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Research Articles

Beyond Climate Finance Dependency: Local Innovation and Self-Reliant Pathways to Climate Resilience in Rwanda and Mozambique

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Abstract

Net-zero transitions are commonly framed through national pledges, technological pathways, and climate finance commitments, yet less attention has been given to locally grounded strategies emerging in resource-constrained settings. This paper examines how climate resilience can be advanced through self-reliant and community-embedded approaches in two African case studies: Rwanda and Mozambique. It compares Rwanda's forest and wetland restoration policies and urban nature-based adaptation initiatives with Mozambique's mangrove restoration, community carbon projects, and agroforestry-based regeneration efforts. Drawing on secondary literature, policy documents, and climate project evaluations, the paper argues that these cases reveal under-recognised forms of mitigation and adaptation rooted in indigenous knowledge, institutional innovation, and collective organisation.

At the same time, the paper analyses the dependency paradox that structures these transitions. Although the international climate regime is formally guided by the principle of Common But Differentiated Responsibilities (CBDR), support from developed countries has frequently been delayed, insufficient, or delivered through mechanisms that generate new forms of vulnerability. The comparison identifies key enabling conditions for self-reliant climate action, including customary tenure arrangements, decentralised governance, community trusts, local finance, and nature-based solutions, while also highlighting persistent constraints related to scaling,

monitoring and verification, benefit-sharing, and external dependence on donor finance and carbon markets.

The paper contends that climate justice should be understood not only in distributive terms, as a matter of financial transfer, but also in relation al and institutional terms, as recognition of local agency, indigenous innovation, and the right to self-determined development. In doing so, it advances a more grounded account of net-zero transition in the Global South: one that values context-specific resilience-building while remaining attentive to the limits of replication and scale.

Keywords climate resilience, climate justice, self-reliance, indigenous innovation, Rwanda, Mozambique, Global South.

Introduction

As climate change has become a defining policy challenge, countries across the world have made net-zero commitments with varying levels of ambition and implementation. Bhutan is frequently presented as a prominent example of carbon negativity (Tzung, 2022), with international recognition for sequestering approximately nine million tonnes of carbon annually while emitting only two million tonnes. Its constitutional requirement to maintain 60 per cent forest cover reinforces this position (GVI, 2022). By contrast, less attention has been given to emerging models across Africa, where countries facing severe financial and technological constraints are developing localised, resource-efficient strategies that move them toward lower-emission and more climate-resilient pathways. Examining these experiences is especially important in light of persistent gaps in international climate support.

This paper examines these under-researched models through case studies of Rwanda and Mozambique. From Rwanda's urban nature-based adaptation initiatives to Mozambique's community carbon projects, the analysis shows how communities draw on indigenous knowledge, institutional innovation, and collective organisation to pursue climate resilience under constrained conditions. At the same time, the paper acknowledges the fragility of these models, as many communities continue to rely on the CBDR framework while confronting support that is often delayed, partial, or insufficient.

The paper therefore adopts a pragmatic approach that gives climate justice conceptual space to incorporate indigenous innovation and local agency. In doing so, it argues for a more sustainable pathway through which the Global South can pursue climate resilience and net-zero transitions.

Legal Framework

The legal principles guiding this discussion are drawn from Sands (2003). The "Principle 21/2 paradigm," reflected in Stockholm Principle 21 (1972) and Rio Principle 2 (1992), sets out the tension between sovereignty and responsibility. On the one hand, states retain the sovereign right to exploit their own resources in accordance with their environmental and developmental policies. On the other hand, they are responsible for ensuring that activities within their jurisdiction do not cause transboundary environmental harm.

