised, equity factors are not well incorporated in policy formulation, and there are few mechanisms to safeguard vulnerable groups. This is a major flaw in the present-day climate policy frameworks.

2.9 Themes Synthesis

In the literature, several major themes were identified, for instance, that policy and governance systems mediate the impacts of climate change rather than biophysical factors. Another theme is that livestock systems should not be homogenised into sectors; they should be differentiated in policy contexts. Furthermore, this theme showed ongoing conflict between food security outcomes and mitigation goals. Theoretically superior but weakly implemented integrated approaches (adaptation + mitigation + food systems). Equity and capacity in governance are key factors that determine the success of policies. With all these developments, the identified themes from the literature have been integrated.

2.10 Gap in Literature

Although much has been written on climate change, livestock systems and food security, there are still several significant gaps that need to be addressed.

First, there are no integrated analytical frameworks that simultaneously analyse the outcomes of climate policy, livestock sustainability and food security. The majority of the literature concentrates on single dimensions, either the emissions, adaptation or productivity, without incorporating their interdependences. Such fragmentation constrains the possibility of comprehending trade-offs and synergies between policy objectives.

Second, the lack of empirical data in Sub-Saharan Africa, especially at the nexus of policy and livestock systems, is an issue. Although literature mainly discusses global models and conceptual studies, there are no context-specific studies and transformative change opportunities.

3 METHODOLOGY

3.1 Research Design Systematic Literature Review (SLR)

This paper will take the form of a mixed-method systematic literature review (SLR) to summarise both empirical and policy-focused data regarding the effects of climate-change policies on sustainable livestock production and food security in Sub-Saharan Africa (SSA). The mixed-method approach allows the incorporation of both quantitative and qualitative results. Thus, the strength and policy implications of systematic literature review are increased.

The review is based on PRISMA 2020 (Preferred Reporting Items of Systematic Reviews and Meta-Analyses) to provide transparency, reproducibility, and methodological rigour. The search strategy involved a thorough search of various academic databases, such as Scopus, Web of Science, Google Scholar, AGRIS, and PubMed, supplemented with grey literature from institutional sources, including FAO, IPCC, World Bank, HLPE and IFAD.

A systematic search was performed using Boolean operators. The search terms used were: *climate change policy* AND *livestock systems* AND *food security*, AND *Sub-Saharan Africa (SSA)*.

3.2 PICO Framework and Study Eligibility Criteria

To enhance methodological clarity, the study used the PICO framework (Population, Intervention, Comparison, Outcome) to set the inclusion criteria and the study selection.

i. **Population(P):** Sub-Saharan Africa Livestock systems (pastoral, mixed crop-livestock, intensive systems) in Sub-Saharan Africa.
ii. **Intervention(I):** Climate-change policies (adaptation, mitigation, and climate-smart livestock policies)
iii. **Comparison(C):** Comparisons across policy types, regions or production systems where appropriate.
iv. **Outcome(O):** Sustainable livestock production (productivity, resilience, emissions intensity) and food security outcomes (availability, access, utilisation, stability, nutrition).

Inclusion criteria

Inclusion criteria: The review was limited to articles published from 2015 to 2026, which reflects the current context of climate policies. Specifically, targeted at Sub-Saharan Africa. Discussion on climate change policies on livestock and reported sustainability or food security results were retained. There was also grey literature on FAO and IPCC. Studies that were published in English.

Exclusion criteria

The studies have been filtered based on the following criteria:

i. Studies such as editorials and commentaries that were not empirical or policy relevant.
ii. Studies that were focused on climate change without linking to livestock systems.
iii. Studies that did not report measurable outcomes related to sustainability or food security.
iv. Studies that did not fall within the specified geographical or time area.

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3.3 Data Extraction

Data extraction was carried out using a structured framework to provide consistency in the review. In each study, data were documented on the type of policy, either adaptation, mitigation, or integrated climate-smart livestock. To reflect the agro-ecological zones, climatic exposures and temperature region variability across SSA, a geographical focus was taken. The policy covered livestock systems, which were categorised into intensive, semi-intensive, extensive and mobile pastoral systems. Policy tools, such as regulatory, economic, institutional, and informational tools, were recorded. Lastly, the reported outcomes consisted of livestock productivity, resilience, food availability, access, and nutritional security. The systematic comparison and thematic synthesis were made possible by this systematic extraction.

