Research Article

Sustainable entrepreneurial ecosystems in developing economies: A conceptualisation of complex adaptive systems approach

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Sustainable Entrepreneurial Ecosystems (SEEs) establish a connection between entrepreneurial ecosystems and sustainability concerns. This connection relies on a sustainable business model, which describes how entrepreneurs, acting as catalysts for development, invest in sustainable solutions within impoverished communities. They operate guided by sustainability principles while simultaneously generating profits for themselves. While existing research predominantly emphasizes ecological sustainability within sustainable business models, other scholars recognize these models as instrumental in addressing social needs. For example, they have explored entrepreneurial strategies targeting impoverished regions. This paper focuses on three key areas. Firstly, it presents inclusive agribusinesses as examples of SEEs, illustrating how they generate value for themselves while also creating additional value for income-constrained smallholder communities. Secondly, it examines the links between value chains, frequently employed in such contexts, and SEEs. Lastly, it synthesizes concepts to show the intricate processes of complex adaptive systems that drive entrepreneurial activity within SEEs.

1. Introduction

Sustainable entrepreneurial ecosystems (SEEs) can be viewed as ecosystems for sustainable entrepreneurship (Volkmann et al., 2021). They are defined as an interconnected group of actors in a local geographic community committed to sustainable development through the support and facilitation of new sustainable ventures (Cohen, 2006 p.3). The entrepreneurial ecosystem concept

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presents a real-world phenomenon as an abstracted idea (Wurth et al., 2022). In developing countries, Inclusive Businesses (IBs) embody the traits of sustainable enterprises. Prior research extensively covers the intricate nature of agribusiness value chains and the need to address the complex nature of activities (e.g., Smidt & Jokonya, 2022; Gulati et al., 2022; Mghenyi et al., 2022; Lashitew & Tulder, 2017). There is also a rising demand for a fresh theoretical framework to fully clarify the complex structures (Chamberlain & Anseeuw, 2019).

This paper seeks to achieve three key things. First, to present IBs, that generate value for themselves while also creating additional value for income-constrained smallholder communities, as examples of SEEs. Second, to show the link between the value chains concept mostly used in such settings and SEEs. Third, to bring together the concepts that can help us understand the complex adaptive systems processes that drive entrepreneurial activity in SEEs.

The use of the ecosystems concept as a metaphor to map interrelationships between actors and components within an entrepreneurial space without referencing real-world phenomena, limits our ability to understand the structure and complexities of entrepreneurial ecosystems (Roundy et al., 2018). When mapping (e.g., at a national level) is inadequate to understand real life issues, detailed boundaries can be determined to explore actors' processes within the boundaries, to understand how the links between ecosystem actors impact ecosystem outcomes (Phillips & Ritala, 2019). Smallholder households, a diverse group of agricultural producers who primarily reside in impoverished rural regions, are an example of disadvantaged actors that might be left out when ecosystems boundaries are not explicitly determined (Akiode, 2021). Research suggests that the recognition and implementation of sustainable development opportunities are more complex for the entrepreneur than the recognition of non-sustainable opportunities (Volkmann et al., 2021). Crafting sustainable business models is more complicated than traditional ones because they need stronger ties to society to work effectively (Neumeyer & Santos. 2017). Sustainable entrepreneurial activities involve capturing value for the business while simultaneously creating alternative forms of value for income-constrained groups (Schoneveld, 2020; Reficco & Márquez, 2012). Sustainable agriculture entrepreneurs require collaborations and support from diverse partners and organisations to work with smallholder groups (Schoneveld, 2020; German et al., 2018). Therefore, one can conjecture that complex multi-actor collaborative relationships exist within SEEs.

This paper hopes to answer the broad research question: "What are the complex adaptive systems processes that drive entrepreneurial activity in SEEs?" The question is then broken down to consider

the implications of processes on sustainable entrepreneurial ecosystems interdependencies, output and outcomes (Wurth et al., 2022). It probes further through the following questions:

1. What is the relationship between value chains and SEEs?
2. What connections exist between sustainable entrepreneurial processes and specific types of outputs?
3. What connections exist between sustainable entrepreneurial processes and ecosystem outcomes?

