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Collaborative governance and institutional synergies for building climate resilience in rural school communities: A systematic review

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Abstract

This study examines how collaborative governance and institutional synergies contribute to improved climate resilience outcomes in rural school communities, particularly within vulnerable rural contexts. Guided by the PRISMA framework, the study systematically reviewed 40 peer-reviewed studies that were published between 2014 and 2024 from Scopus, Web of Science, and Google Scholar. A narrative synthesis and thematic analysis that were informed by Smith and Pelling's adaptation assessment framework were used to analyse institutional arrangements, adaptive capacity, and resilience outcomes. Climate resilience in rural schools is shaped through multi-actor institutional arrangements involving governments, schools, non-governmental organisations (NGOs), community-based organisations, and local communities. Government-school partnerships emerged as the dominant governance structure supporting policy coordination, disaster risk reduction, climate education, and resource mobilisation, while NGOs and community-based organisations strengthened local participation and the implementation of adaptation initiatives. Resilience outcomes were stronger where institutional coordination and stakeholder participation were effectively integrated. However, public-private collaborations remained limited, particularly in African rural contexts that are characterised by fragmented governance systems, inadequate climate financing, and limited technical capacity. The review further identified a significant shortage of African-based empirical research despite the heightened vulnerability of rural school communities to climate-related hazards. The review was limited to English-language and peer-reviewed studies that were published between 2014 and 2024. The findings highlight the need for strengthened decentralised governance systems, multi-sectoral coordination, and sustainable financing for climate adaptation in rural schools. The study positions rural schools as underexplored sites of climate governance and contributes evidence linking collaborative governance with institutional synergies and climate resilience outcomes.

Keywords: *Climate resilience; Collaborative governance; Institutional synergies; Rural schools*

Introduction

Schoolchildren are among the populations that are most affected by climate change worldwide. Their physical fragility, emotional support needs, dependence on others for decision-making, and their risky behaviours increase their vulnerabilities (Marshall *et al*, 2020; Bhadra, 2022). According to the Global Partnership for Education- GPE (2020), about 175 million children are affected by natural disasters each year. Climate-induced hazards affecting children include heat waves, droughts, diseases, and floods (Rubens and Hambrick, 2020). For instance, Cyclone Idai, in Zimbabwe in 2019, had a comparatively greater impact on rural school communities than on their urban counterparts. The disaster had a major impact on about 90,800 children in 139 schools (Musarandega and Masocha, 2023). Similar magnitudes were noted in Mozambique and numerous other Southern African nations (Ibid). Research attributed this to inadequate emergency response and disaster preparedness systems, which mirrors poor governance (Cost, 2015; Ingutia, 2024).

In order to safeguard the needs of rural school communities, particularly children, it is imperative to build strong synergies for climate resilience. Children directly and indirectly bear the psychological, social, and financial costs of climate change and natural disasters. For example, the social friction and family migration that is brought about by droughts and poverty can exacerbate the marginalization of rural communities, especially for vulnerable children attending rural schools (Drabo and Mbaye, 2015). In order to lessen the pressures they face, children require parental care and social assistance, and this can be achieved when strong synergies are built among institutions. The institutions may include local communities, school communities, civil society, the private sector and government. The lack of institutional synergies weakens emergency response and disaster risk reduction (Sharif, 2021; Kyriakopoulos and Sebos, 2023). The foregoing authors highlight that when climate disasters strike, impacts are felt more acutely in rural areas due to high vulnerability. The disintegrated governance system also exacerbates climate disaster impacts. Thus, institutional synergies become a key element of school governance and vice-versa.

Despite the increasing scholarly attention on climate adaptation and community resilience, limited research has specifically examined how institutional collaborations contribute to climate resilience within rural school communities. Existing studies predominantly focus on urban resilience systems, household adaptation strategies, or sector-specific climate interventions, with little attention being given to schools as critical sites of climate governance and resilience building. Furthermore, evidence from developing countries remains limited despite the heightened vulnerability of rural school populations to climate-induced hazards. This study therefore addresses an important research gap by systematically examining institutional synergies for building climate resilience in rural school communities.

Conceptualizing collaborative governance and institutional synergy

Collaborative governance has emerged as a central institutional approach for strengthening climate resilience by integrating multi-actor coordination, shared decision-making, and cross-sectoral learning in adaptation processes. A global synthesis by McNaught (2024) demonstrates that local-level climate and disaster resilience initiatives increasingly rely on collaborative arrangements that bring together state agencies, civil society, and community actors to address complex and context-specific risks, although effectiveness varies depending on institutional capacity and power-sharing arrangements. Similarly, Brink and Wamsler (2018) emphasize that climate adaptation outcomes are significantly shaped by the quality of citizen- municipality interactions, arguing that meaningful participation, trust-building, and iterative communication

are essential for translating governance collaboration into tangible resilience gains. However, evidence from urban contexts such as Bandar Lampung City highlights persistent structural and procedural constraints, including fragmented institutional mandates, weak coordination mechanisms, and limited stakeholder inclusion, which undermine the potential of collaborative governance to deliver adaptive policy outcomes (Mukhlis and Perdana, 2022). In complementing these findings, Ouyang et al. (2023) conceptualize collaborative governance as a critical enabler of resilience building under conditions of increasing climate extremes, noting that adaptive effectiveness improves when governance systems are flexible, learning-oriented, and capable of integrating scientific knowledge with local experience.