A central pillar of this paper is the uneven implementation of the CBDR (Common But Differentiated Responsibilities) principle, crystallised in Rio Principle 7, which recognises the shared responsibility of all states to protect global environmental resources while accounting for historical contributions, differing capabilities, and the special circumstances of developing countries (Hey, n.d.). In practice, this differentiation has been reflected in measures such as longer implementation timelines, technology-transfer provisions, and financial mechanisms including the Global Environment Facility. Yet the principle becomes more complex in application. As Sands (2003) notes, the 2011 ITLOS Advisory Opinion warned against "sponsoring states of convenience" and sought to prevent developing countries from becoming regulatory havens. This concern connects the discussion to sustainable development, which the Brundtland Commission framed around intergenerational equity, sustainable use, intragenerational equity, and integration. Within this broader legal framework, the precautionary approach under Rio Principle 15 supports proactive climate action even when global consensus or support remains incomplete. The UNFCCC-Kyoto-Paris pathway has institutionalised this framework, but it has also contributed to a structural dependency in which climate action in developing countries is often tied to external finance.

Case Study: Rwanda

Rwanda presents a compelling case of state-driven environmental recovery in contemporary Africa. It is not discussed here as a net-zero country, but as an example of how top-down policy and bottom-up participation can interact in climate governance. Three areas are especially relevant: forests as a national strategy, wetland conservation, and adaptation through nature-based solutions (Collaborative Action For Nature and People and Albertine Rift Conservation Society, 2019). Despite pressures on forest cover linked to population growth and historical instability, Rwanda has developed a notable National Forest Policy (Wfcadmin, 2024). Forest cover increased from 18% in 2010 to 30.4% in 2022 (Wfcadmin, 2024). The policy's distinctiveness lies in its implementation, which has earned international recognition, including

a Gold Future Policy Award. Rwanda is also among the first countries to align with the 30 x 30 biodiversity target under the Kunming-Montreal Global Biodiversity Framework. Agroforestry is especially important within this model because it links tree planting with agricultural production, thereby addressing food security and carbon sequestration together.

Rwanda currently has 708,629 hectares of forest under restoration and has committed under the Bonn Challenge to restore 2 million hectares by 2030. This has contributed to a significant increase in the forest sector's budget, from $1.36 million in 2004 to $4 million in 2019. Within this broader effort, the Bugesera region has undergone extensive greening, the Umutara afforestation plan has expanded, and 600 hectares in the Gishwati area have been restored with indigenous species, leading to the declaration of Gishwati-Mukura as a National Park. Yet these important gains should be assessed alongside larger structural pressures. As Arakwiye, Rogan, and Eastman (2021) show in their study of forest cover in western Rwanda from 1987 to 2019, periods of conflict and policy change underscore the need for sustained and robust implementation to protect globally important biodiversity hotspots.

The robust wetland ecosystem of Rwanda, covering 165,000 hectares, provides critical ecosystem services. The long-standing and well-established importance of wetlands is reflected in the National Policy on Environment (2003), which mandates the rehabilitation of degraded wetland ecosystems while also preserving the endangered species therein. The Rugezi wetland restoration effort, initiated in 2005, is a case in point. It achieved Ramsar site status and earned Rwanda the Green Globe Award, introducing an effective ecosystem rehabilitation methodology that produced the desired outcome.

Despite sustained efforts to mainstream wetlands into national policy, ecological integrity[1] and effective implementation remain ongoing challenges.

The SUNCASA model is another important dimension of the Rwanda case, highlighting the value of urban nature-based solutions (International Institute for Sustainable Development,

n.d.). SUNCASA, which stands for Scaling Urban Nature-Based Solutions, responds to Kigali's climate challenges, including flash floods, landslides, and soil erosion. It is a three-year, $7 million project running through 2026 and is intended to strengthen resilience for 975,000 residents. Working with local partners including ARCOS Network, AVEGA-Agahozo, and Rwanda Water Professionals, SUNCASA seeks to implement gender-responsive nature-based solutions across the Kicukiro, Nyarugenge, and Gasabo districts. Its concrete targets also indicate potential for replication. One of its most notable features is the network of women-led

cooperatives operating eleven nurseries across the city, preparing hundreds of indigenous seedlings while creating green jobs and supporting skills development. The model demonstrates how nature-based solutions can provide cost-effective climate adaptation while also generating employment and restoring urban ecosystems.

