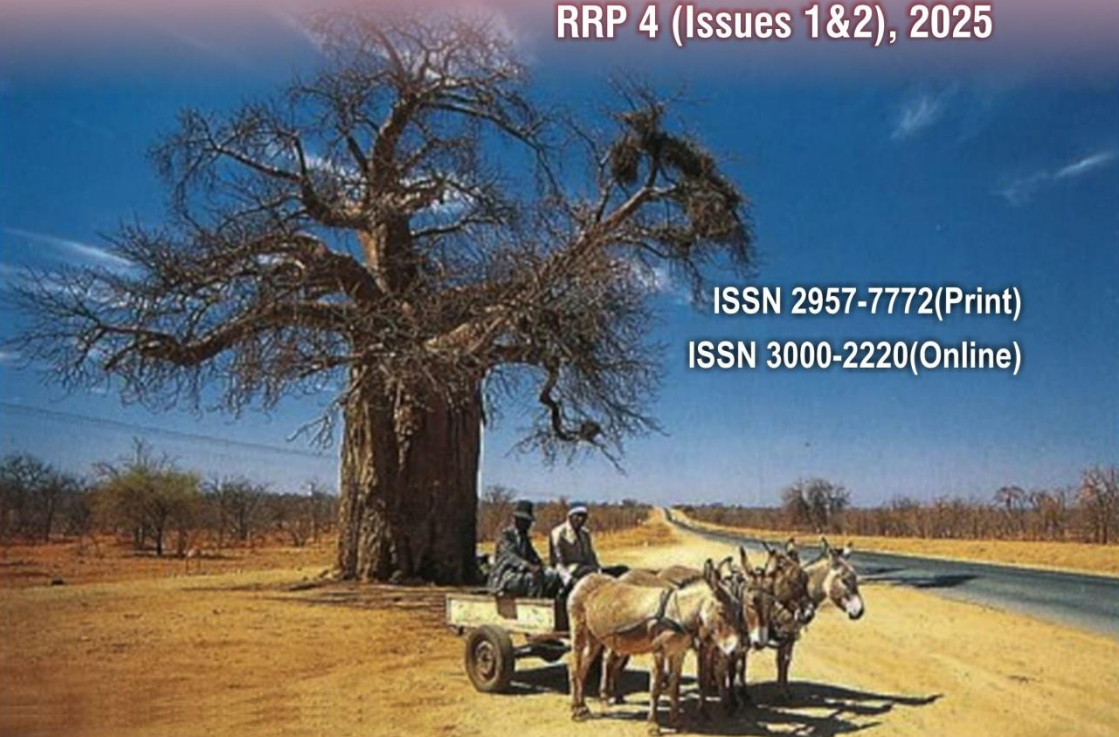
ZEGU
ZIMBABWE
EZEKIEL GUTI
UNIVERSITY

Committed to Excellence

REVIEW OF Rural Resilience Praxis

RRP 4 (Issues 1&2), 2025

ISSN 2957-7772(Print)
ISSN 3000-2220(Online)



REVIEW OF
Rural Resilience Praxis

RRP 4(Issues 1&2), 2025

ISSN 2957-7772 (Print)
ISSN 3000-2220 (Online)

Published by the Zimbabwe Ezekiel Guti University Press
Stand No. 1901 Barrassie Rd,
Off Shamva Road
Box 350
Bindura, Zimbabwe

Typeset by Divine Graphics
Printed by Divine Graphics

SUBSCRIPTION AND RATES
Zimbabwe Ezekiel Guti University Press Office
Stand No. 1901 Barrassie Rd,
Off Shamva Road
Box 350
Bindura, Zimbabwe
Telephone: ++263 8 677 006 136 | +263 779 279 912
E-mail: zegupress@admin.uz.ac.zw
http://www.zegu.ac.zw/press

About the Journal

JOURNAL PURPOSE

The purpose of the *Review of Rural Resilience Praxis is* to provide a forum for disaster risk mitigation, adaptation and preparedness.

CONTRIBUTION AND READERSHIP

Sociologists, demographers, psychologists, development experts, planners, social workers, social engineers, economists, among others whose focus is that of rural resilience.

JOURNAL SPECIFICATIONS

Review of Rural Resilience Praxis

ISSN 2957-7772(Print)
ISSN 3000-2220(Online)

SCOPE AND FOCUS

As much as the urban territory is increasing by each day, the rural economy, especially in many developing countries, still retains a great proportion of the extractive and accommodation industry. Retaining some space as rural remains critical given the sectors role in providing ecosystem services to both wildlife and humanity. In this light, rural resilience as practice beckons for critical studies especially in the face of the ever-threatening extreme weather events and climate change that then impact on the livelihoods and lifestyles of the rural communities. Review of Rural Resilience Praxis (RRRP) comes in as a platform for critical engagement by scholars, practitioners and leaders as they seek to debate and proffer solutions of the rural sector and trying to champion the philosophy of the right to be rural. The issue of conviviality between the different constituencies of the sectors, compiled with the competing challenges of improving rural spaces while also making the conservation and preservation debates matter is the hallmark of this platform of criticality. The journal is produced bi-annually.

Guidelines for Authors for the Review of Rural Resilience Praxis

Articles must be original contributions, not previously published and should not be under consideration for publishing elsewhere.

Manuscript Submission: Articles submitted to the *Review of Rural Resilience Praxis* are reviewed using the double-blind peer review system. The author's name(s) must not be included in the main text or running heads and footers.

A total number of words: 5000-7000 words and set in 12-point font size width with 1.5 line spacing.
Language: British/UK English
Title: must capture the gist and scope of the article
Names of authors: beginning with the first name and ending with the surname
Affiliation of authors: must be footnoted, showing the department and institution or organisation.
Abstract: must be 200 words
Keywords: must be five or six containing words that are not in the title
Body: Where the authors are more than three, use *et al.,*
Italicise *et al.*, *ibid.,* words that are not English, not names of people or organisations, etc. When you use several authors confirming the same point, state the point and bracket them in one bracket and in ascending order of dates and alphabetically separated by semi-colon e.g. (Falkenmark, 1989, 1990; Reddy, 2002; Dagdeviren and Robertson, 2011; Jacobsen *et al.,* 2012).

Referencing Style: Please follow the Harvard referencing style in that:
— In-text, citations should state the author, date and sometimes the page numbers.
— the reference list, entered alphabetically, must include all the works cited in the article.

In the reference list, use the following guidelines, religiously:

Source from a Journal

Anim, D.O and Ofori-Asenso, R (2020). Water Scarcity and COVID-19 in Sub-Saharan Africa. *The Journal of Infection*, *81*(2), 108-09.

Banana, E, Chitekwe-Biti, B and Walnycki, A (2015). Co-Producing Inclusive City-Wide Sanitation Strategies: Lessons from Chinhoyi, Zimbabwe. *Environment and Urbanisation*, *27*(1), 35-54.