Collectively, these studies suggest that while collaborative governance provides a robust normative and operational framework for climate resilience, its success is contingent upon institutional coherence, equitable participation, and sustained coordination across governance scales. In this study, collaborative governance is conceptualized as a multi-level, inter-institutional coordination system through which diverse actors jointly mobilise resources, knowledge, and decision-making authority to enhance adaptive capacity within the education sector under climate stressors. Adaptive capacity refers to the ability of individuals, communities, or systems to adjust to climate change impacts, absorb shocks, recover from stresses, and capitalize on emerging opportunities (Serdeczny *et al.*, 2024; Biesbroek and Wals, 2017; Siders, 2019; Cinner *et al.*, 2019). By increasing the adaptive capacity of rural school communities against climate change risks, children are ultimately safeguarded and their right to health, safety and education is protected.

In contrast, institutional synergy describes the enhanced effectiveness and value addition that result when collaborative governance is well-aligned and mutually reinforcing (Sharif, 2021). It is a process of fostering collaboration, coordination and innovation among different stakeholders resulting in greater impact than could be seen from an individual element (Rahn *et al.*, 2014; Roy *et al.*, 2021). Associated outcome includes improved climate resilience by and within a particular community (Somorin *et al.*, 2016; Vedeld *et al.*, 2021). This suggests that stakeholder collaboration; including actors such as government, local community, private sector and the civil society, can build climate resilience in rural schools. Institutional synergies therefore, strengthen adaptive capacity by facilitating resource mobilisation, knowledge sharing, policy coordination, climate education, and the implementation of resilience-building interventions. The study adopts Smith and Pelling's adaptation assessment framework to examine how institutional arrangements influence vulnerability reduction, adaptive capacity enhancement, and resilience outcomes in rural schools. While this appears a common phenomenon, little is known on how societies can build strong synergies for rural communities and particularly for schools. Yet, stakeholder collaboration brings ideas, efforts, actions and policies together hence, fostering good and effective governance (Thaler and Levin-Keitel, 2016; Wilk *et al.*, 2016).

However, effective synergies for climate resilience depend on various factors. For example, the local community's participation in climate resilience initiatives may depend on the willingness of change agents such as the government, civil society and the private sector to support climate programs (Pienaaah *et al.*, 2024; Elkady *et al.*, 2024). This highlights the importance of collaborative governance in climate resilience building. Other underlying factors include power dynamics, level of local community awareness, institutional capacity, nature of decision making processes and resource availability (Roy *et al.*, 2021). Studies further highlight that adaptive capacity varies with the level of climate hazards and risk awareness, relative mobility, risk exposure levels or the level of support given to, and the socio-economic status

of the community (Fila *et al.*, 2024; Kyriakopoulos and Sebos, 2023, Bhowmik *et al.*, 2021). Collectively, these interrelated factors underscore that the effectiveness of institutional synergies and collaborative governance in building climate resilience is not inherent in the existence of partnerships alone, but is instead contingent upon enabling socio-institutional conditions that shape participation, equity, and adaptive capacity within affected communities.

Methods

A systematic literature review of relevant literature that involved several phases was done. In this section, the researchers present the four key steps as informed by the PRISMA approach. These include search strategy, inclusion criteria, exclusion criteria, and data extraction.

Initially, the researchers explored three separate databases to identify relevant literature and these were the Web of Science, Scopus, and Google Scholar Database. However, the researchers preferred Scopus due to its comprehensive data and superior ranking across multiple scientific disciplines. The database was augmented by various literature studies taken from Google Scholar Database sources to ensure research accuracy and well-informed conclusions. During the planning stages, a search scope study identified appropriate key alternate terms, in order to develop a search-strategy concept grid (*see table 1*)

Table 1. Search strategy grid.