3.4 Quality Appraisal

To achieve methodological rigour, all eligible studies were put through a quality appraisal process using the following criteria:

i. Ease of research objectives and policy focus.
ii. Methodology and data sources are appropriate.
iii. Relevance to SSA livestock systems.
iv. Strength of evidence of policy-outcomes linkage.
v. Reporting finding transparency.

Studies that did not achieve the minimum quality were excluded. This measure ensured that the synthesis was informed by only credible and policy-relevant evidence.

3.5 Data Extraction

An organised data extraction model provided consistency and comparability among studies. Systematic extraction of the following variables was carried out:

i. Policy type: Adaptation, mitigation or integrated (climate-smart livestock)
ii. Geographical focus: Country/region in SSA.
iii. Livestock system: Extensive, semi-intensive, intensive or pastoral.

Policy instruments: Regulatory, economic, institutional or informational.

Outcomes:

i. Livestock resilience and productivity.
ii. Intensity and sustainability of emissions.
iii. Food security dimensions (availability, access, utilisation, stability, nutrition).

This systematic comparison facilitated thematic synthesis and enabled systematic comparison.

3.6 PRISMA Flow Description

The process of selecting the study adhered to PRISMA 2020, which guarantees the transparency, reproducibility, and methodological rigour of the study. The first step as shown in Figure 2 was to search for 129 records in Scopus, Web of Science, AGRIS, PubMed, and other grey literature such as FAO, the World Bank, HLPE, and IFAD. The selection of the studies was performed according to PRISMA 2020 and included four steps: identification, screening, eligibility, and inclusion.

i. **Identification:** 129 records were identified by searching databases and grey literature.
ii. **Duplicate Removal:** There were 106 distinct records after the removal of duplicates (n = 23).
iii. **Screening:** The titles and abstracts were screened against the inclusion criteria, and 75 records were retained to be reviewed in full text.
iv. **Eligibility:** The inclusion criteria included the relevance of the articles to climate policy, livestock systems, and reported results.
v. **Inclusion:** 15 studies were incorporated in the end synthesis after quality appraisal.

3.6.1 RATIONALE BEHIND THE INCLUSION OF FIFTEEN STUDIES

The inclusion of 15 studies represented a rigorous selection process. A significant number of studies that were first found were omitted because of:

i. The absence of direct attention to climate policy (as opposed to overall climate effects)
ii. Lack of livestock-specific analysis.
iii. Little or no coverage of food security or sustainability results.
iv. Poor quality of methods or lack of empirical evidence.

In this way, the end sample is highly relevant, policy-oriented, and methodologically sound studies, which are deep rather than broad. This aligns with the best practices in systematic reviews, in which quality and relevance are more important than quantity. The selected studies were reviewed using the following criteria: policy type, geographic scope, livestock system, policy tools, and the sustainability and food security results reported, which constituted the evidence base of the Results, Discussion, and Policy Recommendations sections.

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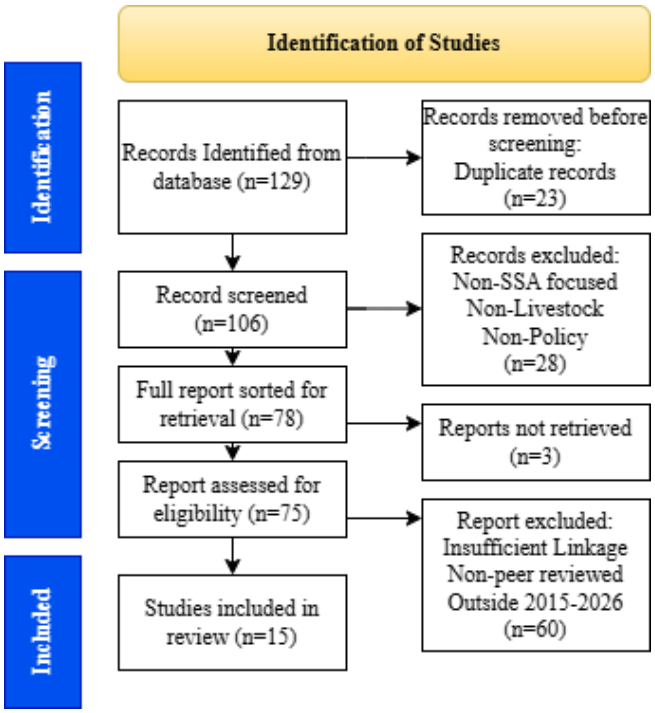


Figure 2: The PRISMA Flowchart

Only pivotal studies published in the last five years (2015-26) were chosen within each category to guarantee relevance to current climate policy dynamics in Sub-Saharan Africa (SSA). The analysis involved 15 studies with a variety of climate change contexts, livestock production systems, and policy strategies in SSA. It incorporated a mix of empirical research and institutional reports, 9 peer-reviewed journal articles and 6 policy or institutional sources (for example, FAO, IPCC) representing both academic and applied policy views.