Neal, M.J. (2020). COVID-19 and Water Resources Management: Reframing Our Priorities as a Water Sector. *Water International*, *45*(5), 435-440.

Source from an Online Link

Armitage, N, Fisher-Jeffes L, Carden K, Winter K *et al. (*2014). Water Research Commission: Water-sensitive Urban Design (WSUD) for South Africa: Framework and Guidelines. Available online: https://www.greencape.co.za/assets/Water-Sector-Desk-Content/WRC-Water-sensitive-urban-design-WSUD-for-South-Africa-framework-and-guidelines-2014.pdf. Accessed on 23 July 2020.

Source from a Published Book

Max-Neef, M. (1991). *Human Scale Development: Concepts, Applications and Further Reflections,* London: Apex Press.

Source from a Government Department (Reports or Plans)

National Water Commission (2004). Intergovernmental Agreement on a National Water Initiative. Commonwealth of Australia and the Governments of New South Wales, Victoria, Queensland, South Australia, the Australian Capital Territory and the Northern Territory. Available online: https://www.pc.gov.au/inquiries/completed/water-reform/national-water-initiative-agreement-2004.pdf. Accessed on 27 June 2020.

The source being an online Newspaper article

The Herald (2020). Harare City Could Have Used Lockdown to Clean Mbare Market. *The Herald*, 14 April 2020. Available online: https://www.herald.co.zw/harare-city-could-have-used-lockdown-to-clean-mbare-market/. Accessed on 24 June 2020.

Dynamics of Rural Settlement Patterns Amid Environmental Change in Selected Zimbabwean Districts

WISEMAN KADUNGURE[1]

Abstract

Environmental change profoundly impacts rural settlement patterns, livelihoods and socio-economic stability, particularly in vulnerable regions like Zimbabwe. This study employs a case study approach, focusing on Chimanimani, Lower Muzarabani and Binga districts, to systematically analyse the interplay between climate change, natural hazards and human activities in driving rural settlement dynamics. Using qualitative methods, including interviews, focus group discussions and policy analysis, the research investigates changes in settlement structures, adaptive strategies and the effectiveness of government policies. Key findings reveal the significant influence of natural hazards, such as Cyclone Idai in Chimanimani that displaced over 14 000 residents and created fragmented communities. In Lower Muzarabani, drought-induced migration along riverbanks reflects adaptive but risky strategies tied to cyclical environmental pressures. In Binga, resettlement following the construction of the Kariba Dam emphasises the long-term challenges of displacement, including water scarcity and socio-economic disruptions. The discussion critically evaluates these findings, linking them to theoretical perspectives, such as the Human-Environment Interaction Theory, the Location Theory and the Push-Pull Theory. The study assesses the National Climate Policy and Zimbabwe National Human Settlements Policy, highlighting successes in infrastructure development but identifying gaps in addressing water scarcity and resilience. Recommendations include integrating indigenous knowledge with modern technologies, developing climate-smart villages, enhancing participatory land-use planning and implementing ecosystem-based adaptation strategies. This research advances understanding of rural

[1] Department of Town Planning, Mbire Rural District Council, Mbire, Zimbabwe, https://orcid.org/0000-0001-6513-4403

settlement dynamics and proposes actionable solutions to support resilience and sustainable development in Zimbabwe's rural communities.

Keywords*: climate resilience, adaptive strategies, sustainable development, Zimbabwe.*

INTRODUCTION

Rural settlements across developing countries face escalating vulnerabilities due to the impacts of environmental change. These challenges are particularly evident in Zimbabwe, where the interplay of climate change, natural hazards and human activities profoundly affects settlement patterns and livelihoods. Climate change, characterised by erratic rainfall patterns, prolonged droughts and extreme weather events, has disrupted agricultural productivity, water availability and ecosystem stability (IPCC, 2018). Severe droughts in Zimbabwe between 2010 and 2020 reduced crop yields by over 30% in affected regions, prompting communities reliant on subsistence farming to migrate to areas with better resources (FAO, 2021). In addition, extreme weather events such as Cyclone Idai in 2019 caused widespread destruction in Chimanimani District, displacing over 14 000 residents and damaging critical infrastructure (Munsaka *et al.*, 2021). Such events highlight the fragility of rural settlements and emphasise the urgent need for effective adaptation strategies.

Natural hazards exacerbate these challenges, disrupting livelihoods and forcing cyclical migration patterns. In Muzarabani District, recurring floods have compelled communities to temporarily relocate during rainy seasons and return when water levels subside, reflecting adaptive but precarious responses to environmental risks (Generis Global Legal Services, 2024). These pressures are compounded by human activities such as deforestation, overgrazing and peri-urbanisation which accelerate environmental degradation. Between 2000 and 2020, Zimbabwe experienced an average annual deforestation rate of 327 000 hectares, severely impacting soil fertility and agricultural viability (FAO, 2021). Additionally, rapid urban expansion in areas like Harare has displaced rural populations and disrupted traditional land-use practices, creating new

challenges for community resilience (Enu-Kwesi, 2022). Despite the significance of these issues, existing research disproportionately focuses on urban areas, leaving rural contexts underexplored. This lack of attention to rural dynamics limits policy-makers' understanding of the unique vulnerabilities faced by these communities. Addressing this research gap is essential for developing context-specific interventions that enhance resilience and sustainability in rural areas. By examining the experiences of communities in Chimanimani, Muzarabani and Binga districts, this study contributes to a more nuanced understanding of how environmental change shapes rural settlement patterns in Zimbabwe. The primary objectives of this research are to analyse the impacts of environmental change on rural settlement locations and structures, evaluate the consequences of these changes on livelihoods, investigate adaptive strategies employed by affected communities, assess the effectiveness of existing government policies and propose actionable recommendations for sustainable rural development. Through a case study approach, the research provides evidence-based insights to inform policy and practice, ultimately supporting rural resilience in the face of environmental change.

THEORIES UNDERPINNING THE STUDY

Understanding the complex interplay between environmental change and rural settlement patterns requires robust theoretical frameworks. This study integrates three key theories: the Human-Environment Interaction Theory, the Location Theory and the Push-Pull Theory. These frameworks collectively provide essential insights into the dynamics between ecological factors, human activities and settlement configurations, forming the foundation for analysing rural resilience in Zimbabwe.

