From Seeds to Systems: Cultivating Climate-Resilient Entrepreneurial Ecosystems for Innovation and Equality by 2050

Asha A G*[1] and Vijay Lakshmy K V[2]

[1,2] Assistant Professor, JAIN (Deemed-to-be University), India

Abstract

The escalating twin crises of climate change and socio-economic inequality demand entrepreneurial ecosystems that move beyond profit-driven logics toward systemic transformation. Yet, existing ecosystem frameworks remain predominantly growth-centric, neglecting justice, inclusivity, and climate resilience. This study addresses this critical gap by proposing a Justice-Centred Ecosystem Framework (JCEF) that reimagines entrepreneurship as a driver of equitable and sustainable futures by 2050. Employing a conceptual synthesis of interdisciplinary literature on entrepreneurship, climate justice, inclusive innovation, and sustainability transitions, the paper identifies six enabling dimensions: decentralized and accessible finance, inclusive policy and regulatory design, integration of indigenous knowledge, climate-adaptive innovation infrastructure, multi-stakeholder collaboration, and capacity building for resilience. The framework illustrates how grassroots, community-driven enterprises ("seeds") can evolve into transformative, scalable systems through supportive and justice-oriented ecosystems. Aligned with global sustainability agendas—including the UN Sustainable Development Goals, Net Zero commitments, and Vision 2050—the model provides actionable pathways for policymakers, ecosystem builders, and development agencies. By advancing a justice-centred architecture of ecosystems, this study contributes a novel theoretical lens and practical blueprint for cultivating climate-resilient entrepreneurship capable of bridging grassroots innovation with systemic change.

Keywords: Climate-resilient entrepreneurship; Justice-centred ecosystem; Inclusive innovation; Sustainability transitions; Social equity

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1. Introduction

The 21st century is shaped by converging crises that demand urgent, systemic responses. Climate change has emerged as an existential threat, with rising global temperatures, biodiversity loss, and extreme weather events disrupting economies, health systems, and livelihoods (IPCC, 2023). These impacts are not evenly distributed. Vulnerable populations in developing and low-income regions face disproportionate risks due to structural inequalities in access to resources, finance, and adaptive infrastructure (UNDP, 2022; World Bank, 2023).

The scale of the challenge is stark. Between 3.3 and 3.6 billion people already live in highly climate-vulnerable regions (IPCC, 2022). Under high-emission scenarios, climate change could push an additional 32–132 million people into extreme poverty by 2030. In 92 developing countries, the poorest 40% of the population experienced climate-related losses 70% greater than those of average-income groups, illustrating how climate shocks amplify pre-existing inequalities.

Simultaneously, widening socio-economic inequality undermines collective progress toward the United Nations Sustainable Development Goals (UNEP, 2022). The World Inequality Report 2022 highlights that the top 1% of the global population has captured 38% of additional wealth since the mid-1990s, while the bottom 50% has secured only 2%. These disparities restrict adaptive capacity, perpetuate exclusion, and intensify vulnerabilities in climate-fragile contexts. Incremental reforms are insufficient. Addressing these intertwined crises requires systemic innovation that reconfigures economic and institutional structures around resilience and justice (World Economic Forum, 2023).

Entrepreneurship has long been recognized as a catalyst for economic growth and innovation (Isenberg, 2011), but its role in advancing climate resilience and social equity remains underexplored. Entrepreneurial ecosystems (EEs) the networks of individuals, enterprises, financial institutions, regulatory systems, and support organizations establish the conditions under which entrepreneurship flourishes (Audretsch & Belitski, 2022). When inclusively designed, ecosystems not only enable new business creation but also influence how ventures respond to broader societal challenges.

Recent trends, however, expose the fragility and exclusionary nature of current ecosystems. Globally, venture capital investment fell to US$248.4 billion in 2023, marking a 42% year-on-year decline and the lowest level in six years. Deal volume also contracted by nearly 30%. Emerging markets were disproportionately affected: in India, funding dropped by 63% in 2023 to just US$7.8 billion, representing less than 3% of global VC flows; in Africa, VC investment declined by 54% during the same period. These contractions severely constrain early-stage and grassroots enterprises, which already struggle to access capital despite their importance in building community resilience and addressing local sustainability challenges.

Traditional entrepreneurship scholarship has emphasized high-growth ventures, competitiveness, and capital accumulation. Yet emerging perspectives argue that ecosystems can and should be designed to embed sustainability, inclusivity, and justice at their core (World Economic Forum, 2023). This requires recognizing grassroots enterprises as “seeds” of systemic transformation, supporting them with enabling structures such as inclusive finance, adaptive innovation infrastructure, and policy frameworks that integrate indigenous and local knowledge. In this way, entrepreneurship can be reframed not only as an economic activity but also as a pathway for social transformation and climate adaptation.

Despite recognition of entrepreneurship’s potential in advancing sustainable development, existing EE frameworks remain growth- and profit-centric. Indicators of ecosystem success are typically tied to venture capital attraction, unicorn creation, firm survival rates, and regional competitiveness (Audretsch & Belitski, 2022). Such metrics neglect dimensions of justice, resilience, and environmental sustainability, thereby reinforcing the very inequalities they aim to mitigate.

Furthermore, empirical studies of EEs disproportionately prioritize advanced economies, leaving blind spots in contexts where climate vulnerability is most acute (UNDP, 2022; World Bank, 2023). In low- and middle-income regions, grassroots enterprises although highly adaptive and locally embedded are often marginalized from mainstream support systems. This constrains their ability to scale and hinders their potential to influence systemic change. The absence of a justice centred, inclusive, and climate-responsive ecosystem model represents a critical research and practice gap.

Objective and Research Question

The study responds to this gap by proposing a Justice-Centred Ecosystem Framework (JCEF) to guide the design of entrepreneurial ecosystems for climate resilience and inclusive innovation by 2050. The central research question is:

How can entrepreneurial ecosystems be reimagined to embed justice, inclusivity, and climate resilience, thereby enabling grassroots enterprises to evolve into systemic innovations by 2050?

The objectives of the study are to:

1. Redefine the purpose of entrepreneurial ecosystems beyond growth, embedding justice and resilience as core objectives.
2. Demonstrate how grassroots enterprises ("seeds") can evolve into scalable, systemic innovations when supported by inclusive and adaptive ecosystems.
3. Provide a forward-looking model aligned with global sustainability agendas such as the UN Sustainable Development Goals, Net Zero commitments, and Vision 2050.