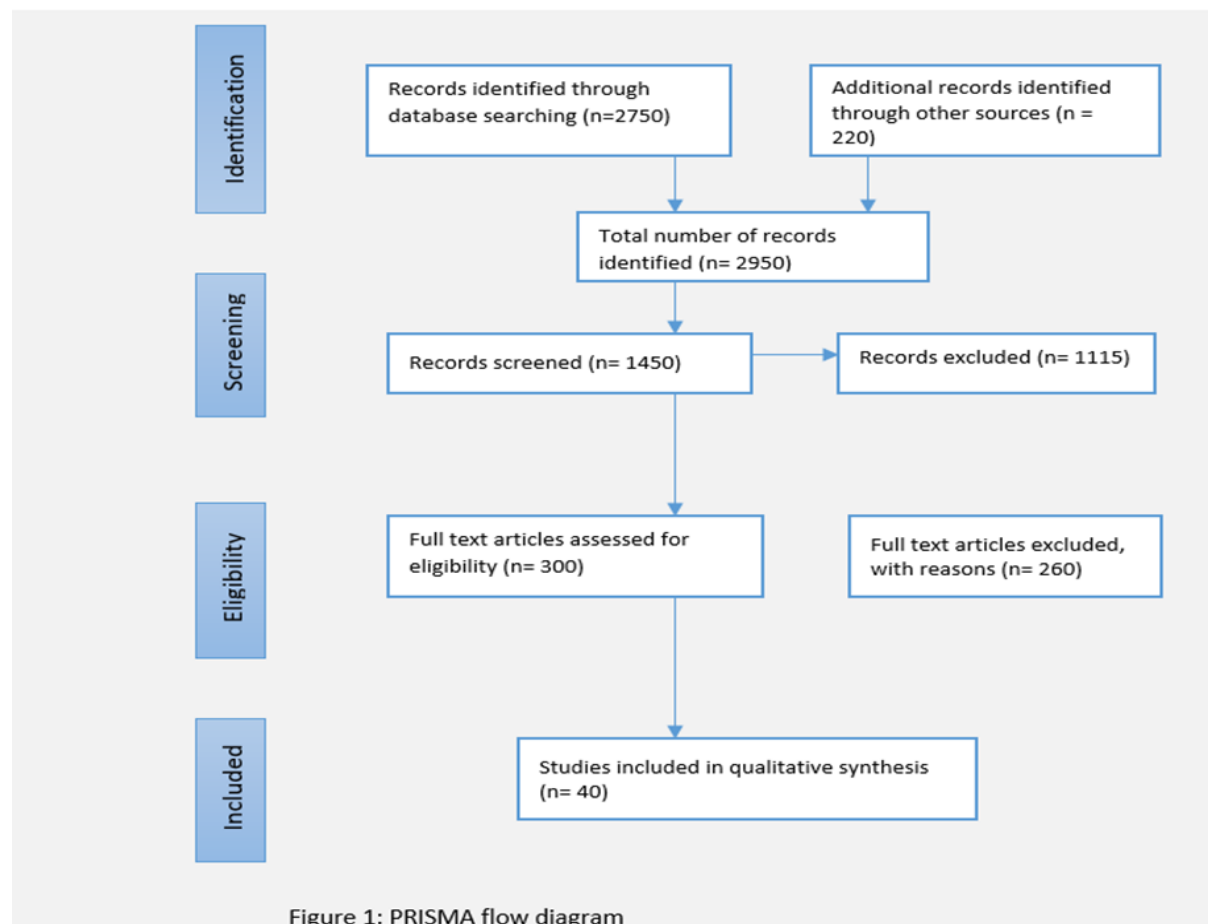
Key words identified in the title	Institutional	Synergy	Climate resilience	Rural schools
Alternative words identified	Governance	Collaboration	Climate adaptation	Rural schools
	Stakeholders	Networking	Adaptive capacity	Remote schools
	Structural	Partnership	Climate proofing	Rural communities
	Actors	Engagement	Climate risk mitigation	Rural areas

(Source: Author, 2025)

Inclusion and exclusion criteria

The next step involved refining the search themes to establish suitable search strings for each database in line with the revised focus on collaborative governance and institutional synergies for climate resilience in rural school communities. Based on relevance and appropriateness, the following search queries were developed: ‘Collaborative Governance’ AND ‘Institutional Synergies’ AND ‘Climate Change’ OR ‘Climate Resilience’ OR ‘Adaptation’ AND ‘Rural Schools’ OR ‘School Communities’. Additional related terms such as governance, partnerships, stakeholder coordination, adaptive capacity, and community resilience were also considered during the search process to improve comprehensiveness. The researchers applied the simplified ‘preview, question, read, and summarise’ (PQRS) approach to screen and process the literature that was identified through the search strings.

The review was limited to peer-reviewed journal articles that were published in English between 2014 and 2024, with full-text accessibility. Eligible studies focused on collaborative governance, institutional coordination, stakeholder partnerships, adaptive capacity, or climate resilience initiatives within rural school or rural community contexts. Studies that did not address climate resilience, governance systems, institutional collaboration, or rural educational settings were excluded. Following screening and eligibility assessment, 40 studies met the inclusion criteria and were selected for review. The PRISMA flow chart in Figure 1 summarises the stages of identification, screening, eligibility assessment, and final inclusion of studies in the systematic review process.