Rwanda has positioned itself as an important advocate for a greener development pathway in Africa (Republic of Rwanda, Ministry of Lands and Forestry, 2018). The government has announced an ambitious climate agenda that targets a 38% reduction in greenhouse gas emissions by 2030. Rwanda's broader achievements in climate action and sustainability have also been notable. In March 2024, the country hosted the 38th Green Climate Fund (GCF) Board meeting, underscoring its leadership in climate finance as the first nation to accredit a government institution for direct GCF funding (International Institute for Sustainable Development, 2024).

Case Study: Mozambique

Mozambique contains East Africa's largest mangrove forest system along its nearly 2,000-kilometre coastline. These ecosystems have experienced severe degradation: estimates suggest that around 2,000 hectares disappear each year, and if current trends continue, more than 100,000 hectares of biodiversity-rich mangrove ecosystems could be lost by 2050 (Viridios Capital, 2023), the target year for Mozambique's net-zero goal. The MozBlue project (Removall and Blue Forest partner to finance the largest mangrove reforestation project in Africa, n.d.), developed over three years through collaboration with 300 local communities and 20 partner organisations, represents the largest mangrove restoration initiative in Africa. Phase 1 involves planting 10 million mangrove trees across 1,300 hectares, with the broader aim of restoring 30,000 hectares of tidal wetland habitat by 2030. Located in the Zambezi River Delta, the project has secured 60-year land-use agreements and established legal frameworks intended to support long-term carbon sequestration, with projected mitigation of more than 15 million tonnes of carbon dioxide equivalent over the life of the project.

Importantly, the MozBlue initiative shows that blue carbon projects can combine ecological restoration with community development. Although it was developed by a French company in collaboration with the Mozambican government, its implementation depends substantially on local participation, underscoring the central role of community engagement in the project's success.

The Sofala Community Carbon Project and its successor, Kukumuty, illustrate community-led approaches to forest regeneration and agricultural transformation (Johnson & Ryan, n.d.). Working with rural households in the Mangunde Regulado of Chibabava district, these initiatives aim to restore the Miombo woodlands, the most widespread vegetation type in Sofala province. Two-thirds of the project area is classified as High Conservation Value Forest, underscoring its ecological importance. The project has supported the rehabilitation and management of approximately 10,000 hectares of community forests and benefited nearly 1,700 farmers through improved land-use systems. These systems include homestead planting, dispersed interplanting of Faidherbia and Gliricidia, non-burning of agricultural residues, boundary planting, mango and cashew orchard development, and woodlot creation (Johnson and Ryan, n.d.).

The project employs three ecosystem regeneration strategies built entirely on community knowledge: the Miombo Soil Strategy, utilizing indigenous knowledge of grasses and soil quality to create “soil fertility maps” combined with mulching and swaling; the Miombo Fire Strategy, leveraging community fire knowledge to establish strategic fire breaks; and the Miombo Enrichment Strategy, combining biomass and soil monitoring with targeted planting of native Miombo trees.

This community-led regeneration work has also supported agroforestry nurseries for horticultural and fuelwood species, reducing pressure on natural forests while diversifying household income. The governance structure of the project is especially significant. The Mozambique Carbon Livelihoods Trust (MCLT) manages carbon funds, with part of the revenue directed to community development initiatives such as sustainable sawmills, drip irrigation systems, beekeeping, and livestock rearing. The model also includes contracts between individual producers and the project for each adopted land-use system, creating clearer accountability and a more transparent framework for distributing benefits to participating households (Johnson and Ryan, n.d.; Anwar et al., 2022).

The need for locally tailored solutions, with precision applied at every level of implementation, enables such projects to achieve their desired outcomes.

The Energy Transition Strategy (ETE), approved in 2023, sets a long-term vision for Mozambique to achieve universal, affordable, and reliable access to modern energy by 2030. The International Energy Agency's (IEA) first-ever energy policy review of Mozambique states that the country’s significant energy resources can support government efforts to achieve

universal access to electricity and clean cooking while charting a path to economic development (Mozambique 2024 – Analysis - IEA, 2025).