This study makes contributions at three levels:

- Theoretical Contribution: It expands entrepreneurial ecosystem scholarship by introducing the Justice-Centred Ecosystem Framework (JCEF), shifting analysis from growth-centric logics toward justice and resilience as guiding principles.
- Empirical Relevance: It contextualizes the framework using contemporary data on inequality, climate vulnerability, and funding trends, highlighting the urgency of ecosystem redesign.
- Practical Significance: It provides actionable insights for policymakers, development agencies, and ecosystem enablers, including strategies to promote equitable finance, inclusive regulation, adaptive innovation infrastructures, and the integration of indigenous knowledge.

By embedding justice and resilience into ecosystem design, entrepreneurship can be positioned as a cornerstone of systemic sustainability transitions. Cultivating grassroots "seeds" today offers the potential to transform them into resilient and equitable systems by 2050.

2. Literature Review

Entrepreneurship has long been celebrated as a driver of innovation, competitiveness, and economic growth. Yet in the face of climate disruption and widening inequalities, scholars increasingly question whether existing entrepreneurial frameworks adequately address the urgent need for justice, resilience, and inclusivity. This review synthesizes four strands of literature traditional entrepreneurial ecosystems, climate-resilient entrepreneurship, inclusive and justice-centred innovation, and global sustainability agendas to identify critical gaps and lay the foundation for a justice-centred ecosystem framework.

2.1 Entrepreneurial Ecosystems

The concept of entrepreneurial ecosystems (EEs) has become a dominant lens for understanding how entrepreneurship emerges and thrives. Isenberg's (2011) seminal model highlighted six domains finance, markets, culture, human capital, policy, and support systems as foundational pillars. Subsequent contributions (Audretsch & Belitski, 2022) underscored the systemic interdependencies among actors, institutions, and resources, arguing that entrepreneurship is best explained by the collective dynamics of these ecosystems rather than by firm-level factors alone.

The strengths of traditional EE frameworks are significant. They move beyond the "heroic entrepreneur" narrative, highlighting how networks, institutions, and policy environments enable entrepreneurial activity (Stam, 2021). Empirical studies demonstrate that strong ecosystems foster start-up creation, knowledge spill overs, and regional competitiveness, especially in advanced economies with robust infrastructure and governance (Roundy et al., 2022). For policymakers, the EE approach has proven valuable as a diagnostic tool to identify bottlenecks and design interventions.

Yet these models reveal important limitations. First, they remain growth- and profit-centric**,** with success often measured by venture capital inflows, unicorn creation, and firm survival rates (Brown & Mason, 2022). This neglects micro and grassroots enterprises whose contributions to social equity and environmental sustainability may be substantial but less financially visible. Second, the literature is geographically biased toward North America and Europe. The Global South where entrepreneurship is central to livelihoods and where climate risks are most acute remains underrepresented (Mason & Brown, 2021; Mago & van der

Merwe, 2023). Third, most frameworks overlook justice, inclusivity, and resilience**.** Marginalized groups, including women, indigenous peoples, and rural communities, often face systemic barriers to ecosystem resources (George et al., 2021). Finally, resilience to shocks is under-theorized, despite evidence that cohesive and diverse networks are critical for ecosystems to adapt during crises (Spigel & Harrison, 2022).

A bibliometric analysis confirms these shortcomings: between 2004 and 2023, fewer than 120 Scopus-indexed publications explicitly examined sustainable entrepreneurial ecosystems, highlighting the early stage of integration between entrepreneurship, sustainability, and justice (Mago & van der Merwe, 2023). Thus, while EE frameworks provide valuable systemic insights, they inadequately address equity and resilience.

2.2 Climate-Resilient Entrepreneurship

Climate-resilient entrepreneurship is defined as the creation and scaling of ventures that enable communities and systems to anticipate, withstand, and adapt to climate-related shocks while advancing sustainable development (Hallegatte et al., 2020). It differs from traditional entrepreneurship by embedding adaptation, sustainability, and inclusivity into core objectives.

This approach is increasingly vital as climate change intensifies vulnerabilities. The World Bank (2023) estimates that climate change could push 32–132 million people into extreme poverty by 2030, with the harshest impacts in low- and middle-income countries. The UNDP (2022) highlights that communities with access to adaptive enterprises demonstrate greater resilience to environmental stressors, underscoring the significance of entrepreneurship in climate adaptation.

Case evidence illustrates this potential. In India, decentralized solar energy enterprises have expanded rural electrification, reducing fossil fuel dependence and increasing resilience to grid instability. In Kenya, M-Pesa's mobile money system has enabled financial resilience by facilitating remittances and insurance payouts during droughts and floods. In Latin America, agro ecological ventures rooted in indigenous practices have strengthened food security while promoting biodiversity (Agrawal, 2022). These examples show that climate-resilient entrepreneurship contributes to livelihood security, environmental sustainability, and systemic adaptation**.**

Yet major challenges persist. First**,** financing gaps are severe. Less than 5% of global climate finance currently supports adaptation**,** with the majority directed toward mitigation projects in developed economies (UNEP, 2022). Second, many climate-resilient enterprises remain localized and struggle to scale, partly because their embeddedness in specific contexts makes integration into global value chains difficult (Roundy et al., 2022). Third, these ventures often operate at the margins of entrepreneurial ecosystems, excluded from mainstream finance, policy networks, and mentorship structures (Spigel & Harrison, 2022). Finally, governance quality significantly influences outcomes: research shows that in countries with stronger governance, natural disasters exert less suppressive effects on entrepreneurship compared to weaker governance contexts (Springer, 2025).

Thus, while climate-resilient entrepreneurship has demonstrated adaptive potential, systemic barriers constrain its scalability and integration, leaving its transformative role under-realized.

2.3 Inclusive and Justice-Centred Innovation

Parallel scholarship on inclusive and justice-centred innovation stresses that sustainable transformation requires not only technological solutions but also the participation and empowerment of marginalized communities. Inclusive innovation involves co-creating solutions with disadvantaged groups and ensuring equitable access to benefits (George et al., 2021; Sutz, 2022).

Evidence demonstrates the value of indigenous and community-based knowledge systems. For example, indigenous farming practices in Latin America **and** cooperative enterprises in Sub-Saharan Africa have provided scalable models for food security, biodiversity protection, and community resilience (Agrawal, 2022; Smith et al., 2023). These models highlight the context-specific expertise of grassroots actors, which often surpasses external interventions in adaptability and effectiveness.

However, these contributions remain under-integrated into mainstream ecosystems. Institutional and epistemic biases frequently marginalize non-Western knowledge systems, limiting their influence in policy and investment decisions. Moreover, social entrepreneurial ecosystem studies indicate that support structures are perceived as weaker in regions most vulnerable to climate change, suggesting a troubling misalignment between need and ecosystem support (Sustainability, 2024).