Among the relevant articles, 5 were mainly based on adaptation measures, especially in arid and semi-arid areas, where drought resilience and early warning systems were of major concern. Four studies focused on climate-smart livestock systems, with an emphasis on integrated systems that integrate productivity, mitigation, and adaptation. Three articles were on governance and institutional coordination with emphasis on policy coherence and capacity to implement. Two studies explicitly addressed the outcomes of food security, whereas one study discussed climate finance and mechanisms of resource allocation. Regarding livestock systems, the studies spanned a variety of production systems: 6 included smallholder systems, 4 mixed crop-livestock systems, 3 pastoral systems, and 2 livestock systems in more general terms across various production systems. This distribution represents the heterogeneity of livestock production systems in SSA, including a relative underrepresentation of pastoral systems.

The studies covered various areas in SSA. There were five multi-country or SSA-wide studies and five country-specific Nigeria (3 studies), Ethiopia (3 studies), South Africa (1 study), and East Africa (3 studies). This distribution also underscores the diversity of these regions, as well as the empirical studies that are concentrated in a few countries. The review comprised both qualitative and quantitative studies. Six studies used modelling or systems-based analytical models to evaluate the effects of policies on productivity and emissions. Five studies were based on survey or field empirical data, household-level or community-level results. Three studies utilised policy analysis as a methodology, with the institutional framework and governance dynamics, and one study used a climate finance assessment framework. The sample is also variable in terms of scale and intensity of data. Other studies examined national or multi-country data, whereas others examined localised evidence at the community level. Nevertheless, the use of large-scale quantitative data is still confined to the SSA livestock policy literature. Most studies are based on medium-scale empirical or model-based studies.

In general, the evidence base shows a higher focus on adaptation and climate-smart solutions, yet lacks governance analysis, representation of pastoral systems, and direct measurement of food security outcomes. The distribution justifies the overall result of the study, wherein climate policy in SSA is not uniform, situational, and influenced by institutional and socio-economic factors, not just technical interventions alone.

3.7 Thematic Analysis and Data Synthesis

Due to the heterogeneity of the study designs, policy contexts, and outcome measures, a narrative synthesis method was chosen.

Thematic synthesis was performed in a three-stage coding process:

i. **Open Coding:** Preliminary discovery of important concepts and findings among studies.
ii. **Axial Coding:** Sorting of similar ideas into more generalised groups.
iii. **Selective Coding:** Construction of broad themes between policy actions and outcomes.

This procedure led to the discovery of five broad analytical themes, such as:

i. Adaptation-based policy responses in Livestock systems
ii. Climate-Smart Livestock Policies
iii. Governance and Institutional Coordination
iv. Marginalisation of Pastoral and Extensive Livestock Systems.
v. Conditional Relations Between Climate Policy and Food Security.

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The Results, Discussion and Policy Recommendations chapters are analysed using these themes.

3.8 Ethical Considerations

This study does not require ethical approval, as it uses only secondary data. The secondary data used are available publicly and peer-reviewed. All sources were also referenced per academic guidelines.

4 RESULTS AND DISCUSSION

4.1 Findings

A systematic review of 15 peer-reviewed journal articles and institutional reports (2015-2026) revealed five dominant and interrelated themes that influence the effects of climate-change policies on sustainable livestock production and food security in Sub-Saharan Africa (SSA). Although the results affirm the growing policy focus on climate-livestock interactions, a more in-depth study reveals that policy efficacy is not uniform, situation-specific, and moderated by quality of governance, systems differentiation, and socio-economic inclusion. Climate policies do not have homogeneous effects on different livestock systems and regions but create conditional and even contradictory effects.

4.1.1 ADAPTATION-BASED POLICY RESPONSES IN LIVESTOCK SYSTEMS

The policy arena is dominated by adaptation-oriented policies, especially in arid and semi-arid areas such as the Sahel, the Horn of Africa and some parts of Southern Africa. In the reviewed studies, interventions such as early warning systems, drought preparedness programmes, rangeland rehabilitation, and water infrastructure are consistently shown to be effective in the short term, reducing livestock deaths and stabilising herd productivity (Thornton et al., 2015; IPCC, 2019; FAO, 2017). Nevertheless, a cross-study comparison reveals a significant limitation: Adaptation policies are mainly reactive and not transformative, i.e. they are geared towards responding to climate shocks, restructuring the system in the long-term. The positive results of resilience are noted in studies such as Abanishe et al. (2024) and Ruggeri (2017), further emphasising the lack of integration with overall livestock development strategies, leading to fragmented effects on food security.