HUMAN-ENVIRONMENT INTERACTION THEORY

The Human-Environment Interaction Theory emphasises the reciprocal relationship between humans and their environment. Developed by Moran and Brondízio (2013), the theory examines how rural communities adapt to ecological pressures such as deforestation, climate variability and resource scarcity, while concurrently modifying their surroundings through activities like agriculture, infrastructure development and migration. For instance,

Nagendra *et al.* (2022) highlight case studies from India's forest landscapes, demonstrating how human policies impact ecological systems and settlement patterns. The interdisciplinary nature of this theory incorporates perspectives from geography, sociology, ecology and anthropology, offering a holistic approach to understanding settlement dynamics. Historical perspectives, such as those explored by Childs, Goldstein and Wangdui (2013), reveal how past interactions between communities and their environments influence current settlement practices. However, critiques suggest that the theory's broad scope may overlook socio-economic variables critical to specific rural populations (Brondízio and Moran, 2012). Despite its limitations, the Human-Environment Interaction Theory is instrumental in analysing the adaptive strategies employed by Zimbabwean communities facing environmental change.

LOCATION THEORY

The Location Theory, proposed by Walter Christaller (1933) and Alfred Weber (1909), analyses the spatial distribution of human settlements based on accessibility to resources and land suitability. In rural Zimbabwe, environmental factors such as soil fertility, climate conditions and water availability remain pivotal in determining settlement locations. Juraev (2023) shows that degraded landscapes caused by deforestation and erosion in rural areas lead to spatial reorganisation, with communities relocating to regions with more favourable conditions.

Recent applications of the Location Theory have adapted its traditional principles to incorporate sustainability and climate adaptation. Welford and Yarbrough (2021) expand the theory's scope by integrating economic factors with ecological sustainability, while Nikou and Luukkonen (2024) critique its narrow focus on economic considerations, arguing that cultural and social dimensions play an equally critical role in settlement decisions. In Zimbabwe, shifts in agricultural productivity due to climate variability, further reinforce the applicability of the theory, particularly in understanding resource-driven relocations (FAO, 2021). By balancing resource accessibility with cultural and economic priorities, the theory provides a nuanced framework for analysing rural settlement patterns.

PUSH-PULL THEORY

The Push-Pull Theory, formulated by Ravenstein in the 1880s, explains migration patterns as influenced by push factors (e.g., environmental degradation, natural disasters) and pull factors (e.g., better living conditions, fertile land). In the context of rural Zimbabwe, prolonged droughts have acted as significant push factors, compelling communities to leave areas where agricultural productivity has been severely diminished. Conversely, regions such as Muzarabani that benefit from river systems and water availability, serve as pull factors that attract resettlement (Anyolo, 2010). While the simplicity of the theory makes it a valuable tool for analysing migration trends, its limitations include an insufficient focus on emotional and cultural dimensions. For example, Gao, Lyu and Liu (2023) reveal that strong ancestral ties often influence migration decisions, complicating the push-pull dichotomy. Mohamed and Abdul-Talib (2020) similarly argue that socio-economic inequalities must be considered alongside ecological drivers to capture the complexities of migration. Despite its critiques, the Push-Pull Theory remains relevant for understanding how environmental changes drive settlement shifts, particularly under Zimbabwe's recurring droughts and floods.

The integration of these theories enables a multidimensional analysis of rural settlement patterns under environmental change. The Human-Environment Interaction Theory provides the foundation for exploring adaptive strategies employed by Zimbabwean communities. The Location Theory underpins the investigation of spatial shifts driven by resource availability and ecological conditions, while the Push-Pull Theory contextualises migration patterns, linking environmental stressors to settlement changes. By combining these perspectives, the study constructs a nuanced framework for addressing rural resilience and sustainability challenges in Zimbabwe.

LITERATURE REVIEW

Environmental change and its profound impacts on rural settlement patterns have been the subject of growing academic inquiry. This section synthesises existing research to provide a comprehensive understanding of the relationship between environmental factors, human activities and rural settlements. Key themes explored include the impacts of climate change,

natural hazards, human-induced environmental changes, settlement dynamics and government policy interventions.

Impact of Climate Change on Rural Settlements

Climate change is widely recognised as one of the most critical global challenges affecting rural settlement patterns. Rising temperatures, erratic precipitation and intensified extreme weather events have led to widespread disruptions in agricultural productivity, water availability and overall ecosystem stability (IPCC, 2018). Huang *et al.* (2024) argue that unpredictable weather patterns undermine traditional agricultural practices, forcing rural communities to alter their land use and settlement structures to adapt to new environmental realities. For instance, extreme droughts in Sub-Saharan Africa have resulted in decreased arable land, prompting communities to migrate to regions with better water resources (Makwala, 2020).

In addition to altering land use, climate change impacts settlement patterns by influencing migration trends. As extreme weather events such as floods and storms increase in frequency, they displace communities from vulnerable areas to safer locations. Xie, Sun and Song (2024) provide empirical evidence on how these climate-induced migrations create both social and environmental challenges, including overcrowding in urban peripheries and strain on limited resources in host regions. While these studies provide critical insights into the ecological impacts of climate change, their narrow focus often excludes interconnected socio-economic factors, such as economic instability and health outcomes (Li and Song, 2022). Bridging this gap requires interdisciplinary research that examines the multifaceted effects of climate change on rural settlements comprehensively.

Natural Hazards and Rural Settlement Patterns

Natural hazards have historically shaped rural settlement patterns by forcing populations to adapt to both immediate and long-term environmental disruptions. Disasters such as floods, droughts, cyclones, volcanic eruptions and wildfires cause large-scale displacement, infrastructure damage and disruptions to livelihoods (Monika, Kirti and Pawaria, 2022). For example, floods in the Zambezi Valley have resulted in widespread destruction of

agricultural fields, driving communities to relocate to higher ground (Meena, 2021).

Beyond immediate disruptions, natural hazards also exert long-term impacts on settlement patterns. Malawani *et al.* (2021) highlight the unique dual nature of volcanic eruptions, where initial displacement due to pyroclastic flows is followed by resettlement encouraged by the enhanced fertility of volcanic soils. In Indonesia, settlements around Mount Sinabung demonstrate how communities rebuild in areas initially deemed hazardous, drawn by the promise of improved agricultural productivity (Global Volcanism Program, 2019). Despite these insights, existing literature often fails to address the sustainability of such resettlements, particularly in regions where recurring disasters are likely. Future research should focus on developing adaptive frameworks that prioritise resilience and long-term viability in disaster-prone areas (Marshall *et al.*, 2022).

HUMAN-INDUCED ENVIRONMENTAL CHANGES

Human activities, including deforestation, overgrazing and peri-urbanisation, have significantly accelerated environmental degradation, further impacting rural settlement dynamics. In Zimbabwe, deforestation rates have reached critical levels, averaging 327 000 hectares of forest lost annually between 2000 and 2020 (FAO, 2021). This alarming trend has led to soil erosion, reduced agricultural productivity and migration away from degraded areas. Similarly, overgrazing in semi-arid regions has contributed to land degradation and desertification, further displacing vulnerable rural communities (Anyolo, 2010).