Justice-centred perspectives thus call for a reconfiguration of innovation systems to prioritize redistributive outcomes, inclusivity, and recognition of diverse knowledge systems**,** rather than treating entrepreneurship solely as a vehicle for growth.

2.4 Vision 2050

Global agendas reinforce the urgency of reimagining entrepreneurial ecosystems. The UN Sustainable Development Goals (SDGs)**,** the Paris Agreement**,** and the World Economic Forum's Vision 2050 all underscore the need for innovation that is inclusive, climate-responsive, and systemic. The IPCC (2023) warns that the window to limit global warming to 1.5°C is rapidly closing, with escalating risks for vulnerable populations. Similarly, the UNFCCC (2022) highlights the necessity of aligning innovation with adaptation and resilience.

At the same time, entrepreneurship is increasingly positioned as central to the "twin transitions" of digitalization and sustainability (WEF, 2023). National-level evidence illustrates how supportive policies can create favourable conditions: the Global Entrepreneurship Monitor (2025) ranks the UAE first globally in entrepreneurship support, citing strong institutional frameworks, access to finance, and market openness. Yet such examples remain exceptions, and most ecosystems continue to privilege growth-centric outcomes rather than embedding justice and resilience. This mismatch between global aspirations and local ecosystem design underscores the pressing need for new frameworks that bridge ambition and practice.

The reviewed literature reveals several critical insights. Traditional EE frameworks provide valuable systemic perspectives but remain dominated by growth-oriented logics. Climate-resilient entrepreneurship demonstrates potential but is constrained by financing gaps, scalability barriers, and weak ecosystem integration**.** Inclusive innovation scholarship highlights the role of indigenous knowledge and marginalized actors, but these contributions remain under-recognized in formal systems. Finally, while global agendas articulate ambitious visions for 2050, entrepreneurial ecosystems remain poorly aligned with these long-term objectives.

Together, these strands point to a fundamental gap: the absence of an integrated, justice-centred entrepreneurial ecosystem framework that explicitly embeds equity, inclusivity, and resilience as core principles. Addressing this gap provides the rationale for the Justice-Centred Ecosystem Framework (JCEF) advanced in this study.

3. Conceptual Framework: Justice-Centred Entrepreneurial Ecosystem (JCEF)

3.1 Rationale for a New Framework

The synthesis of existing literature reveals that while entrepreneurial ecosystem (EE) models have advanced our understanding of systemic enablers of entrepreneurship, they remain overly firm- and growth-centric**,** often privileging high-growth ventures and advanced economies (Audretsch & Belitski, 2022). These models typically neglect issues of equity, justice, and resilience, despite evidence that entrepreneurship is deeply embedded in social and ecological contexts (George et al., 2021).

At the same time, climate-resilient entrepreneurship and inclusive innovation studies highlight the transformative potential of grassroots and community enterprises in building adaptive capacity. However, such enterprises are systemically marginalized in mainstream ecosystems due to financing gaps, weak institutional support, and policy neglect (UNEP, 2022; World Bank, 2023).

This tension creates a conceptual void: entrepreneurship is recognized as a tool for sustainability transitions, but existing frameworks do not provide systemic guidance on how ecosystems can be designed to centre justice and resilience**.** The Justice-Centred Entrepreneurial Ecosystem Framework (JCEF) is proposed to address this gap. It builds upon the foundations of EE scholarship while reorienting its purpose toward inclusive adaptation, equity, and systemic transformation by 2050**.**

3.2 Theoretical Foundations of the JCEF

The JCEF is anchored in three complementary theoretical perspectives:

1. Systems Theory – Ecosystems are viewed as complex adaptive systems where interactions among actors and institutions create emergent outcomes (Holland, 2014). Embedding justice ensures that these emergent outcomes reduce inequalities rather than exacerbate them.
2. Sustainability Transitions Theory – The framework draws on the multi-level perspective (MLP), which highlights how niche innovations (e.g., grassroots enterprises) can scale to transform regimes under supportive landscape pressures (Geels, 2020).

3. Institutional Theory – Institutions shape "rules of the game." Justice-centred ecosystems require institutional redesign that removes barriers for marginalized groups and aligns policies with global sustainability agendas (Scott, 2014).

These theoretical underpinnings ground the JCEF not only in entrepreneurship studies but also in broader discourses on systemic transformation.

3.3 Core Principles of the JCEF

The JCEF advances four guiding principles:

1. Justice and Equity – Ecosystems must prioritize the inclusion of marginalized groups (women, rural populations, indigenous communities) by ensuring equitable access to finance, markets, and networks (UNDP, 2022).
2. Resilience and Adaptability – Ecosystems must cultivate diversity and redundancy, enabling them to withstand shocks such as climate disasters, pandemics, or geopolitical disruptions (Spigel & Harrison, 2022).
3. Sustainability and Regeneration – Ecosystem activity must operate within planetary boundaries, supporting low-carbon pathways, biodiversity conservation, and regenerative practices (IPCC, 2023).
4. Multi-actor Collaboration – Entrepreneurs, policymakers, finance providers, civil society, and academia must act as **co**-creators of systemic solutions, transcending siloed interventions (WEF, 2023).

3.4 Structural Domains of the JCEF

Building upon traditional EE domains but extending them to embed justice and resilience, the JCEF identifies six structural domains:

1. Inclusive Finance Systems – Expanding climate finance, blended finance, and impact investing. Current flows are inadequate: less than 5% of global climate finance supports adaptation**,** with the majority concentrated in mitigation and in developed economies (UNEP, 2022). The JCEF advocates mechanisms such as green bonds, microfinance, and mobile-enabled financial inclusion to close this gap.
2. Equitable Policy and Governance – Policies must explicitly integrate justice goals**,** addressing systemic discrimination in entrepreneurship. For instance, the World Bank

(2023) notes that women entrepreneurs face $1.7 trillion in financing gaps globally. Decentralized and adaptive governance is vital to align local initiatives with global agendas like the SDGs and Net Zero**.**

3. Knowledge and Capacity Building – The JCEF emphasizes plural knowledge systems, recognizing indigenous knowledge as critical to climate adaptation (Agrawal, 2022). Universities, NGOs, and community organizations must partner to strengthen entrepreneurial capacity that is context-specific and resilience-oriented.
4. Climate-Resilient Infrastructure and Technology – Resilient energy, transport, and digital systems are essential enablers. Digital platforms such as M-Pesa in Kenya show how technology can expand adaptive capacity by enabling faster financial responses to climate shocks.
5. Culture and Social Capital – Entrepreneurial culture must shift from individualistic, high-growth norms to values of collective resilience, solidarity, and justice. Social capital trust, reciprocity, and cooperation emerges as a critical determinant of resilience (Springer, 2025).
6. Markets for Sustainable Solutions – Ecosystems must foster demand for inclusive and sustainable innovations. Mechanisms such as public procurement policies, ethical certifications, and consumer awareness campaigns can amplify market access for grassroots enterprises.