(Source: Author, 2025)

The study adopted a narrative synthesis of mixed methods data. Quantitatively, the study sought to document the general characteristics of the reviewed articles. To ensure consistency, the researchers developed an article review questionnaire that explored study characteristics including title, authorship, year of publishing, study design and the geographical location in which the study was undertaken. A methodological quality evaluation was further conducted to determine the level of rigour as well as the limitations of the study.

Qualitatively, the study sought to examine existing institutional governance and synergies for climate resilience in rural school communities. Smith and Pelling's adaptation assessment framework guided both thematic coding and the interpretation of findings. The framework was operationalised through three analytical dimensions: (1) institutional arrangements and

collaborative structures, (2) factors influencing adaptive capacity and institutional effectiveness, and (3) measurable climate resilience outcomes within rural school communities. The framework enables a systematic examination of how governance systems, stakeholder participation, and institutional coordination contribute to resilience building (Peck *et al.*, 2022). Table 2 provides a detailed framework for the thematic analysis.

Table 2. Qualitative data analysis framework

Code	Theme	Questions to be addressed
1	Institutional arrangements and collaborative governance structures	1. What forms of collaborative governance and institutional synergies are described in the study (e.g., partnerships, networks, multi-stakeholder collaborations)? 2. Which institutions and actors are involved in the collaborative arrangements (e.g., schools, local government, NGOs, community-based organisations, private sector, and local communities)? 3. What roles and responsibilities do different actors perform within the governance arrangements? 4. What are the key objectives, strategies, and activities implemented to strengthen climate resilience in rural school communities?
2	Factors influencing adaptive capacity and institutional effectiveness	1. What factors influence the effectiveness of collaborative governance and institutional synergies (e.g., leadership, trust, resources, coordination, and technical capacity)? 2. How do governance systems, institutional frameworks, and policies support or constrain the climate resilience initiatives in rural school communities? 3. How do power dynamics, stakeholder participation, and decision-making processes affect institutional coordination and adaptive capacity? 4. What role do community engagement, climate awareness, and local knowledge systems play in strengthening resilience initiatives?
3.	Climate resilience outcomes	1. What climate resilience outcomes are reported in the studies (e.g., improved adaptation, reduced vulnerability, enhanced preparedness, and continuity of learning)? 2. How do collaborative governance structures and institutional synergies contribute to resilience outcomes in rural schools? 3. What contextual factors influence the sustainability and effectiveness of resilience outcomes? 4. What are the implications of the reported resilience outcomes for policy, governance, and practice in rural education systems?

(Source: Author, 2025)

Results and discussion

The results are presented in two parts as the first part presents the quantitative data analysis of study characteristics while the second part presents a qualitative narrative analysis of data based on pre-defined themes in terms of the objectives of the study. These include forms of institutional synergies, outcomes of institutional synergies on climate resilience and factors influencing institutional synergies. The section concludes by highlighting the implications on practice and policy.

Quantitative analysis

In this section the quantitative results of the study characteristics are presented based on the studies by year, region/ country, subject and methodology.

Studies by year

Forty studies were included in systematic literature review; particularly research articles published between 2014 and 2024. This accounts for only 13.3% of the full text articles assessed for eligibility. The exclusion of the majority of studies (n =260) due to the lack of focus on rural areas points to the need for more research into climate resilience in rural schools to safeguard children. However, a systematic review of the 40 articles revealed a growing number of scholarly interests on climate resilience issues in rural communities. There has been a generally upward trend in studies during the 10 year period with the years 2021, 2022 and 2024 recording the highest number of studies on institutional synergies and climate resilience in rural school communities (n= 8 each). These results show that scholars continue to seek ways to protect vulnerable rural communities against climate change the world over (Schloesser *et al.*, 2024; Steiner and Atterton, 2015; Alam *et al.*, 2017). The upward trend in Figure 2 indicates a growing realisation of the devastating impacts of climate change on children and subsequently the need to bring policy and practice reforms for climate resilience in vulnerable societies.