This implies that although adaptation policies are required, their uncoordinated application limits their potential to deliver long-term gains in productivity and food security, and thus, their role in the overall system sustainability.

4.1.2 CLIMATE-SMART LIVESTOCK POLICIES

One of the main analytical conclusions of the literature is the greater effectiveness of integrated climate-smart livestock policies as opposed to those that are single-focused. Research findings have consistently shown that adaptation-mitigation-proclivity-enhancing policy interventions have stronger effects on sustainability and food security (Herrero et al., 2015; Loboguerrero et al., 2020; Scoones, 2023). For example, in mixed crop-livestock systems, a combination of interventions (improved feeding, animal health, manure management, and resilient breeds) results in productivity improvements and a concomitant decrease in emissions intensity. The benefits of these improvements include higher household income and greater food availability, resulting in greater food security than mitigation-only or adaptation-only approaches. But the evidence suggests variability as well: Integrated policies in comparatively developed systems (for example, East and Southern Africa) with superior infrastructure and institutional support are more successful. Conversely, they are not effective in pastoral systems and resource-constrained systems, with barriers to adoption remaining. Thus, although integration becomes a key success factor, its results are dependent on facilitating institutional and socio-economic conditions.

4.1.3 GOVERNANCE AND INSTITUTIONAL COORDINATION (THE DECISIVE MEDIATING FACTOR)

In all of the studies, governance is found to be the most conclusive determinant of policy effectiveness. The literature proves that there is a distinct divergence between:

i. The existence of fragmented systems of governance in which the policies of climate, agriculture, and livestock are in silos.
ii. Integrated governance structures, in which cross-sectoral integration aids implementation.

The research (FAO, 2017; Alamayehu et al., 2025; Bahouh and Mohammed, 2026) always indicates that fragmented systems result in Policy duplication, Weak implementation capacity and Limited monitoring and evaluation. Conversely, the following are realised in countries with good institutional coordination and decentralised governance structures: Higher policy uptake, permanent and better sustainability results and better coordination of climate objectives and food security objectives.

Notably, governance is not merely an implementation problem but also a learning and adaptation process. Poor governance inhibits feedback mechanisms, restricting policy development in reaction to the evolving climate risks. It means that the effectiveness of climate policy is not so much a matter of the design of the policy but rather a matter of the governance capacity and coherence.

4.1.4 MARGINALISATION OF PASTORAL AND EXTENSIVE LIVESTOCK SYSTEMS

One of the few things that have consistently and critically been identified throughout literature is the systematic

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marginalisation of pastoral and extensive livestock systems in climate policy frameworks. Although they play a key role in food security and are resilient in SSA, these systems are frequently not adequately represented in policy formulation (Ogundeji, 2022; Omakpariola et al., 2025).

As a comparison, policies have been seen to have the tendency to favour sedentary and commercially based systems, which are easier to control and incorporate into formal markets.

Mobile pastoral systems sharing tenure of land and cross-border dynamics are not well accommodated. This leads to:

i. Less policy relevance to the pastoral communities.
ii. More susceptible to climate shocks.
iii. Poor food security gains.

Nevertheless, studies that use pastoral sensitive interventions, including mobility corridors, reforms in the rangeland governance and conflict sensitive resource management report a high level of resilience and food security.

This underscores the fact that inclusivity in policy and differentiation in systems are not a choice but a necessity towards fair and successful climate policy results.

4.1.5 CLIMATE POLICY AND FOOD SECURITY: MEDIATED RELATIONSHIP THAT IS CONDITIONAL

Climate-change policies and food security are observed to be indirectly related, complex, and conditional. Although most of the policies enhance livestock productivity or environmental performance, such benefits do not necessarily result in better food security outcomes. Cross-study evidence (Rojas-Downing et al., 2017; Olarenwaju et al., 2025; Ghebrenucael et al., 2026) shows that: Productivity increase is not enough to enhance food access and use. Complementary policies, such as those, are needed to achieve food security outcomes, including:

i. Social protection measures.
ii. Access to markets and value-chain building.
iii. Gender-sensitive interventions

For instance, Emission-reduction policies can enhance efficiency, but raise the cost of production, which would adversely impact affordability. Interventions that are productivity-oriented can lead to more production, but without better distribution or access, especially to vulnerable populations. The evidence, therefore, shows that food security is an intermediate phenomenon, influenced by more comprehensive socio-economic and institutional factors, and not by the livestock policy.