3.5 Pathways of Systemic Transformation

The JCEF conceptualizes ecosystem transformation as **a** three-stage process**:**

- Seeding – Grassroots enterprises, rooted in local knowledge and necessity-driven innovation, emerge to address pressing socio-ecological challenges.
- Nurturing – Ecosystems provide tailored resources (finance, mentorship, policy support) to enable these ventures to consolidate and expand.
- Scaling Systemic Change – Successful grassroots innovations are scaled through policy integration, cross-sectorial partnerships, replication, and diffusion, reshaping markets and institutions to embed justice and resilience.

3.6 Importance and Implications

The JCEF offers contributions on three levels:

- Theoretical – It extends EE scholarship by reframing entrepreneurship as a justice-centred and resilience-driven process**,** integrating insights from systems theory, sustainability transitions, and institutional analysis.
- Empirical – It provides a lens to analyse case evidence across geographies. For example, decentralized solar energy ventures in India, agro ecological enterprises in Latin America, and digital financial platforms in Africa demonstrate how grassroots enterprises act as "seeds" of systemic resilience.
- Practical – It provides policymakers and practitioners with a diagnostic and design framework to evaluate ecosystem justice, resilience, and inclusivity. This includes identifying financing gaps, policy barriers, and opportunities for knowledge integration.

The urgency of this framework is underscored by global imperatives. The IPCC (2023) stresses that adaptation pathways must be inclusive and transformative to avoid deepening inequalities. The UNDP (2022) highlights that adaptation failure is closely tied to systemic inequities. Without a justice-centred approach, entrepreneurship risks reinforcing vulnerabilities rather than alleviating them.

The JCEF thus positions entrepreneurial ecosystems not merely as engines of economic growth but as vehicles for systemic transformation toward just, resilient, and sustainable futures by 2050**.**

4. Justice-Centred Ecosystem Framework (JCEF)

The Justice-Centred Ecosystem Framework (JCEF) operationalizes the principles of equity, resilience, and inclusivity by embedding them into six interdependent dimensions. Each dimension addresses critical shortcomings in traditional entrepreneurial ecosystem models while aligning with global sustainability agendas such as the SDGs, Paris Agreement, and Vision 2050**.**

4.1 Decentralized and Accessible Finance

Conventional financial systems often channel resources toward high-growth ventures, leaving grassroots, women-led, and necessity-driven enterprises severely underfunded. According to the OECD (2023)**,** only 7% of venture capital in the EU went to women-founded companies, while the global financing gap for women entrepreneurs stands at $1.7 trillion (World Bank,

2023). Similarly, Africa despite being home to 17% of the global population receives less than 1% of global VC funding (Partech, 2022).

The JCEF calls for decentralized and accessible finance through mobile money, microfinance, blended finance, community-owned banks, and green bonds. For instance, M-Pesa in Kenya has expanded access to financial services to over 50 million users across Africa, enabling households to better withstand droughts and economic shocks. Such models illustrate how financial inclusion is not merely about credit access but also about building resilience in climate-vulnerable populations.

4.2 Inclusive Policy and Regulatory Design

Policies act as the "rules of the game" in ecosystems. Yet many entrepreneurship policies remain focused on competitiveness, ignoring equity. The Global Entrepreneurship Monitor (GEM, 2023) found that in 59 surveyed economies, regulatory and cultural barriers were cited as the biggest obstacles for women and youth entrepreneurs. Furthermore, informal enterprises account for 60–80% of employment in developing regions (ILO, 2022), yet most ecosystem policies fail to integrate them into formal support systems.

The JCEF emphasizes inclusive and adaptive regulatory frameworks. This means gender-responsive policies, simplified registration for informal entrepreneurs, and subsidies or incentives for climate-resilient ventures. For example, Bangladesh's renewable energy policy, which supported over 4.5 million solar home systems, shows how adaptive policies can both empower local entrepreneurs and accelerate sustainable transitions.

4.3 Integration of Indigenous and Local Knowledge

Indigenous and community knowledge systems are proven drivers of resilience but remain systematically marginalized. The IPBES (2022) highlights that local and indigenous practices are essential to biodiversity protection, yet less than 10% of national adaptation plans explicitly incorporate them.

The JCEF elevates such knowledge to the same level as formal R&D. For example:

- Agro ecological practices in Latin America increase yields by up to 79% under drought conditions while preserving biodiversity.

- Water harvesting techniques in Rajasthan, India, based on centuries-old indigenous systems, have restored groundwater levels and sustained agriculture in arid regions.
- In the Arctic, indigenous reindeer herding practices have informed climate monitoring and adaptation strategies.

Integrating these systems not only diversifies innovation pathways but also ensures cultural legitimacy and local ownership of ecosystem outcomes.

4.4 Climate-Adaptive Innovation Infrastructure

Infrastructure is a cornerstone of entrepreneurship, yet much of the existing infrastructure is climate-vulnerable**.** The World Bank (2021) estimated that climate impacts could cause $1.7 trillion in annual infrastructure lo**sses** by 2050 if resilience is not prioritized.

The JCEF stresses investments in climate-adaptive infrastructure, including renewable micro-grids, resilient logistics, green buildings, and digital platforms. For instance:

- India's decentralized solar micro-grids have expanded electricity access to rural communities while reducing carbon emissions.
- In Fiji, climate-resilient housing programs are creating entrepreneurial opportunities in green construction.
- During the COVID-19 pandemic, digital platforms in Southeast Asia enabled SMEs to shift to e-commerce, cushioning economic shocks. By embedding resilience in infrastructure, ecosystems can reduce vulnerability while unlocking green entrepreneurial opportunities**.**

4.5 Multi-Stakeholder Collaboration

The complexity of sustainability transitions requires ecosystems to function as multi-actor collaborative platforms**.** The World Economic Forum (2023) stresses that achieving net zero will require $3.5 trillion in annual investment, necessitating collaboration across states, private actors, NGOs, and communities.

The JCEF emphasizes that such collaboration must be inclusive and participatory, not top-down. For example:

- In Rwanda, public-private partnerships in agriculture have improved smallholder productivity while reducing post-harvest losses.
- In Costa Rica, collaboration between government, NGOs, and communities enabled the country to achieve nearly 100% renewable energy generation.
- In South Africa, NGO-led entrepreneurship hubs have supported township entrepreneurs excluded from formal networks.