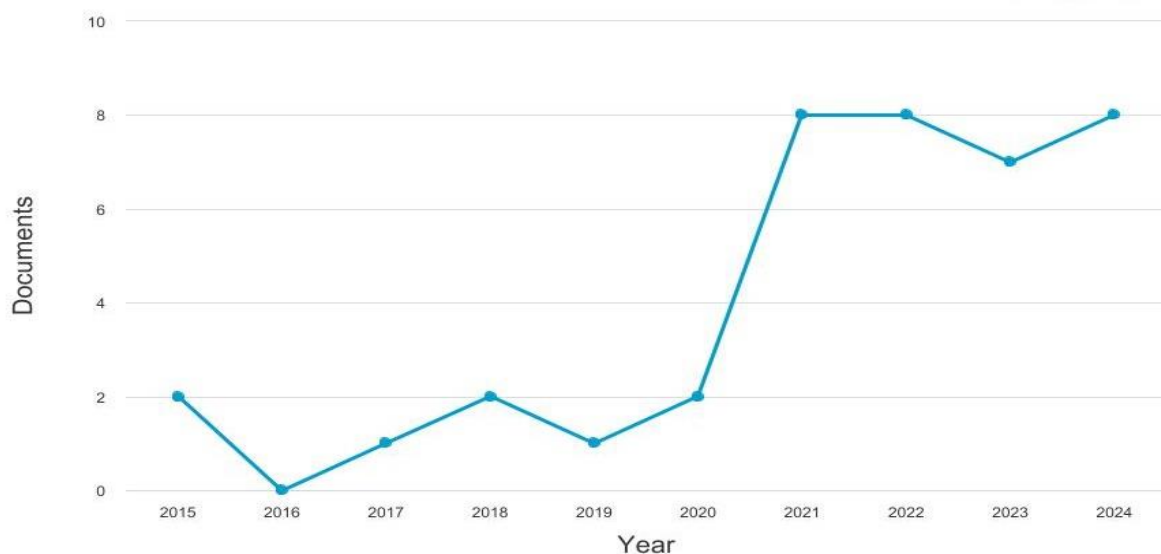


Figure 2. Number of studies by year

Studies by country/ region

While the trend of studies over the 10-year period is a positive development in terms of adding a new body of knowledge on this emerging issue for vulnerable children in rural areas, most of these studies were conducted in 1st world countries with the United State of America (USA) leading followed by the United Kingdom (UK) based on the first 15 countries. Studies conducted in the US alone accounted for more than 31 percent (n= 11) while studies from African countries accounted for only 23% (n= 8) of the first 15 leading countries with studies that were conducted on institutional synergies for climate resilience in rural areas, and schools in particular. Few studies were conducted in developing countries where climate risk vulnerability is very high in rural areas and particularly on children (Alam *et al.*, 2017; Apollo

and Mbah, 2021; Singh *et al.*, 2022). As depicted by Figure 3, the number of studies per region emerged as follows; Asia (n= 5), Africa (n= 8), Europe (n= 22).

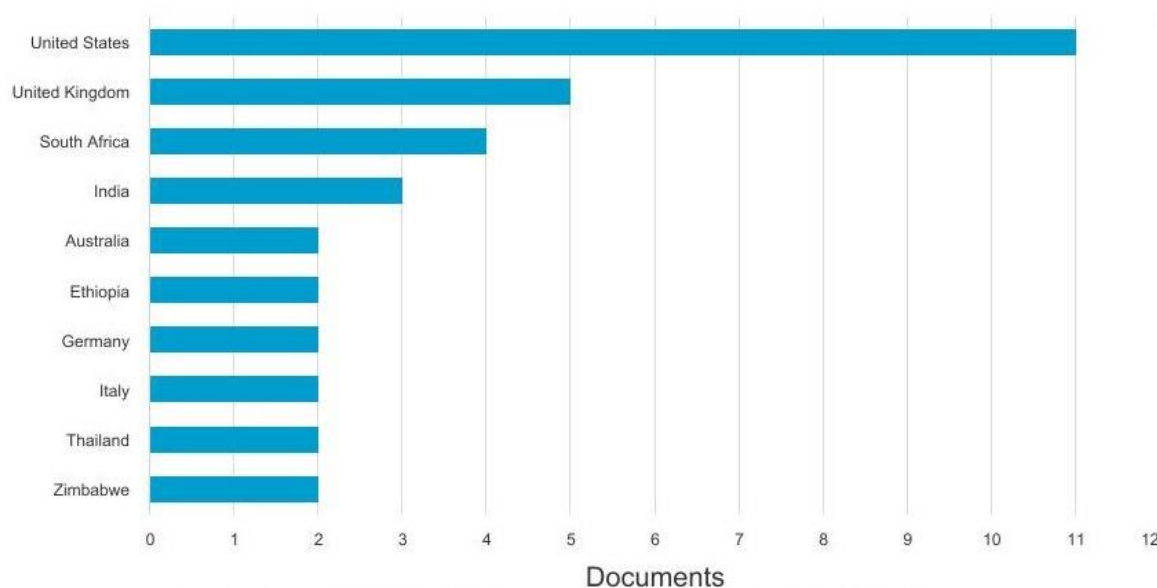


Figure 3. Number of studies by country based on the Scopus extract of the leading 15 countries.