4.1.6 FINDINGS SYNTHESIS

On the whole, the results suggest that the effects of climate-change policies on sustainable livestock production and food security in SSA are:

i. Favourable and disproportionate to systems and regions.
ii. Very sensitive to policy integration and quality of governance.
iii. Limited by structural inequalities and system disregard (particularly pastoral systems)
iv. Indirect in its impact on food security results.

4.2 DISCUSSION

This paper aimed to discuss the effects of climate-change policies on sustainable livestock production and food security outcomes in Sub-Saharan Africa (SSA). The results show that although climate policies are becoming a key part of livestock system change, their impact is not uniform, context-specific, and moderated by the quality of governance, system heterogeneity, and socio-economic inclusion.

Instead of establishing a linear relationship between policy adoption and better outcomes, the evidence demonstrates that there is a conditional, non-linear policy-outcome pathway, which adds to the wider discussions on the effectiveness of climate policy in developing countries.

4.2.1 MORE THAN ADAPTATION: REACTIVE POLICY PARADIGMS LIMITS

The prevalence of adaptation policies in SSA can be attributed to the fact that the region is severely exposed to climatic risks. In line with the literature (Thornton et al., 2015; Nyong et al., 2021), the review affirms that adaptation interventions, including early warning systems and rangeland management, are effective in mitigating vulnerability and stabilising livestock production in the short term. Nevertheless, this paper contributes to the discussion by showing that adaptation policies in SSA are mostly based on a reactive risk-management paradigm, and not a transformative systems approach. This cripples their contribution to sustainability and food security in the long term. This result is consistent with critiques of the literature on climate policy that adaptation can act to strengthen structural vulnerabilities instead of mitigating them. Thus, adaptation ought not only to be re-conceptualised as resilience-building but also as a component of structural change of livestock systems.

4.2.2 CLIMATE-SMART POLICIES AS A VEHICLE TO SYSTEM CHANGE

One of the contributions of the present study is the identification of the integrated climate-smart livestock policies as the most effective way of realising the outcomes

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of sustainability and food security. In contrast to fragmented interventions, integrated policies tackle adaptation, mitigation and productivity concurrently and produce co-benefits on both environmental and socio-economic levels (Herrero et al., 2016; Loboguerrero et al., 2020). The analysis goes beyond the current knowledge to demonstrate that integration is technically beneficial, institutionally and contextually contingent. Specifically, integrated approaches perform best in mixed crop–livestock systems, where synergies between crops and livestock can be leveraged. They are limited by the fact that they are only effective in resource-poor and pastoral systems where institutional and infrastructural support is minimal. This implies that climate-smart livestock policies cannot be viewed as universal solutions, but instead, must be viewed as a context-specific framework that has to be adapted to local production systems.

4.2.3 GOVERNANCE MISSING LINK IN POLICY EFFECTIVENESS

The current study contributes to theoretical literature by establishing governance coherence as the key mediating variable between climate policy design and outcomes. Although prior research recognises the issues with governance (FAO, 2017; IPCC, 2022), this review shows that: Fragmented institutional arrangements result in inefficient policy and poor implementation. The coordinated governance systems improve uptake of policies, monitoring and adaptive learning. This strengthens the institutional theory, which argues that the effectiveness of policies depends on the quality of governance structures, but not the intent of the policy. In this way, the research adds to the knowledge base by redefining climate policy effectiveness as a governance issue, and not essentially a technical or environmental issue.

4.2.4 STRUCTURAL INEQUALITY AND MARGINALISATION OF PASTORAL SYSTEMS

One of the most important conclusions of this research is that climate policies in SSA are not neutral but indicate structural biases that discriminate against pastoral and extensive livestock systems. Although pastoral systems are vital to food security and resilience, they are frequently overlooked due to their mobility, informality, and intricate land tenure structures (Ogundeji et al., 2022). This leads to an inappropriate alignment of policies with local realities and consequently less efficiency. The finding has the potential to add to the literature, noting that policy effectiveness is connected to equity and inclusion. Climate policies that do not include multiple production systems are likely to increase vulnerability and compromise the food security outcomes.