4.6 Capacity Building for Resilience and Equity

Capacity building is central to embedding justice in ecosystems. Yet the UNESCO Global Education Report (2022) found that only 5% of entrepreneurship education programs worldwide explicitly integrate sustainability or climate resilience. Similarly, digital divides persist: in Sub-Saharan Africa, 37% fewer women than men use mobile internet (GSMA, 2023), limiting their participation in digital entrepreneurship.

The JCEF therefore emphasizes multi-level capacity building:

- Individual capacity (technical skills, digital literacy, adaptive entrepreneurship).
- Institutional capacity (data systems, climate monitoring, inclusive policymaking).
- Community capacity (networks of trust, social capital, and local leadership).

For example, the Philippines' Community-Based Disaster Risk Reduction programs integrate local leadership training with entrepreneurship, enabling communities to recover faster from typhoons. Such initiatives illustrate how resilience is both a technical and a social capability.

Figure 1: Justice-Centred Ecosystem Framework (JCEF)

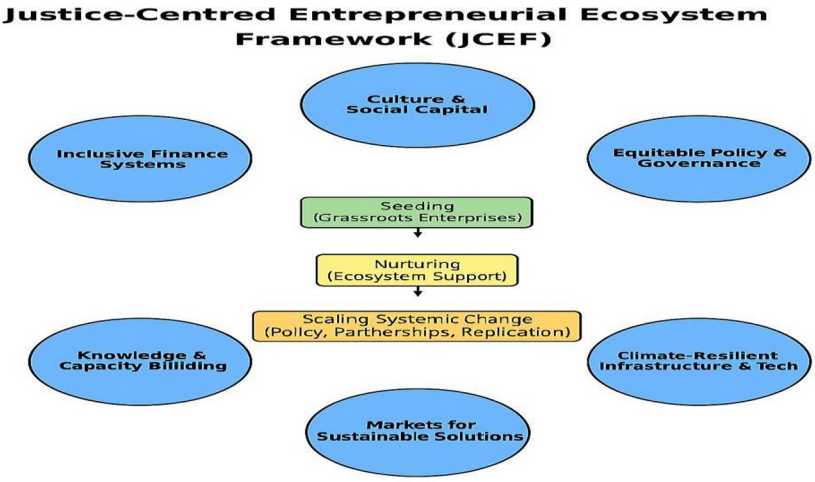


Figure 1. Justice-Centred Entrepreneurial Ecosystem Framework (CEF): Six structural domains interact with transformation pathways (Seeding → Nurturing → Scaling), embedding justice, inclusivity and resilience into entrepreneurial

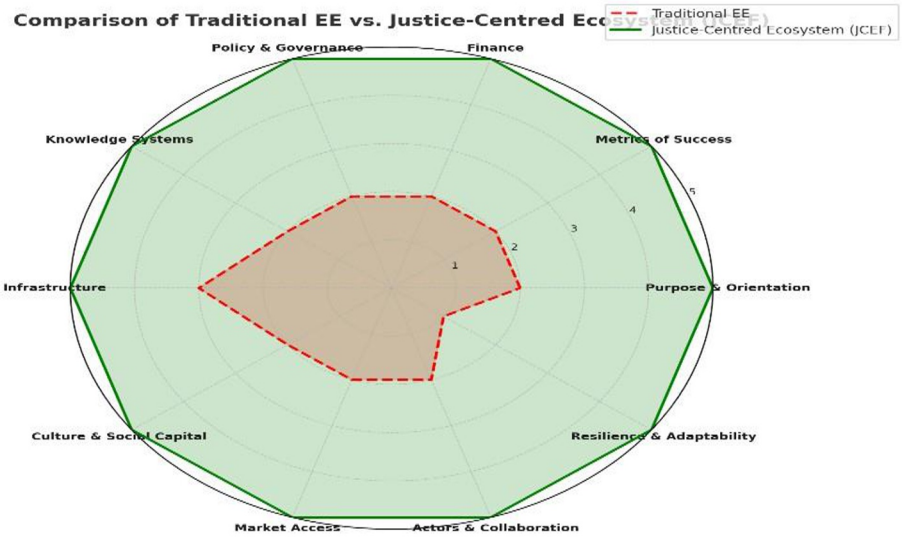
Together, these six dimensions constitute the Justice-Centred Ecosystem Framework (JCEF). Unlike traditional entrepreneurial ecosystem models, which prioritize growth and competitiveness, the JCEF explicitly foregrounds justice, inclusivity, and resilience as systemic outcomes. By decentralizing finance, embedding inclusive policies, valorising indigenous knowledge, investing in adaptive infrastructure, fostering multi-actor collaboration, and strengthening capacity, the JCEF provides a roadmap for entrepreneurial ecosystems to evolve as vehicles of systemic transformation by 2050

Table 1. Comparison of Traditional Entrepreneurial Ecosystems and the Justice-Centred Ecosystem Framework (JCEF)

Dimension	Traditional EE Models	Justice-Centred Ecosystem Framework (JCEF)
Purpose & Orientation	Growth-centric, focused on firm creation, venture capital, and regional competitiveness (Isenberg, 2011; Audretsch & Belitski, 2022).	Justice- and resilience-centred, embedding equity, inclusivity, and climate adaptation as core objectives.
Metrics of Success	Unicorn creation, venture funding, firm survival rates, regional GDP growth.	Equity of access, resilience capacity, inclusion of marginalized groups, contribution to SDGs, Net Zero, and Vision 2050.
Finance	Venture capital, private equity, bank loans; biased toward high-growth ventures.	Decentralized and accessible finance (microfinance, blended finance, mobile money, green bonds) enabling grassroots and women entrepreneurs.
Policy & Governance	Policy support geared toward competitiveness and regulatory efficiency.	Inclusive, adaptive, and equity-driven policy frameworks addressing systemic barriers (gender, rural, indigenous participation).
Knowledge Systems	Emphasis on formal education, R&D, and technology transfer.	Integration of indigenous and local knowledge alongside formal R&D, strengthening context-specific adaptation.
Infrastructure	Focus on industrial, digital, and logistical infrastructure to accelerate growth.	Climate-adaptive infrastructure (renewable energy, resilient housing, decentralized systems) that reduces vulnerability and creates green opportunities.
Culture & Social Capital	Entrepreneurial culture emphasizing risk-taking, competitiveness, and individual success.	Community-oriented culture emphasizing solidarity, collective resilience, and justice-driven innovation.
Market Access	Prioritizes integration into global value chains, high-growth sectors.	Builds inclusive markets for sustainable and justice-oriented products through procurement policies, certifications, and awareness campaigns.