In Zimbabwe for example, only two studies have examined institutional synergy and climate resilience in rural schools (Chirisa, 2021; Nyahunda *et al.*, 2024), an indication of the dearth of literature that informs policy makers on the policy and practice needs that protect vulnerable children from climate shocks. This also suggests an extended divide between rural and urban children in terms of accessibility to and enjoyment of their right to education, health and safe lives among other fundamental needs.

Studies by subject

In an analysis of studies by subject or discipline, the researchers discovered a positive status as most studies were social sciences oriented. The vulnerability of children against climate shocks, and especially in rural areas are purely social determinants of a society (Muttarak and Lutz, 2014; Kousky, 2016). Institutional synergies in school context obviously aim to build climate resilience and adaptation, and safeguarding children from climate shocks and violation of their fundamental rights. The safety, health and welfare aspects of children are more social science in nature. Positively, the majority of the studies examined climate resilience building for rural school communities within the field of social sciences, accounting for 24.3% of the subject areas and the leading field as seen in Figure 4

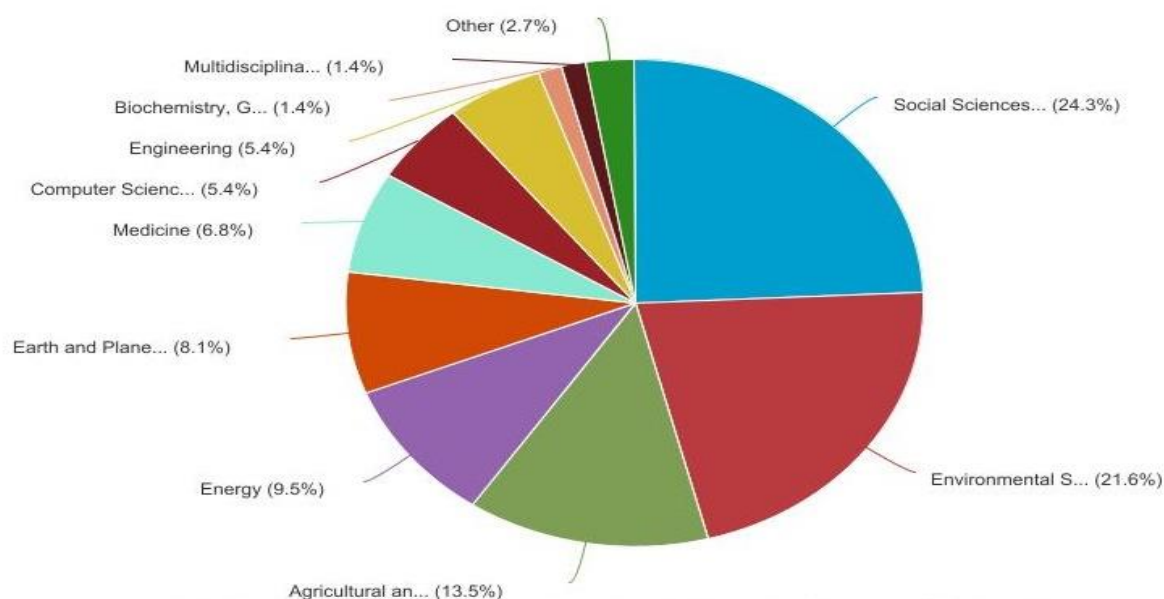


Figure 4: Studies by subject

Methods used in Publications

Regarding the methods and materials used in publications, the researchers classified the studies by the data collection techniques that are used in examining institutional synergies and climate resilience systems in schools. The six categories include modelling and simulation; geographical information systems (GIS) and remote sensing; secondary data; questionnaire; field surveys and experiments; and interviews, focus group discussions (FGDs) and observation as the last category. The results revealed that the majority of studies that were reviewed employed a quantitative approach (n= 30) using various data collection techniques, while very few studies (n=10) employed a qualitative approach. Table 3 provides a detailed breakdown of studies by data collection techniques and approach.

Table 3. Studies by methodological approaches

Data collection technique	No. of studies	Methodology
Modelling, Simulation	n= 3	Quantitative
GIS & Remote Sensing	n= 2	Quantitative
Secondary data	n= 12	Quantitative (n=10) Qualitative (n= 2)
Questionnaire	n= 15	Quantitative
Interviews, FGDs, Observations	n= 8	Qualitative
Field survey, Field Experiment	n= 0	N/A

(Source: Author, 2025)

The uneven distribution of the methodological approaches in a growing field of climate resilience in schools suggests the dearth of scientific literature supported by qualitative data and specifically interviews, observations and FDGs. These instruments are key in establishing the lived experiences, perceptions and attitudes of populations and they generate new knowledge that may not be obtained quantitatively (Paschen and Ison, 2014; Moezzi *et al.*, 2017). This suggests that qualitative techniques ensure a better understanding of the nature of synergistic interventions, programs and initiatives that foster climate resilience in rural school communities.