Peri-urbanisation, the expansion of urban areas into rural peripheries, poses additional challenges to settlement patterns. Enu-Kwesi (2022) critiques peri-urbanisation for its socio-economic consequences, including displacement, loss of agricultural land and disruption of traditional rural lifestyles. For example, the peri-urban expansion in Harare has forced rural populations to relocate, altering the social fabric of affected communities. While such studies provide valuable insights into human-induced environmental changes, they often overlook the mechanisms through which these changes directly reshape settlement configurations. Detailed analyses that integrate socio-economic,

ecological and cultural dimensions would strengthen understanding and inform targeted interventions (CCMT, 2021; Sahana *et al.*, 2023).

DYNAMIC RURAL SETTLEMENT PATTERNS

Rural settlement patterns exhibit significant dynamism, adapting to both environmental and socio-economic conditions. Common settlement configurations include nucleated (clustered), dispersed and linear patterns, each influenced by specific geographical and resource-related factors. Nucleated settlements are typically found in fertile areas with abundant water resources, where communities cluster around shared infrastructure, such as markets or communal grazing lands. Dispersed settlements, on the other hand, emerge in less fertile regions, where individual homesteads are spread out to optimise resource use (Ambe, Imoke and Oba, 2018).

Figlus and Musiaka (2020) analyse morphological transformations in Poland's rural areas, demonstrating how spatial dynamics evolve in response to changing environmental conditions. Their study highlights the importance of the Graph Theory in understanding the connections between settlement structures and resource distribution. Similarly, Wang and Gao (2020) examine co-evolutionary processes between settlements and river systems, noting how water availability shapes linear settlement layouts. While these studies contribute valuable perspectives, their emphasis on non-African contexts limits their applicability to rural settlements in Zimbabwe. A more localised focus on adaptive strategies employed in nucleated and dispersed settlement patterns would enhance understanding and offer actionable insights for rural resilience (Chen, Sharma and Liu, 2023).

EFFECTIVENESS OF GOVERNMENT POLICIES

Government policies play a pivotal role in mitigating the impacts of environmental change and supporting rural settlements. Zimbabwe's National Climate Policy outlines strategies for promoting climate-resilient agricultural practices, such as conservation agriculture and drought-resistant crops. In regions, like Matabeleland South, these interventions have enabled farmers to maintain agricultural productivity despite erratic rainfall patterns. However, implementation challenges persist, including limited access to funding and technical support which undermine the policy's effectiveness (Ministry of

Environment, Climate, Tourism and Hospitality Industry, 2020). Similarly, the Zimbabwe National Human Settlements Policy (ZNHSP) has facilitated infrastructure development, including roads and sanitation facilities in areas such as Gokwe. These improvements have enhanced the quality of life for rural residents, yet persistent water scarcity and resource limitations remain significant barriers to sustainable development. Critically evaluating the successes and shortcomings of these policies provides valuable insights for refining future interventions and ensuring greater resilience in rural communities (Government of Zimbabwe, 2020; Generis Global Legal Services, 2024).

CAUSALITY AND INTEGRATION

Understanding the causal relationships between environmental changes and rural settlement patterns is essential for developing effective adaptation strategies. For example, deforestation directly leads to soil erosion which diminishes agricultural viability and prompts migration. Conversely, improved access to water resources, such as irrigation systems, attracts settlements and promotes nucleation. Existing literature acknowledges these links but often treats them in isolation, failing to integrate ecological, social and economic dimensions comprehensively. Bridging this gap through interdisciplinary approaches would enable holistic solutions to the challenges faced by rural settlements (World Resources Institute, 2023; Nikou and Luukkonen, 2024).

STUDY DESIGN AND METHODOLOGY

The research employs a qualitative case study approach, supported by desktop studies and internet-based reviews, to examine the impacts of environmental change on rural settlement patterns in Zimbabwe. The methodological framework is designed to provide a comprehensive understanding of settlement dynamics, community resilience and the effectiveness of policy interventions by synthesising multiple data sources. Case study methodology has long been regarded as a powerful tool for examining complex phenomena in specific contexts. Yin (2018) highlights the strength of case studies in providing detailed insights into localised events, allowing researchers to explore how particular environmental factors influence settlement patterns. For this study, three districts, Chimanimani, Lower Muzarabani and Binga,

were selected based on their exposure to distinct environmental challenges. Chimanimani provides insights into the effects of tropical cyclones, while Lower Muzarabani exemplifies adaptations to droughts and floods. Binga highlights the socio-economic consequences of forced resettlement due to infrastructure projects like the Kariba Dam.

To complement the case study approach, desktop research is employed to analyse existing academic literature and policy documents. Johansson (2019) emphasises the value of desktop studies as cost-effective methods for accessing secondary data across diverse sources, offering opportunities for comparative analysis and theoretical refinement. This study utilises peer-reviewed articles, theses and government reports, to identify key trends in rural settlement dynamics. For instance, literature on Cyclone Idai (Kabonga *et al.*, 2021) provides insights into recovery strategies adopted by affected communities.

Internet-based reviews were integral to this methodology, enabling the exploration of government reports, academic articles and case studies hosted on digital platforms. Salmons (2021) discusses the advantages of internet-based research in expanding access to contemporary sources and real-time data. Online resources, including databases and institutional websites, provide valuable information on policy frameworks such as the National Climate Policy and Zimbabwe National Human Settlements Policy and community-level adaptive practices. Moore (2018) adds that desktop and internet-based reviews enhance the researcher's ability to synthesise diverse perspectives and contextualise findings effectively.

Data analysis was conducted using thematic coding to identify patterns in settlement fragmentation, migration trends and resilience strategies. The triangulation of case study findings, desktop research and internet reviews ensured validity and reliability, minimising biases inherent in single-method approaches. Ethical considerations included accurate citation of sources, respect for intellectual property and adherence to institutional guidelines for secondary research. While the combined use of case studies, desktop research and internet reviews provided broad access to relevant information, the

methodology has limitations. For example, the absence of fieldwork may restrict the depth of contextual insights gained from direct observation and participant interaction. Future studies could incorporate mixed-method approaches to complement qualitative findings with quantitative data, enhancing the scope and depth of analysis.

KEY DISCUSSION POINTS

UNDERSTANDING THE COMPLEXITIES OF ENVIRONMENTAL CHANGE

Environmental change is a multifaceted phenomenon driven by both natural processes and human activities. This section delves into these complexities, exploring how each dimension contributes to the transformation of rural settlement patterns.

NATURAL DIMENSIONS

Natural hazards, such as floods, volcanic eruptions, droughts, earthquakes, wildfires and hurricanes, have long played a role in shaping the environment and influencing human settlements. These events can cause immediate and severe disruption to rural areas, resulting in the displacement of populations, destruction of infrastructure and loss of livelihoods.