Dimension	Traditional EE Models	Justice-Centred Ecosystem Framework (JCEF)
Actors & Collaboration	Entrepreneurs, investors, policymakers, universities — often siloed.	Multi-stakeholder collaboration involving state, private sector, NGOs, and communities in co-creation and governance.
Resilience & Adaptability	Resilience is rarely an explicit focus; ecosystems vulnerable to systemic shocks.	Explicitly designed for resilience, diversity, redundancy, and adaptability to climate and economic shocks.

Figure 2. Comparison of Traditional Entrepreneurial Ecosystems (EE) and the Justice-Centred Ecosystem Framework (JCEF).



JCEF across ten dimensions. Traditional frameworks (red, dashed) remain largely growth-oriented, privileging firm survival, venture capital attraction, and competitiveness, with limited attention to equity, inclusivity, and resilience. By contrast, the JCEF (green, solid) embeds justice, resilience, and sustainability into each dimension, including finance, policy, knowledge integration, and market access.

This visual comparison highlights the novel contribution of the JCEF: while traditional ecosystems provide valuable insights into systemic enablers of entrepreneurship, they are

insufficient for addressing climate risk and structural inequality. The JCEF advances a comprehensive model that aligns entrepreneurship with the SDGs, Net Zero targets, and Vision 2050**,** ensuring ecosystems function as vehicles for systemic transformation rather than solely engines of growth**.**

Figure 3. Seeds-to-Systems Transformation Pathway within the Justice-Centred Ecosystem Framework (JCEF).

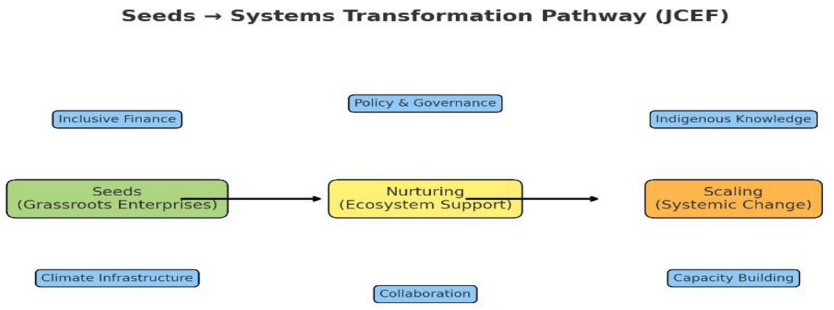


Figure 3. Seeds-to-Systems Transformation Pathway within the Justice-Centred Ecosystem Framework (JCEF): Grassroots enterprises ('seeds') are nurtured through inclusive finance, policy, indigenous knowledge, adaptive infrastructure, collaboration, and capacity building, ultimately scaling into systemic innovations that drive justice and resilience.

The pathway illustrates how grassroots enterprises "seeds" can evolve into scalable, systemic innovations when embedded in a justice-centred entrepreneurial ecosystem. At the initial stage, local enterprises emerge from community needs, indigenous knowledge, and necessity-driven innovation. Through nurturing processes including inclusive finance, supportive policies, capacity building, multi-stakeholder collaboration, and climate-adaptive infrastructure these seeds gain stability, legitimacy, and access to resources.

The final stage, scaling systemic change, occurs when successful grassroots innovations diffuse beyond their local origins to reshape markets, policies, and institutional practices. This transition transforms isolated entrepreneurial activities into structural drivers of justice, resilience, and sustainability. By explicitly mapping this seeds :systems progression, the JCEF underscores that entrepreneurship is not simply about firm growth but about cultivating pathways of systemic transformation aligned with the SDGs, Net Zero commitments, and Vision 2050**.**

5. Discussion

5.1 Differentiating the JCEF from Existing Frameworks

The Justice-Centred Ecosystem Framework (JCEF) diverges significantly from established entrepreneurial ecosystem (EE) models in both orientation and scope. Conventional EE frameworks, beginning with Isenberg's (2011) foundational model, were designed to accelerate firm creation, venture capital attraction, and regional competitiveness. Subsequent studies reinforced these growth-centric logics, emphasizing metrics such as startup density, unicorn creation, and GDP contributions (Audretsch & Belitski, 2022; Spigel, 2017). While these frameworks have advanced understanding of systemic enablers of entrepreneurship, they have been criticized for three limitations:

1. Profit-orientation – privileging firms with high-growth potential while marginalizing necessity-driven and community-based entrepreneurs.
2. Geographic bias – focusing heavily on ecosystems in North America and Europe, while under-theorizing the realities of the Global South (Mason & Brown, 2021).
3. Neglect of justice and resilience – overlooking how ecosystems reproduce inequalities and remain vulnerable to systemic shocks (George et al., 2021).

The JCEF addresses these gaps by embedding justice, inclusivity, and climate adaptation into ecosystem design. Unlike traditional frameworks, it treats entrepreneurship not only as an economic activity but as a vehicle for systemic transformation. Justice-centred principles reorient ecosystem priorities toward equity of access, resilience-building, and the integration of indigenous knowledge. This reframing aligns entrepreneurship research with global sustainability transitions and positions the JCEF as a conceptual advance that responds directly to calls for inclusive, climate-responsive models (World Economic Forum, 2023; UNDP, 2022).

5.2 Pathways for Scaling Grassroots Climate Enterprises

A central innovation of the JCEF is the seeds: systems transformation pathway, which conceptualizes how grassroots enterprises often necessity-driven and locally embedded can evolve into system-level innovations when supported by inclusive ecosystems. Grassroots enterprises are particularly critical in climate-vulnerable regions, where they provide locally

adapted solutions such as solar micro grids, drought-resistant agriculture, and community based health innovations. However, their impact is often constrained by exclusion from mainstream finance, weak institutional support, and lack of policy recognition.

The JCEF identifies three mutually reinforcing pathways to enable scaling:

1. Financial Scaling

   Inclusive finance mechanisms are vital for bridging the climate adaptation financing gap, which accounts for less than 5% of global climate finance flows (UNEP, 2022). Traditional venture capital is heavily biased toward technology hubs and elite entrepreneurs, with less than 2% of VC funding in 2023 reaching Africa and a 63% decline in India's startup funding (PitchBook, 2023). The JCEF advocates for blended finance, micro-insurance, green bonds, and mobile money platforms that extend capital access to grassroots actors. Kenya's M-Pesa exemplifies this potential, transforming mobile-based microfinance into a continental financial infrastructure that has enhanced household resilience to climate and economic shocks.

2. Policy Scaling

   Grassroots innovations must be integrated into formal development strategies through adaptive and inclusive regulation. Bangladesh's Solar Home System program, which scaled decentralized renewable energy to over 4.5 million households, illustrates how policy frameworks can elevate local solutions to national impact. By embedding grassroots ventures into broader climate adaptation and energy transition policies, the JCEF ensures that such innovations move from the periphery to the mainstream.