The conceptual design

Developing a robust theory to study complex systems using a complex adaptive systems approach requires defining systems boundaries, establishing the context or controls, and identifying the fundamental dimensions of an ecosystem research design (Phillips & Ritala, 2019). Boundaries define ecosystem types and scope (Phillips & Ritala, 2019). A lack of defined boundaries limits our understanding of how localized conditions, and the agency of entrepreneurial actors create and transform their own contexts (Wurth et al., 2022). It also limits our ability to grasp not only how entrepreneurs are affected by their broader context (Gnyawali & Fogel, 1994) but also how they influence their broader context. Studying complex systems can be challenging when clear boundaries are not defined, and it makes the development of robust theory more difficult (Phillips & Ritala, 2019). Table 1. shows the conceptual dimensions of this paper and their implications (Phillips & Ritala, 2019).

	Conceptual dimension	Implication
Systems-theoretic definition.	Theoretical considerations and implications for scope and design of ecosystem research.	The ecosystem-as-structure perspective (Phillips & Ritala, 2019; Adner, 2017).
Focus of systems-based inquiry.	Boundaries: Determining ecosystem type and scope - Process-function and population-community approaches (Post et al., 2007).	**Type:** Sustainable entrepreneurial ecosystem (Volkmann et al., 2021; Pankov et. al., 2021; Bischoff, 2019; Cohen, 2006). **Focus:** Sustainable (agribusiness) entrepreneurial activities – capturing value for the business while simultaneously creating alternative forms of value for income-constrained smallholder communities (Akiode, 2021; Schoneveld, 2020; Reficco & Márquez, 2012). Sometimes referred to as Bottom-of-Pyramid (BoP) – (e.g. Reficco & Márquez, 2012; Prahalad & Hart, 2002). **Scope:** Impoverished rural communities in developing economies (Bruton et al., 2015; Alvarez & Barney, 2014).
Key research design questions.	What are the complex adaptive systems processes that drive entrepreneurial activity in sustainable entrepreneurial ecosystems?	What are the implications of the processes on ecosystems interdependencies, output and outcomes (Wurth et al., 2022).

Table 1. The conceptual dimensions of the paper

Source: Author

The SEE boundary is set by process-function and population-community approaches (Phillips & Ritala, 2019; Post et al., 2007). That is, SEE is depicted as a type entrepreneurial ecosystem that focuses on sustainable agribusiness activities, and exists in impoverished rural communities in developing economies. Using both approaches for boundary definition helps to limit the possibility of

missing out important points about the value creating processes, the actors involved, and also helps to minimize the risk of leaving out actors that are important to the ecosystem but are less obvious or visible (Phillips & Ritala, 2019).

2. Literature review

2.1. Value chains and sustainable entrepreneurial ecosystems (SEEs)

Clarifying the concept of business models is critical to understanding how value chains and SEEs are intertwined. Inclusive Business (IBs) and Inclusive Business Model (IBM), and Sustainable Business Model (SBM) are related terms often used interchangeably. However, it is important to clarify certain aspects and establish their connections to value chains and SEEs within the context of this paper.

2.1.1. Inclusive Business (IB), Inclusive Business Model (IBM) and Sustainable Business Model (SBM).

A business model refers to how an organization creates, delivers, and captures value (Schaltegger et al., 2016). The mechanisms employed in arriving at profit involves the proper design and operation of the various elements. An IB is a type of social enterprise (Schoneveld, 2020). Value chains and the concept of IB, are commonly used in the agriculture sector. Agribusiness includes all farms and businesses involved in producing, harvesting, packing, processing, preserving, distributing, marketing, and disposing of food and non-food agricultural products (Mghenyi et al., 2022). IBs are considered as profit-oriented partnerships between agribusinesses and smallholders that aim to integrate the latter in an equitable and sustainable way into commercial value chains (Chamberlain & Anseeuw, 2019). An IB is centred on integrating low-income individuals or communities into various aspects of a company's operations, such as suppliers, employees, customers, or partners in the value chain (Schoneveld, 2020). The overarching goal is mutual benefit, where these partnerships yield both economic profit for the agribusiness and socio-economic development for the low-income groups involved. This helps to bridge the gap between businesses and the poor.

In Kenya, criticisms have surfaced regarding the objective of these interventions, suggesting that their primary focus may not be on addressing social inequalities and injustice but rather on revitalizing capitalism. This stems from limited understanding of the impact of IBs on smallholder farmer communities (Wangu et al., 2021). In addition, some have defined inclusive business as a business

model that includes the poor as both consumers and producers, suggesting that the poor are objects of value capture (Ros-Tonen et al., 2019; Prahalad & Hart, 2002). Schoneveld (2020) points out that the concept is misused and under-conceptualized.