Lessons from the Case Studies: Optimising Self-Reliance

A central lesson from these case studies is that successful adaptation initiatives are more likely to emerge when governance is decentralised, and communities act as active stakeholders. Localised governance is particularly effective when institutions serve as brokers across both horizontal and vertical dimensions. Horizontally, governance institutions create linkages across villages, enabling collective problem-solving at a larger scale, drawing on traditions of shared decision-making, and opening formal channels for information exchange that support the spread of new technologies and climate awareness. Vertically, communes connect with external actors at national and international levels, increasing the flow of resources and information while linking local strategies to broader climate networks. The SUNCASA model discussed above illustrates this dynamic well. These two dimensions are mutually reinforcing: as horizontal participation becomes stronger, external linkages become more effective, and vice versa.

Across rural Africa, land legislation is often unevenly implemented, and many resource users continue to access land through local tenure systems that combine statutory and customary entitlements, resulting in multiple and overlapping rights over the same resource. Earlier efforts to replace "customary" tenure with "modern" systems have increasingly given way to the recognition that land policies and laws must build on local practices. Several African countries have accordingly adopted legislation that offers greater protection for local land rights.

Indigenous and local knowledge (ILK) systems provide essential climate adaptation strategies across Africa (Dorji et al., 2024). In the agricultural sector, communities use climate-smart crop varieties, adjust planting and harvesting times, practise crop rotation and intercropping, refine cultivation methods, and rely on traditional storage techniques. The success of the MozBlue project similarly depended on community ILK and local initiative in restoring the ecosystem.

A major limitation of indigenous innovation is the difficulty of scaling it beyond its originating context. ILK-based adaptation practices are often hard to replicate because they evolve in response to specific ecological conditions, social structures, and cultural histories. What succeeds in Rwanda's volcanic highlands may not be effective in Ghana's savanna, and

Mozambique's coastal mangrove restoration offers only limited direct lessons for landlocked Sahelian states. Yet this limitation also points to a broader insight: climate adaptation should

not be assessed solely through the lens of universal scalability, but rather by its capacity to support diverse, locally appropriate strategies. The Policy-to-Action (P2A) framework proposed for African decarbonisation emphasises relevance, scalability, and inclusivity by placing African contexts at the centre of policy design. It suggests that context-specific solutions should be developed while still recognising the broader value of principles such as community participation, recognition of customary tenure, decentralised governance, and the integration of indigenous and scientific knowledge.

Barriers to Transition: The Dependency Paradox

The Common But Differentiated Responsibilities (CBDR) principle, formalised in the 1992 UN Framework Convention on Climate Change, recognises that industrialised countries have contributed more to climate change and should therefore bear greater responsibility for mitigation (Hey, n.d.). This principle informed developed countries' commitment to mobilise $100 billion annually in climate finance for low- and middle-income countries. However, the record of delivery has been widely contested. Although donors reported mobilising $83.3 billion in 2020, Oxfam estimated the real value at $24.5 billion because reported figures often include projects with overstated climate objectives and count loans at face value rather than by grant equivalent (Oxfam International, 2024). A further concern is that some donor countries reclassify existing development assistance as climate finance rather than providing new and additional resources, while a large share of funding to poorer countries continues to take the form of repayable loans. Among bilateral providers, France channels 92% of its bilateral public climate finance through loans, Austria 71%, Japan 90%, and Spain 88%. Multilateral development banks show a similar pattern: in 2019-20, 90% of climate finance provided by institutions such as the World Bank was loan-based. This financing structure places additional pressure on countries with low historical responsibility for emissions while limiting their fiscal capacity to invest in resilience. The adaptation finance gap is especially acute. Of the $21-24.5 billion in estimated real value allocated in 2020, only $9.5-11.5 billion was allocated to adaptation. Expectations that private investors would meaningfully close this gap have also not been realised. Private finance amounted to roughly $14 billion annually and was directed primarily toward mitigation. OECD reporting showed a rise in mobilised private adaptation finance from $1.9 billion in 2018 to $4.4 billion in 2020, but this increase was driven largely by a liquefied natural gas project in Mozambique that did not clearly involve adaptation activities, raising questions about reporting practices.