3. Social Scaling

   Beyond finance and policy, diffusion of grassroots models depends on replication and knowledge sharing through community networks and global partnerships. For example, agro ecological farming practices in Latin America, rooted in indigenous traditions, have spread regionally through peasant farmer associations and knowledge exchanges**,** amplifying their systemic impact on food security and biodiversity resilience. The JCEF formalizes such processes by positioning social capital and community networks as critical ecosystem assets for scaling. Together, these pathways redefine scaling not as

firm expansion**,** but as the process of transforming systems, institutions, and markets to enable resilience at scale.

5.3 Implications for Innovation, Equality, and Resilience

The JCEF advances three interconnected implications:

- Innovation: Conventional EE models equate innovation with high-technology and formal R&D. In contrast, the JCEF acknowledges indigenous knowledge, frugal innovation, and necessity-driven entrepreneurship as legitimate sources of creativity (Agrawal, 2022; IPBES, 2022). For example, low-cost water purification devices in rural India or indigenous climate adaptation strategies in the Pacific Islands represent critical innovations overlooked by mainstream ecosystems. By broadening the definition of innovation, the JCEF strengthens entrepreneurial inclusivity and relevance.
- Equality: The JCEF reorients ecosystems to dismantle barriers faced by women, rural entrepreneurs, and marginalized groups. Women entrepreneurs in developing countries face a $1.7 trillion financing gap globally (World Bank, 2023). Informal sector entrepreneurs, who contribute up to 40% of GDP in sub-Saharan Africa, remain excluded from policy support. By institutionalizing inclusivity, the JCEF ensures that entrepreneurial opportunities are equitably distributed, addressing systemic inequalities that conventional ecosystems perpetuate.
- Resilience: Traditional EE frameworks rarely conceptualize resilience as an outcome. The JCEF explicitly integrates diversity, redundancy, and adaptive capacity as ecosystem goals. This reflects resilience thinking in sustainability science, where systems capable of absorbing shocks and reorganizing are more sustainable in the long term (Folke et al., 2016). By embedding resilience, the JCEF positions ecosystems as buffers against climate disasters, pandemics, and financial crises, making them not only engines of growth but also societal safety nets.

5.4 Global South Perspective: Contextualizing Ecosystems in Vulnerable Regions

The Global South is home to over 3.3 billion people living in high climate-risk contexts (IPCC, 2023). Yet, most EE literature continues to privilege advanced economies, rendering its models ill-suited to contexts characterized by informality, institutional voids, and resource constraints

(Mason & Brown, 2021). The JCEF directly responds to this imbalance by embedding mechanisms that reflect Global South realities:

- Decentralized finance (e.g., M-Pesa, mobile micro-insurance in Ghana) enables households and small firms to adapt to shocks without reliance on traditional banking.
- Indigenous knowledge systems (e.g., Andean terracing, Pacific Island early-warning systems) provide time-tested adaptive strategies overlooked by technology-driven models.
- Community-driven innovation (e.g., disaster preparedness cooperatives in the Philippines) demonstrates how local entrepreneurship accelerates recovery after climate shocks.

By foregrounding these dimensions, the JCEF offers a context-sensitive model that ensures ecosystems serve not only elite entrepreneurs but also the most vulnerable communities, thereby correcting the Northern bias of existing scholarship.

5.5 Vision 2050 Alignment: Future Trajectories and Scenarios

Looking forward, the JCEF aligns with the UN Sustainable Development Goals (SDGs)**,** the Paris Agreement on climate change**,** and the World Business Council for Sustainable Development's Vision 2050. These global agendas converge on the principle that achieving net-zero emissions and equitable development by mid-century requires systemic innovation. The JCEF situates entrepreneurship as a transformative system-builder within this trajectory.

Two scenarios are possible by 2050:

- Business-as-usual ecosystems: Entrepreneurship remains growth-centric, privileging elite ventures while deepening inequalities and climate vulnerability. Under this trajectory, systemic risks escalate, disproportionately impacting the Global South.
- Justice-centred ecosystems**:** Entrepreneurship functions as a collaborative, multi-actor driver of systemic adaptation**,** expanding access to finance, building climate-adaptive infrastructure, and strengthening inclusive social capital. This scenario aligns with global sustainability goals and enhances both equity and resilience. The JCEF provides **a** conceptual roadmap for realizing the latter scenario, emphasizing that ecosystem

design choices today will decisively shape the justice and resilience of societies by 2050.

6. Implications

6.1 For Policymakers: Designing Equitable and Climate-Ready Ecosystem Policies

The JCEF underscores that public policy is not merely a facilitator of firm competitiveness but a determinant of justice and resilience in ecosystems. Policymakers must design inclusive financing schemes, adaptive regulations, and climate-responsive infrastructure investments that address the systemic barriers faced by women, rural entrepreneurs, and grassroots innovators. For example, gender-responsive policies that reduce the $1.7 trillion global financing gap for women entrepreneurs (World Bank, 2023) can enhance both inclusivity and productivity. Similarly, integrating grassroots innovations into national adaptation plans as seen in Bangladesh's solar energy program demonstrates how policy can enable local solutions to scale nationally. By aligning entrepreneurship strategies with the SDGs, Net Zero targets, and Vision 2050**,** policymakers can ensure ecosystems become platforms for long-term resilience and equity.

6.2 For Entrepreneurs: Leveraging Indigenous and Local Strengths While Scaling

For entrepreneurs, the JCEF highlights the importance of valuing indigenous knowledge, cultural capital, and community-based innovation as strategic assets rather than peripheral resources. Grassroots entrepreneurs often face exclusion from formal finance and global value chains, yet their solutions are context-specific and adaptive. By leveraging local strengths such as traditional farming practices, frugal health innovations, or digital community platforms entrepreneurs can position themselves as pioneers of sustainability transitions. The framework further emphasizes that scaling should not be equated solely with firm expansion; instead, entrepreneurs should pursue replication, diffusion, and ecosystem partnerships that amplify systemic impact. This reorientation empowers entrepreneurs to act as both economic actors and agents of justice-driven transformation**.**

6.3 For Development Agencies and Ecosystem Enablers: Building Support Structures

Development agencies, international organizations, and ecosystem enablers (incubators, accelerators, NGOs) play a pivotal role in nurturing grassroots enterprises into systemic

innovations. The JCEF identifies the need for blended finance facilities, inclusive incubator programs, and capacity-building initiatives that strengthen marginalized entrepreneurs. Evidence shows that less than 5% of global climate finance reaches adaptation at the community level (UNEP, 2022). Bridging this gap requires agencies to develop targeted programs that channel resources directly to grassroots innovators, support cross-sector collaboration, and facilitate knowledge exchange across regions. By acting as intermediaries between local entrepreneurs and global policy/finance systems, development agencies can accelerate the Seeds Systems transformation pathway**,** ensuring that small-scale innovations contribute to structural resilience.