The researchers further assessed the methodological quality of the 40 included studies by utilizing the Joanna Briggs Institute (JBI) checklist, complementing the overall methodological framework. Methodological quality in systematic reviews refers to the rigor and transparency of the review process, including the assessment of the quality of the included studies (Booth, 2016). The researchers examined aspects such as clear definition of research questions, instrumentation rigour and relevance, data analysis methods, clear presentation and easy interpretation of data, and coherence of results with conclusions. Majority of studies (n= 32) rated high quality while the remaining (n=8) rated moderate quality. This suggests the credibility and reliability of findings from studies undertaken between 2014 and 2024 on institutional synergies and climate resilience in rural school communities. However, the exclusion of non-English articles on search strategy limits the generalizability of the methodological quality of all relevant studies (Pollock and Berge, 2018). In this study context, future studies would need to systematically review non-English articles in order to better establish the methodological quality status in addressing the climate change issues affecting children in schools.

Qualitative analysis

Guided by Smith and Pelling's adaptation assessment framework, the systematic review examined how governance systems, stakeholder participation, and institutional coordination contribute to climate resilience building within rural school communities. The analysis was organized around three interconnected themes: (1) institutional arrangements and collaborative governance structures; (2) factors influencing adaptive capacity and institutional effectiveness; and (3) measurable climate resilience outcomes within rural school communities. This analytical structure reduced thematic repetition by synthesizing the similarities and differences across institutional actors while maintaining focus on resilience-building processes.

Institutional arrangements and collaborative governance structures

The review revealed that climate resilience in rural school communities is largely shaped through multi-actor institutional arrangements involving governments, schools, NGOs, community-based organisations (CBOs), and local communities. Across the reviewed studies, government-school partnerships emerged as the dominant governance structure supporting climate adaptation and resilience initiatives (Vedeld *et al.*, 2021; Somorin *et al.*, 2016). Governments primarily contributed through policy guidance, resource mobilisation, disaster risk reduction (DRR) frameworks, climate education policies, and the technical support delivered through ministries that are responsible for education, agriculture, environment, and local governance. However, the findings showed that resilience-building processes were more effective when government interventions were complemented by localized stakeholder participation and institutional coordination. Community-based organisations and NGOs often strengthened governance systems through community mobilisation, climate awareness campaigns, environmental conservation programmes, and implementation support for

adaptation initiatives (Archer *et al.*, 2014; Fazey *et al.*, 2018; Bryan *et al.*, 2018). In several African rural communities, schools served as important community hubs for climate information dissemination, disaster preparedness training, afforestation programmes, and climate-smart agriculture initiatives that are supported by agricultural extension officers and local environmental committees (Thomas *et al.*, 2019; Defe and Matsa, 2024).

The review further showed important differences across institutional arrangements. Government-led interventions largely focused on policy coordination and institutional legitimacy, while NGOs provided technical expertise and financial resources for climate adaptation projects such as rainwater harvesting systems, renewable energy initiatives, and school feeding programmes (Harvey *et al.*, 2019). In contrast, CBO-school collaborations were more participatory and locally embedded, facilitating context-specific adaptation practices that are informed by indigenous knowledge systems and local environmental realities (Cinner *et al.*, 2018). Nevertheless, public-private collaborations remained limited across most rural settings despite the growing climate governance debates emphasizing multi-sectoral partnerships (Kyriakopoulos and Sebos, 2023). The findings therefore bridge an important scientific gap by demonstrating that climate resilience within rural schools is not solely dependent on isolated institutional interventions, but rather on integrated governance systems that are characterised by coordination, participation, and complementary institutional roles. While previous climate adaptation literature has largely focused on urban resilience systems and household adaptation, this review highlights rural schools as critical yet underexplored sites of institutional climate governance in Africa and beyond.

Factors influencing adaptive capacity and institutional effectiveness

The review identified several interconnected factors influencing the effectiveness of institutional synergies and adaptive capacity within rural school communities. Across all institutional arrangements, successful climate resilience initiatives depended on communication, mutual trust, shared goals, leadership capacity, stakeholder participation, and the availability of financial and technical resources (Corner *et al.*, 2015; Carter *et al.*, 2015; Carmen *et al.*, 2022). These governance dimensions significantly shaped the ability of institutions to coordinate climate adaptation actions and sustain resilience-building programmes.

Resource availability emerged as one of the most critical determinants of institutional effectiveness. Several studies observed that schools with stronger institutional support, external funding, and technical expertise were more likely to implement climate-smart agriculture, environmental rehabilitation, disaster preparedness programmes, and nature-based solutions (Ferreira *et al.*, 2020; Elkady *et al.*, 2024). However, many rural schools, particularly in developing countries, operated under conditions of inadequate infrastructure, weak governance systems, and limited access to climate finance (Nyahunda *et al.*, 2024; Alam *et al.*, 2017). These constraints weakened their adaptive capacity and limited the sustainability of resilience interventions.