Most definitions of IB emphasize fostering commercial viability while addressing social and environmental responsibility through capacity building, access to finance, product adaptation, and innovative distribution strategies to empower and uplift marginalized groups, making them an integral part of the business's core operations (Schoneveld, 2020). Despite emphasizing organizational, market, and societal transformations, the conventional value chain models primarily focus on organizational value appropriation. They are essentially centred on one-dimensional profit maximization, without consideration for the broader social and ecological consequences, potentially overlooking broader environmental and social impacts beyond a company's initial intentions (Schaltegger et al., 2016). This approach could lead to non-economic aspects being seen as merely externalities requiring management, rather than integral components of business outcomes.

A SBM defines, manages, and communicates how a business creates value for customers and stakeholders. It showcases how it delivers this value while capturing economic gains and preserving natural, social, and economic resources beyond its organizational limits (Schaltegger et al., 2016). Crafting sustainable business models is more intricate compared to traditional ones because it requires a deeper level of integration within society to effectively function (Neumeyer & Santos (2017). The SBM comprises of three core aspects namely: environmental, social and economic (Schoneveld, 2020; Schaltegger et al., 2016). The model extends the focus of value creation beyond economic gains.

Although the advancement towards sustainable business models has often been rooted in ecological sustainability, some scholars have also seen business models as tools for addressing social needs (Schaltegger et al., 2016). The typical way an IBM is conceptualised tends to prioritize social value creation while potentially under emphasizing environmental aspects (Schoneveld, 2020). For instance, entrepreneurial approaches that cater to social needs in impoverished regions and low-income markets (Seelos, 2014; Sánchez & Ricart, 2010).

An in-depth analysis of SBM literature reveals that IBM can be seen as a variant of SBM and the paper proposed definition is that it is, “any type of self-sustaining business entity with an IBM that creates net value for income-constrained groups” (Schoneveld, 2020, p.10). That is, it aligns its activities with value creation, securing unaltered net value for income-constrained groups. It is self-sustaining

without charity, and it reinvests surplus to broaden impact. Table 2 illustrates the assessment of an inclusive agribusiness in Nigeria and its alignment with the proposed IBM benchmarks.

Country: Northern Nigeria.	*Entrepreneur A ventured to a Northern Nigerian village in 2012 with the aim of combating unemployment through agriculture. By empowering smallholder farmers, the enterprise shifted subsistence farming to profitable ventures. The entrepreneur's expertise in finance and operations drove this financially sustainable and scalable agricultural enterprise, providing comprehensive services to franchise farmer groups.*
Proposed IBM Benchmarks (Schoneveld, 2020, p.10).	**Elements found in the business**
Alignment with IBM Mission.	Demonstrating smallholder segment as a viable investment model. Creating jobs and pathways out of poverty for smallholder farmers. Empowerment of female entrepreneurs (WEDI program). Training and education through Farm U.
Equitable Value Creation.	Providing training, financial credit, and quality inputs. Support services for optimal yields for smallholders.
Self-Sustaining Financing.	Innovative financing approach for the business & smallholders. Cost-effective debt for expansion. Blended finance structure for smallholders' support.
Reinvestment for Expansion.	Various support services and training programs. Scaling operations to reach more communities.

Table 2. Assessment of an inclusive business in Nigeria against IBM benchmarks.

Source: Author

2.1.2. The areas of IBM convergence with SEEs

There are similarities (Table 3.) with the emerging sustainable entrepreneurial ecosystems (SEEs) literatures (e.g. Volkmann et al., 2021; Pankov et. al., 2021; Bischoff, 2019; Cohen, 2006) and IB(M) (Schoneveld, 2020). A sustainable entrepreneur has a profit motive, there is also a strong sense of social responsibility driven by a strong need to connect with others and make a difference in the world (Pankov et. al., 2021; Bischoff, 2019). They actively strive to avoid negatively affecting the environment and society, and the community becomes a centre for entrepreneurial innovations and focus on fostering sustainable entrepreneurship (Bischoff, 2019; Cohen, 2006). Sustainable entrepreneurship is defined as, "the discovery, creation, and exploitation of opportunities to create future goods and services that sustain the natural and/or communal environment and provide development gain for others" (Patzelt and Shepherd 2011, p.632). It differs significantly from traditional entrepreneurship in terms of its intended and realized impact and entrepreneurial success depends on the support that entrepreneurs receive from other individuals (Volkmann et al., 2021). It stems from the need to address critical contemporary societal challenges such as, climate change and social inequality (Pankov et. al., 2021). Sustainable entrepreneurial activities tackle fundamental societal challenges consistent with the UN's Sustainable Development Goals, embracing the economic, ecological, and social dimensions of sustainability (Volkmann et al., 2021).