4.2.5 RETHINKING THE POLICY–FOOD SECURITY NEXUS

The research also shows that the connection between food security and climate policies is indirect and mediated, and not automatic.

Although livestock productivity and sustainability are critical, they do not ensure improved food security without:

i. Market access
ii. Social Protection Systems
iii. Gender-inclusive policies

This viewpoint is held by the larger food systems, which states that food security performance is reliant on distribution, access, and socio-economic status, rather than production (Rojas-Downing et al., 2017).

4.2.6 CONTRIBUTION TO KNOWLEDGE

There are four main contributions to this study. This study contributes to knowledge conceptually via evidence that climate policy effects are conditional, non-linear and mediated by governance and societal-economic elements. This study contributes theoretically, as positions are the explanatory variable of governance that controls the consistency of governance in climate policy effectiveness. This study contributes to knowledge by empirically summarising new (2015–2026) evidence to demonstrate the variability of livestock systems and regions. This study makes a vital policy contribution by integrating designated law, inclusive and system-specific policies in the best of ways.

4.3 STUDY LIMITATIONS

Regardless of the rigour of the methods used, this study has several limitations. One of the study's limitations is its language bias. Only English-language publications have been reviewed, which may not capture any studies that are published in French and Portuguese, which are prominent in the context of SSA but were still excluded. Another limitation is the small size of the studies (n=15). Although it was explained by the stringent inclusion criteria, the sample size is rather small and could restrict generalisability, especially in SSA settings. A third limitation is the use of secondary data. The research relies on the available literature, which might not be comprehensive enough to record current policy changes or realities at local levels. Weaknesses in Sub-National Analysis are another limitation; most of the studies involved are on national-level policies, and little is known about the implementation dynamics on the local level. The fifth limitation can be seen in the heterogeneity of study designs, where the differences in methods and outcome measures in the studies limited the possibility of quantitative meta-analysis. Lastly, there is the potential publication bias, where the published literature may overrepresent the positive

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results of the policy, which can exaggerate the effectiveness. Future studies would follow longitudinal, multi-method, and multi-language designs, but would be more focused on implementation and governance results.

5 CONCLUSION

This systematic review has shown that climate-change policies have a critical yet disproportionate role in determining sustainable livestock production and food security outcomes in Sub-Saharan Africa. The results show that design is not the sole determinant of policy effectiveness, but governance coherence, system differentiation and socio-economic inclusion. Combined climate-sensitive livestock policies, which integrate adaptation, mitigation, productivity, and social protection, become the most effective method. Nonetheless, disintegrated and marginalising policies are detrimental to resilience, especially in pastoral and smallholder systems. Finally, sustainable livestock systems in SSA demand a shift in fragmented and reactive policies to integrated, inclusive and context-sensitive governance frameworks.

6 POLICY RECOMMENDATIONS

The first recommendation is to promote climate-smart, integrated livestock policies. This involves combining productivity improvements with climate mitigation and adaptation measures, ensuring that livestock policies are aligned with broader food systems and rural development goals.

The second recommendation focuses on strengthening governance and institutional coordination. This can be achieved by establishing cross-sector platforms that bring together climate, agriculture, and livestock stakeholders, helping to improve monitoring, reporting, and adaptive learning systems.

Another key recommendation is to prioritise system-specific interventions. For pastoral systems, this means supporting mobility, improving rangeland governance, and enhancing drought resilience. In mixed systems, efforts should focus on feed optimisation, manure management, and improved breeding practices. For intensive systems, the emphasis should be on emissions regulation and adopting circular bio-economy approaches.

The fourth recommendation is to improve inclusion and equity. This includes ensuring that pastoralists and smallholder farmers are actively represented in policy processes, while also addressing gender inequalities in livestock ownership, access, and benefits.

The fifth recommendation is to better integrate climate policy with food security systems. This can be done by linking livestock policies with social protection programmes, strengthening access to markets and value chains, and promoting nutrition-sensitive approaches.

Finally, there is a need for greater investment in data and research systems. Strengthening monitoring, reporting, and verification (MRV) systems, as well as livestock data infrastructure, will support more informed decision-making and encourage locally adapted innovations and effective extension services.

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CONFLICT OF INTEREST

The authors have declared no conflict of interest in relation to this study.

AUTHORS' CONTRIBUTIONS

All authors contributed their quota to this study. M. B. Salako reviewed all the collated information gotten by her and her co-author. Y. Adenuga brought in information from an agricultural/policy perspective. The article was jointly approved by both authors.

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