Climate finance flows to Africa totalled $44 billion in 2021/22, representing only 23% of the estimated $277 billion needed annually to meet the continent's 2030 climate goals. This implies that annual flows would need to increase several times over to close the gap. Distribution is also uneven: the top ten countries receive 50% of total climate finance, while the bottom 30 receive only 10%, and private finance is even more concentrated, with 76% flowing to just ten countries. The ten most climate-vulnerable African countries receive only 11% of total flows, illustrating a substantial mismatch between need and allocation. The financing structure compounds this imbalance. Around 80% of adaptation finance is delivered through debt instruments, despite widespread debt vulnerability across the continent, where 21 countries currently face debt distress. This raises serious concerns about whether the present climate finance architecture alleviates vulnerability or reproduces new forms of financial dependence.

Carbon markets may offer a supplementary source of climate investment, and Africa has seen an 11% increase in demand for its credits, raising the continent's share of global project value from 10% in 2021 to 26% in 2023. However, declining prices and persistent concerns about transparency, additionality, verification, and benefit-sharing (Future Earth, 2025) point to significant limitations within current market structures. Mozambique's carbon projects, which direct 50% of revenues to local communities, suggest a potentially promising model, but ensuring transparent and equitable distribution across more than 50 communities and over 40,000 people requires substantial institutional capacity (Future Earth, 2025).

Towards a Practical Paradigm

The prevailing climate finance architecture tends to conceive justice primarily as the transfer of capital from developed to developing countries. Although this framework acknowledges historical responsibility, it can also reinforce dependency and undervalue local innovation. A more viable approach would recognise indigenous innovation, protect local agency, and support self-determined development pathways aligned with community values and ecological realities (Rajul, 2025). Sam Adelman argues that climate justice must provide criteria for determining who owes what to whom, and why (Adelman, 2021). This perspective encompasses environmental, distributive, gender, global, procedural, and reparative dimensions of justice.

Three criteria—historical responsibility, benefit, and ability to pay—provide a coherent basis for CBDR-RC. The wealth accumulated through carbon-based industrialisation creates an obligation for developed countries to transfer financial and other resources to less developed countries for adaptation, mitigation, and loss and damage. However, this framing also risks

reducing complex ecological relationships and community knowledge systems to monetary values. The case studies examined here show that African communities are not passive recipients awaiting financial transfers, but active innovators developing context-specific solutions that are often more sustainable and socially embedded than externally imposed interventions. Rwanda's integration of agroforestry with forest restoration and Mozambique's community-governed carbon trusts illustrate how communities combine traditional knowledge with contemporary techniques to develop hybrid adaptation mechanisms. The SUNCASA model highlights an additional point: international organisations and wealthier states can play a constructive role by supporting such initiatives in ways that help overcome structural constraints rather than deepen dependency.

Conclusion

This paper has shown that climate adaptation and mitigation models emerging from Rwanda and Mozambique offer important evidence of how resource-constrained countries can build resilience through locally grounded strategies. Rwanda's national forest agenda and Mozambique's large-scale wetland and community-based restoration initiatives illustrate that effective climate action can emerge from strong domestic institutions, community participation, and context-specific innovation, even where international support remains limited.

These achievements, however, unfold within a broader context of global inequity. Developed countries' failure to fully deliver the $100 billion climate finance commitment, together with the reliance on debt-based instruments rather than grants, has weakened trust in international climate cooperation. The current architecture often directs the smallest shares of finance to the most vulnerable countries while exposing them to higher capital costs and fiscal risk, thereby reinforcing rather than redressing historical injustice.

The dependency paradox, therefore, remains central: African countries demonstrate substantial capacity for self-reliant innovation while still requiring external support to expand and sustain these efforts. Climate justice should be reconceptualised not as charity, but as recognition of historical responsibility, ecological debt, indigenous innovation, and the right to self-determined development.

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