	Sustainable entrepreneurial ecosystems (SEEs)	Inclusive Business Model (IBMs)
Focus	Profit motive (economic), ecological, and social dimensions.	Profit motive (economic) and social developmental impact, and in some cases ecological dimensions.
Scope	Geographic community.	Low-income or impoverished communities.
Integration Points	Not specific.	Integration as employees, suppliers, producers, or partners in value chains.
Industry/sector	Not specific.	Agriculture.
Outcome	Outcome of facilitating sustainability for business and society in line with relevant SDGs.	Outcome of facilitating sustainability for business and society in line with relevant SDGs.

Table 3. The areas of convergence with SEEs.

Source: Author

2.1.3. Areas of SEEs divergence from value chains

The success of value chains in India has been variable, and there is a call to enhance the competitiveness, inclusivity, sustainability, and scalability of agricultural value chains through, an enabling policy environment backed by robust institutions. Indicating substantial room for further strengthening to bolster returns for farmers and to drive overall growth within the agricultural sector (Gulati et al., 2022). The need to establish comprehensive localized frameworks supporting the effective adoption of digital solutions among small-scale farmers within South Africa's agricultural contexts arises from the ineffective utilization of digital technologies in agricultural value chains (Smidt & Jokonya, 2022). The relational aspects of Inclusive Business (IB) suggest that the value chain concept might not fully encapsulate the interconnectedness, flow dynamics, incentives, constraints, output assessment, and necessary policy interventions. Traditional value chain models often focus solely on the most significant actors and relationships, potentially overlooking the intricate complexities within IBs. The simplified view of a value chain means that it is constituted by a sequence

of agents (people, companies, etc.) and activities directly connected to a business activity. Therefore, while it is useful for identifying the different activities and agents required to bring products to market, indirect but necessary factors such as infrastructures, institutions, sources of knowledge and human capital spillovers, and network effects are not adequately taken into considered (Audretsch et al., 2019). Cavallo et al. (2018) point out that the linear model has become obsolete because it underestimates the complexity of doing business between a wide spectrum of actors in an environment featuring multiple interdependencies. The increasingly popular approach of utilizing multi-stakeholder partnerships (MSPs) also applies to the development of agricultural value chains, rather than a systems approach (Maryono et al., 2024).

The areas of divergence can be understood from the broader Entrepreneurial Ecosystems (EEs) literature. EEs seeks to understand productive entrepreneurship from a systemic perspective that encompasses multiple actors, institutions and processes (Wurth et al., 2022; Roundy et al., 2018; Brown & Mason, 2017). The focus of EEs research continues to shift more towards productive entrepreneurship (Wurth et al., 2022). The linearity and sequential constitution of value chains does not elaborate all actors and relationships, but identifies only those of greatest significance (Robinson et al., 2014). It was this disadvantage that birthed the Business Ecosystem (BE) concept (Phillips & Ritala, 2019; Porter, 1985).

The ecosystem concept is not novel in IB or Bottom of the Pyramid (BoP) literature. For instance, Prahalad (2005) emphasized the importance of creating an ecosystem that fosters both wealth creation and social development at the BoP while Ramachandran et al. (2012) delved into BoP Producer Ecosystems. Some studies investigating IBs briefly mentioned BEs or ecosystems but did not delve deeper into them. For instance, Reficco and Márquez (2012) noted that ecosystem concepts involve a wide range of arrangements, which was beyond the scope of their study.