6.4 For Researchers: Theoretical and Methodological Avenues for Testing the JCEF

The JCEF opens significant opportunities for advancing both theory and methodology in entrepreneurship research. Conceptually, it extends EE literature by incorporating justice, equity, and resilience as explicit ecosystem goals, offering scholars a new lens for analysing entrepreneurial systems. Methodologically, the framework invites comparative case studies, cross-country ecosystem mapping, and longitudinal scenario analyses that test how justice-centred ecosystems perform relative to traditional models. There is also scope for developing new ecosystem metrics that capture non-financial dimensions such as inclusivity of finance, resilience capacity, and integration of indigenous knowledge alongside traditional indicators like start up density and venture funding. By pursuing these avenues, researchers can provide the empirical evidence needed to validate and refine the JCEF, strengthening its relevance for both academic and policy communities.

7. Conclusion

The study addressed a key gap in entrepreneurial ecosystem (EE) research: the absence of a framework that embeds justice, inclusivity, and resilience. It introduced the Justice-Centred Ecosystem Framework (JCEF), which redefines entrepreneurship as a platform for systemic transformation rather than mere firm growth. Unlike conventional profit-driven models focused on venture capital and GDP contributions, the JCEF positions justice and resilience as foundational objectives, aligning ecosystems with the SDGs, Paris Agreement, and Vision 2050.

The framework's originality lies in its Seeds Systems pathway, demonstrating how grassroots enterprises can evolve into systemic innovations when supported by inclusive finance, adaptive policy, resilient infrastructure, and multi-actor collaboration. Future research should focus on empirical validation, metric development, and regional applications, particularly in the Global South, where vulnerabilities and grassroots innovations intersect.

Ultimately, the JCEF argues that today's ecosystem design choices will shape the justice and resilience of societies by 2050. Cultivating grassroots enterprises as seeds of transformation can yield ecosystems that are not only economically vibrant but also equitable, inclusive, and climate-resilient positioning entrepreneurship as a cornerstone of sustainable global development.

7.1 Summary of Contributions

The study has advanced the Justice-Centred Entrepreneurial Ecosystem Framework (JCEF) as a response to the dual crises of climate change and inequality. Existing entrepreneurial ecosystem (EE) models have been largely growth-centric, profit-driven, and geographically biased, privileging high-growth firms and advanced economies while neglecting vulnerable populations in the Global South. In contrast, the JCEF embeds justice, inclusivity, and climate resilience as structural dimensions, thereby reframing entrepreneurship as a vehicle for systemic transformation rather than only economic expansion**.**

The framework contributes to scholarship by addressing three critical gaps:

1. Theoretical – expanding EE research to include justice and resilience as core design principles.
2. Practical – offering policymakers, investors, and development agencies a roadmap for designing inclusive, climate-responsive ecosystems.
3. Transformational – articulating the Seeds → Systems pathway, which demonstrates how grassroots enterprises can evolve into systemic innovations that drive sustainability transitions.

By aligning with the SDGs, Paris Agreement, and Vision 2050, the JCEF positions entrepreneurship as a strategic lever for building just and resilient futures.

7.2 Implications for Policy and Practice

The framework has clear policy and practical implications. For policymakers, the JCEF highlights the urgency of reorienting national entrepreneurship strategies to include marginalized actors, indigenous knowledge systems, and climate-adaptive infrastructure**.** For practitioners and ecosystem builders, it offers guidance on designing support structures that move beyond firm competitiveness toward systemic resilience. Financial institutions can adopt blended and decentralized finance models to address funding inequities, while universities and innovation hubs can prioritize community-driven and frugal innovations alongside high-technology ventures.

If implemented at scale, these shifts would ensure that entrepreneurial ecosystems contribute not only to economic growth but also to poverty reduction, social inclusion, and ecological sustainability**.**

7.3 Limitations of the Study

As a conceptual contribution, this paper does not offer empirical validation of the JCEF. While case illustrations from Bangladesh, Kenya, Latin America, and the Philippines demonstrate the framework's relevance, systematic empirical testing is needed. Additionally, the framework is intentionally broad and may require contextual adaptation to reflect national, regional, and sectoral variations in ecosystem dynamics.

7.4 Future Research Directions

The JCEF opens several promising avenues for future inquiry:

1. Empirical Validation: Researchers could conduct comparative case studies **or** cross-country analyses to examine how ecosystems that embed justice and resilience perform relative to conventional ecosystems in terms of equity, innovation, and adaptation outcomes.
2. Metrics Development: There is a need for new measurement frameworks that capture justice and resilience indicators such as inclusivity of finance, adaptive capacity, and integration of indigenous knowledge alongside traditional economic metrics.
3. Policy Experimentation: Future work could investigate the effectiveness of policy instruments (e.g., green bonds, community innovation funds, adaptive regulatory frameworks) in operationalizing justice-centred principles.

4. Global South Case Studies: Research that foregrounds African, South Asian, and Latin American contexts can generate deeper insights into how ecosystems function under conditions of institutional voids and climate vulnerability.
5. Longitudinal Futures Research: Scenario modelling for 2050 can assess how justice-centred ecosystems might influence trajectories of resilience, inequality reduction, and progress toward net zero.

7.5 Final Reflection

The urgency of converging crises climate change, inequality, and systemic vulnerability demands a paradigm shift in how entrepreneurship is theorized and supported. The JCEF provides a conceptual foundation for such a shift, highlighting that ecosystems can either perpetuate inequality and fragility or serve as platforms for justice and resilience. By cultivating "seeds" of grassroots innovation today and nurturing them into systemic transformations, societies can build ecosystems that are equitable, adaptive, and sustainable by 2050**.**

In conclusion, the JCEF is both a call to rethink entrepreneurial ecosystems and a blueprint for action. Its relevance extends beyond academic theory to the practical domains of policymaking, investment, and community development underscoring that entrepreneurship, if designed with justice at its core, can be a cornerstone of just, inclusive, and climate-resilient futures**.**

Highlights / Key Contributions

- Proposes the Justice-Centred Ecosystem Framework (JCEF) embedding justice, equity, and resilience.
- Shifts ecosystem focus from profit-driven growth to systemic sustainability transitions**.**
- Introduces the Seeds → Systems pathway for scaling grassroots innovations into systemic change.
- Aligns entrepreneurship ecosystems with SDGs, Paris Agreement, and Vision 2050 agendas.
- Offers theoretical, policy, and practical pathways for inclusive, climate-ready ecosystem design.

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