Climate variability, the natural fluctuations in weather patterns over time, also impacts rural communities by altering agricultural productivity, water availability and ecosystem services. Ecological processes, like soil erosion, sediment deposition and coastal erosion, further contribute to changes in the physical landscape, affecting the suitability of land for habitation and agriculture.

HUMAN DIMENSIONS

Human activities significantly exacerbate environmental change, often accelerating natural processes or introducing entirely new challenges. Urbanisation and peri-urbanisation are key factors, as the expansion of cities into rural peripheries leads to the conversion of agricultural land into urban infrastructure. This encroachment not only displaces rural populations, but also disrupts traditional land use and social structures. Industrialisation and deforestation contribute to environmental degradation through pollution, loss

of biodiversity and changes in land cover. Agricultural practices, particularly those involving intensive farming, pesticide use and water extraction, can lead to soil degradation, water scarcity and reduced agricultural productivity. The degradation of the land leads to desertification which is not inhabitable to people.

Understanding these complexities is essential for developing effective adaptation and mitigation strategies. By recognising the dual influences of natural and human dimensions on environmental change, policy-makers, planners and communities can work together to build resilience and ensure the sustainability of rural settlements.

SHIFTS IN SETTLEMENT PATTERNS OF RURAL AREAS

Rural settlement patterns are dynamic and can undergo significant changes due to environmental factors. In Africa, particularly in Zimbabwe, common settlement patterns include nucleated (clustered), dispersed and linear settlements. Nucleated settlements are typically found in areas with fertile land and access to water sources, where villages cluster around central point's such as marketplaces or communal lands. Dispersed settlements, on the other hand, are spread out in regions with less fertile land or fewer resources, allowing for individual farming. Linear settlements develop along rivers, roads, or ridgelines, where geography dictates the community's layout. Environmental degradation, such as deforestation or soil erosion, can cause nucleated settlements to disperse as previously fertile areas become less suitable for dense habitation. Conversely, the discovery of new resources like water or minerals can attract dispersed communities to cluster around these resources. These shifts highlight the adaptability of rural communities in response to changing environmental conditions, often resulting in new settlement patterns that reflect the altered landscape.

IMPACT ON LIVELIHOODS

The intricate relationship between rural settlement patterns and environmental change is a critical area of study, particularly in regions like Zimbabwe where the livelihoods of rural communities are deeply intertwined with the natural environment. As climate change and other environmental factors continue to

alter the landscape, the traditional ways of life and economic stability of these communities are increasingly under threat. The article explores the multifaceted impacts of environmental change on rural livelihoods, examining how shifts in agricultural productivity, food security, economic stability and migration patterns are reshaping the rural landscape in Zimbabwe.

Impact on Agriculture

Environmental changes, such as erratic rainfall patterns and prolonged droughts, have significantly affected crop yields. For instance, maize, a staple crop in Zimbabwe, is highly sensitive to temperature and precipitation changes, leading to reduced production. Increased temperatures and reduced water availability have also impacted livestock farming. Heat stress and scarcity of water and pasture have led to decreased livestock productivity and increased mortality rates.

Impact of Food Security

The decline in agricultural productivity directly affects food availability. Many rural households rely on subsistence farming and reduced yields mean less food for consumption and sale. In addition, with less food available, the nutritional status of rural communities is compromised. This is particularly concerning for vulnerable groups such as children and the elderly.

Economic Impact

Agriculture is a primary source of income for many rural households. Reduced crop and livestock productivity leads to lower incomes, affecting the overall economic stability of these communities. In addition, the economic strain caused by environmental changes exacerbates poverty levels in rural areas. Households may resort to selling off assets or engaging in less sustainable practices to cope with the financial stress.

Migration and Displacement

As livelihoods become unsustainable, many people migrate to urban areas in search of better opportunities. This migration leads to overcrowding in cities and further strain urban resources. In some cases, extreme weather events such as floods and droughts force communities to relocate, disrupting their

traditional way of life and social structures. These issues are as a result of environmental change in rural communities.

ROLE OF GOVERNMENT POLICIES

Government policies play a pivotal role in shaping rural settlement patterns and livelihoods, especially in the face of environmental change. In Zimbabwe, various policies have been implemented to address the challenges posed by climate change and other environmental factors. These policies aim to promote sustainable development, enhance agricultural productivity and support the resilience of rural communities. This section explores the impact of existing government policies and proposes potential strategies to mitigate the adverse effects of environmental change on rural settlements.

The National Climate Policy outlines strategies for climate change adaptation and mitigation, including promoting climate-resilient agricultural practices and improving water management (Generis Global Legal Services, 2024). Agriculturally, in areas, particularly in regions like Masvingo and Matabeleland South, where erratic rainfall and prolonged droughts have significantly impacted crop yield. Several communities have adopted climate-resilient agricultural practices, such as conservation agriculture and the use of drought-resistant crop varieties in these dry areas (Ministry of Environment, Climate, Tourism and Hospitality Industry, 2020). In addition, in areas like Midlands and Matabeleland North, the policy supports measures to mitigate the effects of heat stress and water scarcity on livestock farming. This includes improving water management and providing resources for sustainable grazing practices (*ibid*.).

The Zimbabwe National Human Settlements Policy (ZNHSP) aims to ensure sustainable provision of housing and social amenities in both rural and urban settlements, considering the adverse effects of climate change that rural settlements should have all the basic services and well-planned housing from the growth points up to remote communal lands. These human settlements should be conscious of climate change issues at the same time having building materials that are standard and resilient to the climate-related disasters (Government of Zimbabwe, 2020). In Gokwe North and South these policies were to be successful through the provision of infrastructure. The policy has

facilitated the development of essential infrastructure, including roads, water supply systems and sanitation facilities. These improvements have enhanced the quality of life for rural residents and supported sustainable settlement patterns (*ibid*.). More so, the Mutawatawa Business Centre in Uzumba Marambapfungwe has been transformed by the construction of modern housing units. This initiative aligns with the ZNHSP's goal of providing sustainable and well-planned settlements.