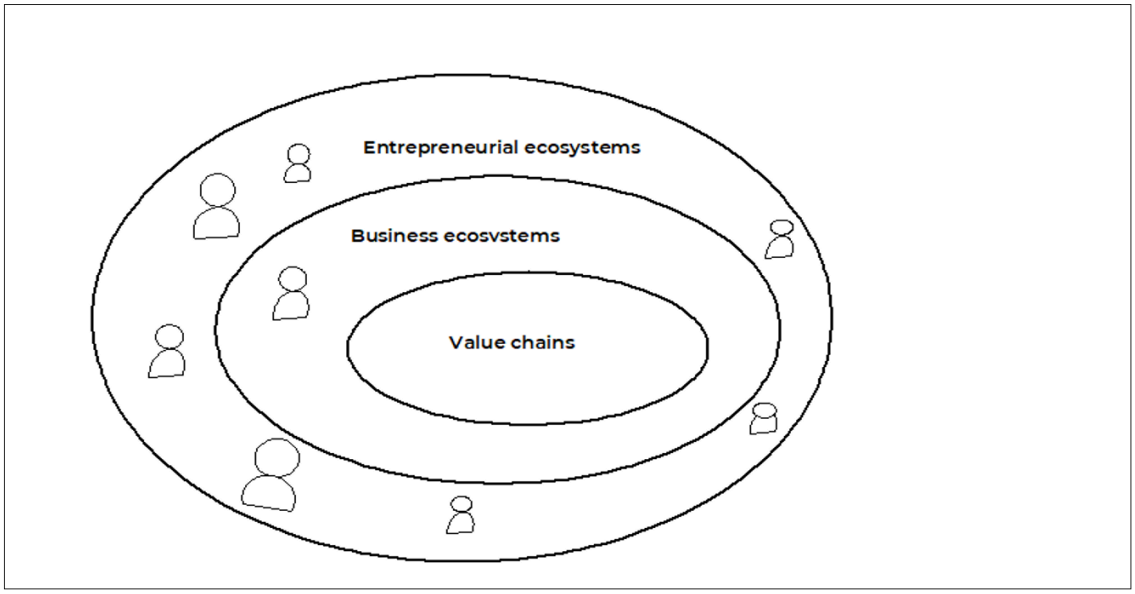

Figure 1. Value chains, Business Ecosystem (BEs) and Entrepreneurial Ecosystems (EEs).

Adapted from: Reficco and Márquez (2012)

Figure 1. illustrates the relationship between the value chains, BEs and EEs. Entrepreneur A's value chain delineates the individuals, companies, and activities directly affiliated with the business operation. Simultaneously, the BE manifests the intricate interplay among all entities, crucial for Entrepreneur A's business sustenance. Despite Entrepreneur A serving as the primary focal point within the EE, other entrepreneurs can similarly chart their own BEs. The intricacy heightens in the EE because it reveals the interconnectedness among all entrepreneurial actors and other pertinent entities within a specified boundary.

A BE is a subset of an EE, which has a core focus on the internal commercialization of knowledge. Therefore, if the overwhelming amount of ideas in an ecosystem is generated and exploited internally, such an ecosystem could be labelled as a BE (Cantner et al., 2021). Although sometimes used interchangeably with EEs, it's widely accepted that some BE relationships are unequal or competitive, with win-lose dynamics (Hakala et al., 2020). An EE, has two main jobs: creating value within the ecosystem and then distributing that value among its members (Audretsch et al., 2019). Systemic conditions are the heart of an ecosystem, comprising of elements and the interactions between them that predominantly determine the success of the ecosystem (Stam, 2015). Therefore, EEs have a

holistic view which makes the linearity, lack of interdependencies, and co-evolution of relevant organizational and institutional actors in value chains as a major drawback (Phillips & Ritala, 2019).

The definition of productive entrepreneurship further underscores the divergence from the value chains concept. Productive entrepreneurship is, "any entrepreneurial activity that contributes directly or indirectly to net output of the economy or to the capacity to produce additional output" (Baumol, 1990, p. 30). Entrepreneurial activity contributes directly to net outputs through the discovery of new attributes, opportunities and procedures (Suaka, 2008), and indirect contributions could be through "catalyst ventures" or failed enterprises that have provided a fertile breeding ground for subsequent ventures or inspired them (Stam, 2015). Many dimensions of inclusive value chain integrations have been operationalized in literature as either process or outcome e.g., double or triple bottom-line, concern for well-being, alignment with smallholders' realities etc. (Ros-Tonen et al., 2019). The dimensions of inclusiveness should encompass both processes and outcomes, and should not be limited to either. These limitations might contribute to why productive entrepreneurship in developing economies remains a complex puzzle that requires unravelling (Sautet, 2013). Prior research reveals the absence of a blueprint for inclusive value chain participation, highlighting that achieving inclusiveness goes beyond merely ticking boxes (Ros-Tonen et al., 2019). Furthermore, the narrow scope of value chains increases the likelihood of overlooking crucial aspects within the value creation process.