The review also highlighted important governance challenges affecting institutional coordination. In several contexts, schools remained passive recipients rather than active initiators of climate adaptation programmes (Bisht, 2020; Rousell and Cutter-Mackenzie-Knowles, 2020). Similarly, NGO-led interventions were sometimes constrained by donor dependency, fragmented implementation approaches, and weak integration into long-term government planning systems (Harvey *et al.*, 2019). While CBOs enhanced local participation and social capital, their effectiveness was frequently limited by inadequate technical expertise

and financial support. Another important finding was the limited attention given to climate literacy, teacher preparedness, and learner participation in resilience-building processes. Very few studies examined how knowledge systems, environmental education, and local awareness influence institutional effectiveness and adaptive capacity within rural schools (Musarandega and Masocha, 2023; Apollo and Mbah, 2021; Anabaraonye *et al.*, 2018). This represents a significant gap in climate resilience scholarship, particularly within vulnerable rural African contexts where information access and institutional support systems remain unevenly distributed.

Climate resilience outcomes within rural school communities

The reviewed studies demonstrated that institutional synergies contribute to several measurable climate resilience outcomes within rural school communities. Across the different governance arrangements, resilience interventions enhanced disaster preparedness, strengthened food and water security, improved climate awareness, and supported the continuity of educational activities during climate-related shocks (Ziervogel *et al.*, 2014; Thomas *et al.*, 2019). These outcomes reflect important dimensions of adaptive capacity and vulnerability reduction that are emphasized within Smith and Pelling's adaptation assessment framework. Government-supported DRR programmes and school-based vulnerability assessments improved the preparedness for floods, droughts, cyclones, and other climate-induced hazards in several rural communities (Nyahunda *et al.*, 2024; Chirisa, 2021). Similarly, climate-smart agriculture projects such as nutrition gardens, conservation farming, water harvesting systems, and drought-resistant crop production strengthened household food security and reduced vulnerability among learners and surrounding communities (Thomas *et al.*, 2019; Defe and Matsa, 2024). NGO-supported renewable energy systems and water infrastructure projects further improved environmental sustainability and adaptive capacity within schools (Harvey *et al.*, 2019).

The findings also showed that institutional synergies enhanced social resilience through climate education, awareness campaigns, and community participation in adaptation initiatives. Schools increasingly functioned as centres for climate information dissemination and local mobilization, particularly within partnerships involving NGOs and CBOs (Archer *et al.*, 2014; Fazey *et al.*, 2018). These collaborative arrangements strengthened social capital and fostered collective responses to climate risks. However, measurable resilience outcomes remained uneven across regions due to disparities in institutional capacity, governance effectiveness, and resource availability. Rural schools in developing countries continued to experience limited access to climate adaptation infrastructure, technical expertise, and sustained funding support (Apollo and Mbah, 2021; Alam *et al.*, 2017). The review therefore underscores the need for integrated and decentralized governance systems capable of strengthening long-term institutional coordination, participation, and climate resilience within vulnerable rural school communities.

Conclusions

This study examined institutional synergies and collaborative governance in strengthening climate resilience in rural schools through integrated qualitative and quantitative analyses. The findings indicate that effective climate resilience is strongly dependent on the strength of inter-institutional coordination, participatory governance processes, and the extent to which actors jointly mobilise and integrate resources for adaptive action. Quantitative results show a significant positive relationship between well-functioning collaborative governance mechanisms and improved school-level resilience outcomes, including preparedness for

climate hazards, continuity of teaching and learning during disruptions, and responsiveness to climate-related risks. However, qualitative evidence reveals persistent implementation constraints, including fragmented institutional mandates, weak coordination across governance levels, limited decentralisation of decision-making, and inadequate resource flows to rural schools. These constraints weaken the translation of collaborative arrangements into meaningful institutional synergies and reduce their overall effectiveness.

A key contribution of this study is its response to a notable gap in the African climate resilience and education governance literature, where empirical evidence on how collaborative governance functions in rural school contexts remains limited and often under-theorised. This lack of context-specific studies has contributed to policy approaches that are frequently normative and externally driven, with limited grounding in the operational realities of rural African education systems. The study therefore provides evidence-based insights that can inform more contextually responsive policy and practice. It concludes that strengthening climate resilience in rural schools requires deliberate institutional reforms that go beyond formal collaboration to ensure functional synergy among actors. This includes strengthening decentralised governance structures, institutionalising multi-sectoral coordination platforms, enhancing capacity at local and school levels, and securing predictable financing for climate adaptation in education. There is also a need for sustained investment in African-led empirical research to deepen an understanding of governance dynamics in climate resilience thus, ensuring that policy development is grounded in locally generated evidence and context-specific institutional realities.

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