CASE STUDIES

CASE STUDY 1: CHANGING SETTLEMENT PATTERNS IN CHIMANIMANI DISTRICT DUE TO CYCLONE IDAI

Cyclone Idai struck Chimanimani District in Zimbabwe on March 14, 2019, causing widespread destruction and significant changes in settlement patterns, impacting at least half of the district's population of about 135,000 people. The region's rural settlements, typically characterised by both clustered homesteads due to family ties, and lineage and dispersed settlements influenced by the hilly and mountainous nature of the region, were severely disrupted (Smith *et al* 2022; Green and Thompson 2023). The cyclone resulted in the destruction of numerous homesteads, particularly those clustered together and created new landforms that rendered previously buildable areas uninhabitable (Munsaka *et al.*, 2021). Approximately 14 000 people were displaced and 250 000 people were affected, with the destruction of 35% of schools, 75% of health facilities and 64% of arable land, leading to significant shifts in settlement locations and the spatial organisation of the community (Nyasha., 2023). The cyclone destroyed 59% of vegetation and trees, 59% of sources of water and 58% of grazing land, severely affecting agricultural productivity and food security (*ibid*.). As a result of the destruction and trauma caused by Cyclone Idai, many residents migrated from Chimanimani to other districts (Munsaka *et al.*, 2021). The migration of survivors of Cyclone Idai created more fragmented communities and the destruction of infrastructure and homes has led to smaller, isolated communities rather than cohesive, clustered settlements (Kabonga, Mhembwe and Dziva 2021). Despite various stakeholders, including local communities, international organisations and government agencies, responding to the disaster, challenges such as inaccessibility of certain areas, lack of resources and inadequate coordination, hindered effective disaster response (Munsaka *et al.*, 2021). To address these

challenges and improve resilience, the study recommends strengthening disaster risk management legislation and institutions, enhancing early warning systems, promoting community involvement in disaster preparedness and response, integrating sustainable land use practices and improving infrastructure resilience to mitigate the impact of future disasters (*ibid.*). Cyclone Idai's profound impact on Chimanimani District highlights the need for robust disaster risk management strategies, sustainable development practices and community resilience initiatives to ensure long-term sustainability and adaptation to environmental changes (*ibid.*).

CASE STUDY 2: LOWER MUZARABANI DISTRICT EXPERIENCES

Lower Muzarabani District in Zimbabwe, located in the arid Zambezi Valley, experiences extremely high temperatures. Due to these harsh climatic conditions, most of the community resorts to cattle and goat production, with limited grain production involving mainly small grains. However, ranching alone does not provide a balanced diet. Since the end of 2022, increased rates of El Niño-induced droughts have exacerbated the situation, prompting communities to relocate and construct houses along the Musengezi River. This has led to a linear settlement pattern along the river as people search for livelihoods, particularly in agriculture, to access the limited water available in the Musengezi River. During dry seasons, when the river sometimes dries up, the communities rely on digging the riverbed to access underground water known locally as *mufuku*. Additionally, they benefit when the Silverstroom Dam releases water into the river. As a result, horticulture and subsistence farming are practised along the riverbanks, despite it being classified as stream-bank cultivation. Interviewed communities have expressed that even with humanitarian aid, they continue to work on their gardens along the river because the soil there, enriched by mineral deposits, supports better crop growth. They also depend on *mufuku* and occasional water flow from the Silverstroom Dam for irrigation. These gardens are crucial for their livelihoods, providing food and income to pay for their children's education. However, during the rainy season, these settlements face significant risks from floods and crocodile attacks, leading to human-wildlife conflicts. To mitigate these risks, residents often relocate to their original villages during the rainy season and return to the riverbanks once the rains have ceased and the water

levels have reduced. This cyclical pattern of migration emphasises the challenges of environmental changes and their impact on rural settlement patterns in the Lower Muzarabani District. This case study, extracted from the highlights from the Zambezi Valley Biodiversity Project (2022-2024), highlights the adaptive strategies employed by the communities in response to environmental changes and the ongoing struggle to secure sustainable livelihoods in an increasingly hostile environment.

CASE STUDY 3: RESETTLEMENT AND ADAPTATION IN BINGA DISTRICT

Binga District in Zimbabwe, located along the shores of Lake Kariba, presents another compelling case study of how environmental changes influence rural settlement patterns. The construction of the Kariba Dam in the late 1950s led to the creation of one of the world's largest man-made lakes that significantly altered the landscape and livelihoods of the Tonga people residing in the area. The dam's construction caused the displacement of thousands of families, who were relocated to less fertile and more arid regions away from the river (Scudder, 1962).

The resettled communities faced numerous challenges, including limited access to water, reduced agricultural productivity and the loss of traditional fishing grounds. To adapt to their new environment, the Tonga people employed various strategies to sustain their livelihoods. One notable adaptation was the introduction of irrigation schemes along the Zambezi River to support agricultural activities in the resettlement areas (Pittock *et al.*, 2020). These irrigation projects helped improve crop yields and provided a reliable source of water for farming.

Another adaptation strategy was the development of fish farming projects in the newly formed Lake Kariba. The Tonga people, traditionally reliant on fishing, adapted to the changes by establishing fish cages and engaging in aquaculture to supplement their livelihoods. This adaptation not only provided an alternative source of income, but also helped preserve their cultural ties to fishing (Tizora, 2020). Despite these adaptations, the resettled communities in Binga continue to face challenges such as water scarcity, soil erosion and limited access to markets. The experiences in Binga District highlight the importance of community involvement in planning and implementing

resettlement projects to ensure sustainable development. Additionally, the case emphasises the need for ongoing support and investment in infrastructure, such as irrigation systems and market access, to enhance the resilience of rural communities facing environmental changes.

CONCLUSION AND FUTURE DIRECTION

The article explores the multifaceted impacts of environmental change on rural settlement patterns in Zimbabwe, emphasising the dual influences of natural and human dimensions. The findings indicate that climate change, natural hazards and human activities, such as urbanisation and deforestation, are significantly altering the landscape and livelihoods of rural communities. The case studies of Chimanimani District, Lower Muzarabani District and Binga District illustrate how environmental changes drive shifts in settlement patterns, impact agricultural productivity and challenge the resilience of rural populations. These changes emphasise the critical need for effective adaptation and mitigation strategies that address both the immediate and long-term challenges posed by environmental change. Government policies, such as the National Climate Policy and the Zimbabwe National Human Settlements Policy, have made strides in promoting sustainable development and enhancing community resilience. However, there is still need for more comprehensive and context-specific approaches hich integrate the social, economic and environmental dimensions of rural development.

For the future considerations and perspectives, there are suggested innovative strategies that warrant further action for resilience in rural areas. To address the long-term challenges posed by environmental change on rural settlement patterns, this study proposes several forward-looking actions aimed at enhancing resilience and fostering sustainable development in Zimbabwe's rural communities. These considerations build upon the main findings of the research, emphasising practical recommendations and innovative strategies aligned with the complexities of rural settlements. Firstly, integrating indigenous knowledge systems with modern scientific approaches, presents a powerful pathway for addressing environmental challenges. As evidenced in Muzarabani District, adaptive strategies grounded in traditional practices—such as seasonal riverbank cultivation—have helped communities navigate cyclical drought conditions. Leveraging such indigenous knowledge alongside

climate-resilient technologies, including drought-resistant crops and efficient irrigation systems, can create context-specific solutions that align with the cultural and ecological realities of rural Zimbabwe. Future initiatives should prioritise participatory research to document and preserve these traditional methods, while fostering collaboration between communities and experts to ensure their integration into broader resilience frameworks.

Developing climate-smart villages offers an innovative model for rural resilience. These villages would incorporate renewable energy solutions such as solar and bioenergy systems, alongside water-efficient technologies like rainwater harvesting and advanced irrigation techniques. Pilot projects implemented in diverse ecological zones—such as semi-arid regions like Binga or flood-prone areas like Muzarabani—can provide empirical data on their effectiveness and scalability. Climate-smart villages could also serve as hubs for sustainable agricultural practices, encouraging agroforestry and conservation farming to combat deforestation while enhancing food security.

Engaging rural communities in participatory land-use planning is another critical consideration. As illustrated in Chimanimani District, the displacement caused by Cyclone Idai highlighted gaps in land management practices that failed to account for community priorities and environmental risks. Future land-use strategies must incorporate participatory approaches to ensure development projects align with local needs and aspirations. By involving communities in decision-making processes, policy-makers can foster greater ownership of development initiatives, while promoting sustainable land management practices.

Ecosystem-based adaptation strategies represent a valuable tool for enhancing rural resilience. These strategies focus on preserving and restoring natural ecosystems to support livelihoods and buffer against environmental hazards. For instance, reforestation efforts in degraded areas and wetland restoration projects in flood-prone regions like Muzarabani could mitigate disaster risks, while providing ecosystem services essential for agriculture and water supply. The long-term success of such initiatives depends on integrating them into broader rural development policies and ensuring sustained investment in infrastructure and capacity-building.

Digital tools for disaster preparedness offer promising avenues for improving resilience to climate-related hazards. Early warning systems, mobile applications for disaster response and remote sensing technologies, can enhance risk mitigation in vulnerable areas. However, ensuring equitable access to these technologies remains a significant challenge, particularly in remote rural settings. Future research should focus on evaluating the accessibility and effectiveness of these tools in Zimbabwe's rural contexts, addressing barriers, such as limited connectivity and technical expertise.

Economic diversification programmes are essential for reducing dependence on vulnerable agricultural practices. In Binga District, the introduction of fish farming has demonstrated the potential for alternative livelihoods that align with community skills and traditions. Expanding such programmes to include eco-tourism, artisanal crafts and renewable energy enterprises, could create new economic opportunities, while fostering resilience. Pilot initiatives should be carefully monitored to assess their impact on rural economies and sustainability.

Finally, transboundary resource management offers a collaborative framework for addressing shared environmental challenges. Given Zimbabwe's reliance on regional ecosystems such as the Zambezi River Basin, future research should explore strategies for cooperative resource management involving neighbouring countries. Such frameworks could include agreements on water allocation, joint conservation efforts and knowledge-sharing platforms to mitigate the impacts of environmental change across borders.

REFERENCES

Ambe, B. A., Imoke, M. J. and Oba, D. (2018). Determinants of Rural Settlement Patterns and Impacts on the Environment of Some Settlements of Cross River State, Nigeria. *Journal of Environmental and Tourism Education*, *1*(1), 1-20.

Anyolo, P. (2010). An Analysis of Uukwaluudhi Communal Conservancy: Alleviating Or Advancing Rural Poverty? Master's thesis, University of Namibia. Accessed on January 18, 2025. Available online: http://repository.unam.edu.na.

Brondízio, E. S. and Moran, E. F. (2012). Introduction to Human-Environment Interactions Research. *Springerlink*. Accessed on January 18, 2025. Available online: https://link.springer.com.

Budhwar, S. (2022). Human Settlements and Natural Calamities: Vulnerability and Resilience. *International Journal of Current Research in Emerging Trends*, *12*(3), 45-58.

Centre for Conflict Management and Transformation (CCMT) (2021). *Development-Induced Displacements in Zimbabwe: Learning from Colonial and Post-Colonial Experiences*. Harare: Weaver Press.

Chen, X. M., Sharma, A. and Liu, H. (2023). The Impact of Climate Change on Environmental Sustainability and Human Mortality. *Environments*, *10*(10), 165. https://doi.org/10.3390/environments10100165.

Childs, G., Goldstein, M. C. and Wangdui, P. (2013). Balancing People, Policies and Resources in Rural Tibet. In: *Human-Environment Interactions: Current and Future Directions*, 113-139). Amsterdam: Springerlink.

Church, R. L. and Murray, A. T. (2009). *Business Site Selection, Location Analysis and GIS*. Hoboken, NJ: Wiley.

Demiroğlu İzgi, B. (2024). Layering Analysis of Typo Morphology Dynamics in Rural Settlements Using the AHP Method. *ICONARP International Journal of Architecture and Planning*, *12*(1), 162-188. https://doi.org/10.15320/iconarp.2024.280.

Enu-Kwesi, F. (2022). A Review of the Impact of Climate Change on Human Health and Well-being. *Journal of Environmental Health and Preventive Medicine*, *6*(3), 45-58.

Figlus, T and Musiaka, Ł. (2020). Morphological Changes in Rural Settlements in the Łódź Metropolitan Area: A Graph Theory Approach. *Journal of Rural Studies*, *75*, 100-113.

Gao, W., Lyu, W. and Liu, B. (2023). Integrating System Spatial Archetypes and Archetypical Evolutionary Patterns of Human Settlements: Towards Place-based Sustainable Development. *Land*, *12*(12), 2164. https://doi.org/10.3390/land12122164.

Generis Global Legal Services. (2024). Climate Change Initiatives in Zimbabwe: Government Policies and Future Directions. Accessed on January 18, 2025. Available online: https://www.generis.com/resources.

Global Volcanism Program (2019). Report on Sinabung (Indonesia) *Bulletin of the Global Volcanism Network*, *44*(8). Smithsonian Institution. https://doi.org/10.5479/si.gvp.bgvn201908-261080.

Government of Zimbabwe (2020). *Zimbabwe* National Human Settlements Policy (ZNHSP). Ministry of National Housing and Social Amenities. Accessed on January 18, 2025. Available online: http://www.gov.zw/national-human-settlements-policy.

Green, T. and Thompson, H. (2023). Topography and Rural Settlement Patterns. *Geographical Review*, *35*(2), 150-165.

Huang, Y. *et al.* (2024). Global Research Progress on Rural Settlement Spatial Patterns from 2000-2024: A Comprehensive Review of Hotspots, Frontiersand Emerging Trends. *Frontiers in Earth Science*. Accessed on January 18, 2025. Available online: https://www.frontiersin.org/articles.

IEEP (2022). Environmental Threats to Rural Areas. *IEEP AISBL*. Accessed on January 18, 2025. Available online: https://www.ieep.eu.

Imbamba, S. K. (2022). Land Degradation and Human Vulnerability in the Drylands of Northern Namibia. *Environmental Impact Studies*. Accessed on January 18, 2025. Available Online: Https://Repository .Example.Edu.

Intergovernmental Panel on Climate Change (IPCC) (2023). *Climate Change 2023: Impacts, Adaptation and Vulnerability*. Cambridge University Press. Accessed on January 18, 2025. Available online: https://www.ipcc.ch/report/ar6.

Johansson, R. (2019). Case Study Methodology and Desktop Research. *New Teaching Resources for Management in A Globalised World*. Accessed on April 18, 2025. Available online: academia.edu.

Juraev, Z. (2023). Review on "Location Theory" - from Classic to Modern Perspectives. *Zenodo*. Accessed on January 18, 2025. Available online: https://zenodo.org/record.

Kabonga, I., Mhembwe, S and Dziva, C. (2021). The Reconstruction of Livelihoods by Survivors of Cyclone Idai in the Chimanimani District of Zimbabwe. In: Nhamo, G. and Chikodzi, D. (eds.).. *Cyclones in Southern Africa: Volume 3: Implications for the Sustainable Development Goals*, 143-156). Amsterdam: Springer. https://doi.org/10.1007/978-3-030-74303-1_10.

Li, J. and Song, W. (2022). Review of Rural Settlement Research Based on Bibliometric Analysis. *Frontiers in Environmental Science*. Accessed on January 18, 2025. Available online: https://www.frontiersin.org.

Liu, P., Zeng, C. and Liu, R. (2023). Environmental Adaptation of Traditional Chinese Settlement Patterns and Its Landscape Gene Mapping. *Habitat International*. https://doi.org/10.1016/j.habitatint.2023.102808.

Mabila, T. (2020). Disaster Response Strategies for Sustainable Development in Zimbabwe's Rural-Urban Settlements. *Technium Social Sciences Journal*, *17*(1), 45-58.

Makwala, N. S. (2020). *Perceptions of Rural Communities on Climate Change and Its Economic Impact*. University of Limpopo. Accessed on January 18, 2025. Available online: http://ulspace.ul.ac.za.

Meena, M. L. (2021). Natural Hazards and Rural Settlement Patterns: A Case Study of Southern Zimbabwe. *Journal of Emerging Trends in Educational Research and Policy Studies*, *14*(2), 123-135.

Ministry of Environment, Climate, Tourism and Hospitality Industry (2020). Background Report on National Policy Priorities, Initiatives and Institutions Relevant for Climate Change Capacity Development in Zimbabwe. Accessed on January 18, 2025. Available online: http://www.climatechange.gov.zw.

Mohamed, M.-A. and Abdul-Talib, A.-N. (2020). Push-Pull Factors Influencing International Return Migration Intentions: A Systematic Literature Review. *Journal of Enterprising Communities: People and Places in the Global Economy*, *14*(2), 231-246.

Monika, K., Kirti, M. and Pawaria, P. (2022). Human Settlements and Natural Calamities: Vulnerability and Resilience. *International Journal of Current Research in Emerging Trends*, *12*(3), 45-58.

Moore, N. (2018). Desk Research and Literature Reviews: Principles and Practices. In: Moore, N. (ed.).. *How to Do Research: A Practical Guide to Designing and Managing Research Projects*, 106-114). Cambridge: Cambridge University Press. Accessed on April 18, 2025. Available Online: Cambridge Core.

Moran, E. F. and Brondízio, E. S. (2013). *Human-Environment Interactions: Current and Future Directions*. Amsterdam: Springerlink. Accessed on January 18, 2025. Available online: https://link.springer.com.

Munsaka, E. *et al.* (2021). When Disaster Risk Management Systems Fail: The Case of Cyclone Idai in Chimanimani District, Zimbabwe. *International Journal of Disaster Risk Science*, *12*, 689-699. https://doi.org/10.1007/S13753-021-00370-6.

Nagendra, H. *et al.* (2022). Peopled Parks: Forest Change in India's Protected Landscapes. In: Brondízio, E.S. and Moran, E.F. (eds.).. *Human-Environment Interactions: Current and Future Directions*, 113-139. Amsterdam: Springerlink. https://doi.org/10.1007/978-3-030-74303-1_10.

Nikou, S. and Luukkonen, M. (2024). The Push-Pull Factor Model and Its Implications for the Retention of International Students in the Host Country. *Higher Education, Skills and Work-Based Learning*, *14*(1), 76-94.

Nyasha, F. (2023). An Assessment of Stakeholder's Disaster Response (Relief Strategies) in Zimbabwe: A Case of 2019 Cyclone Idai, Chimanimani District. Unpublished Phd dissertation, University of Zimbabwe.

Pittock, J., Bjornlund, H. and Van Rooyen, A. (2020). Transforming Failing Smallholder Irrigation Schemes in Africa: A Theory of Change. *International Journal of Water Resources Development*, *36*(Sup1), S1-S19. https://doi.org/10.1080/07900627.2020.1819776.

Rashid, M.H.A. (2024). A Guide for Conducting Academic Research Using the Internet. *Research Methodology*. Accessed on April 18, 2025. Available Online: https://limbd.org/a-guide-for-conducting-academic-research-using-the-internet/.

Ravenstein, E.G. (1885). The Laws of Migration. *Journal of the Statistical Society of London*, *48*(2), 167-227 .

Salmons, J. (2021). Internet-based Research Methods: A Practical Guide. *Sage Research Methods Community*. Accessed on April 18, 2025. Available online: https://oro.open.ac.uk/9653/Scudder, T. (1962). The Kariba Case Study. California Institute of Technology. Accessed on January 18, 2025. Available online: https://resolver.caltech.edu.

Smith, J. *et al.* (2022). Family Ties and Rural Settlement Patterns. *Journal of Rural Studies*, *35*(1), 45-58. https://doi.org/10.1016/j.jrurstud.2022.06.001.

UNCCD (2021). Desertification and Land Degradation and their Impact on Natural Ecosystems and Food Security. *United Nations Convention to Combat Desertification*. Accessed on January 18, 2025. Available online: https://www.unccd.int.

Wang, J. and Gao, J. (2020). Settlement-River Relationship and the Co-Evolutionary Processes in Rural Settlements. *Environment and Planning A: Economy and Space*, *52*(6), 1222-1237. https://doi.org/10.1177/0308518x19898062.

Welford, M. R. and Yarbrough, R. A. (2021). Human-Environment Interactions: An Introduction. Amsterdam: Springer. Accessed on January 18, 2025. Available online: https://link.springer.com/book.

World Resources Institute (2023). Climate Change and Human Health: Risks and Responses. *WRI Report*. Accessed on January 18, 2025. Available online: https://www.wri.org/publications.

Xie, H., Sun, Q. and Song, W. (2024). Exploring the Ecological Effects of Rural Land Use Changes: A Bibliometric Overview. *Land*, *13*(3), 303. https://doi.org/10.3390/land13030303.

Yin, R.K. (2018). *Case Study Research and Applications: Design and Methods* (6th Ed.). London: Sage Publications.