The complex nature of IBs and the necessity for ecosystems perspectives have been well documented in prior research. The performance of agricultural value chains is influenced by a complex set of factors. These factors differentiate among issues affecting upstream primary agriculture, those impacting downstream off-farm agribusiness, and cross-cutting challenges (Mghenyi et al., 2022). The complexity of agricultural development challenges necessitate collaboration and interaction among value chain actors and stakeholders to attain more impactful development outcomes (Maryono et al., 2024). Digital technology adoption among small holders demands a multidisciplinary approach to comprehend the escalating complexity stemming from diverse stakeholder constituencies with varying world-views (Smidt & Jokonya, 2022). Strengthening agri-value chains requires an inclusive framework which embraces multiple players to support specific value chains (Gulati et al., 2022). Businesses in Africa have a range of diverse and multifaceted strategies to engage their communities. Therefore, developing supportive, inclusive ecosystems stands out as a key factor for successfully creating shared value at the BoP (Lashitew & Tulder, 2017). There's a growing need for a renewed

theoretical framework to comprehensively explain the intricate and composite nature of the complex structures observed within inclusive businesses in agriculture (Chamberlain & Anseeuw, 2019).

Complex systems have bottom-up self-organizing properties, that gives it the ability to create structures that are based not only on spatial relations, but on processes generated by interactions over time (Kuckertz, 2019; Phillips & Ritala, 2019). This stresses the importance of bottom-up perspective (Akiode, 2021: Mack & Meyer, 2016; Prahalad, 2012) in advancing our understanding of the processes and essential factors that facilitate sustainable entrepreneurship as a complex system (Audretsch et al., 2023; Bischoff, 2019; Phillips & Ritala, 2019), and the sustainable entrepreneur is crucial in this.

The final point of divergence is that entrepreneurial ecosystems unlike value chains, gives priority to the role of the entrepreneur as an organizational, innovation, and community leader (Wurth et al., 2022). An IB is a self-sustaining business entity that, along with other actors, has the potential to facilitate growth, poverty alleviation and employment creation (Schoneveld, 2020; Murimbika & Urban, 2020; Bruton et al., 2015; Sautet, 2013; Reficco and Márquez, 2012; Ramachandran et al., 2012). The entrepreneur and other actors, who interact together in order for the focal value proposition to materialize, constitute an ecosystem. Any actor involved in these processes would be related to the creation of value propositions or complementarities (Phillips & Ritala, 2019; Adner, 2017).

3. Sustainable entrepreneurial ecosystems (SEEs) process and activity and outputs

Sustainable entrepreneurial ecosystems (SEEs) in developing economies have significant poverty-alleviation consequences, and productive entrepreneurship can be understood from a complex adaptive systems approach. Although it can be argued that since the linearity of value chains is a disadvantage, how can complex systems approach be relevant to SEEs? The previous sections have shown that inherently SEEs have complex structures, the challenge has been the use of linear tools to analyse complexity. Pohl (1999) inquired about alternative tools for understanding and predicting the behavior of interacting elements in complex adaptive systems if decomposition and mathematical modeling fall short. The paper suggested that these tools would likely be quite different from the usual straightforward tools we use. Instead of precise and absolute methods like mathematical equations, these new tools would probably be more about making relative judgments and speculating about what might happen based on past patterns and future trends.

The benefits of systems thinking lie in embracing various viewpoints to understand how individual parts and the entire system interact, recognizing the intricate connections between them. This approach helps in grasping the complexities and interdependencies within a system, leading to more comprehensive insights and solutions (Phillips & Ritala, 2019).

The aim of the next sections is to discuss the complex adaptive systems processes that drive entrepreneurial activity in SEEs in developing countries.

3.1. Complex adaptive systems

A complex system is a collection of elements – two to hundreds of thousands, even millions of elements – interacting with one another (O'Sullivan, 2009a). For a system to be complex, it doesn't always require many parts. Some systems might have only a few parts, each simple on its own, but when they interact, they create a complex and mostly unpredictable outcome (Pohl, 1999). The aspirations of agents about how entrepreneurial ecosystem should function add layers of intricacy compared to biological systems (Cavallo et al., 2018; Roundy et al., 2018). Its complexity is underscored by seemingly unpredictable patterns, behaviours, and structures. The patterns of action produced at one level both emerge from and are influenced by processes operating at different levels, and by the behaviour of the overall system (Roundy et al., 2018; Midmore & Whittaker, 2000).

It is critical to study the components of ecosystems, which may include subsystems and individuals to understand the relationships between them and the processes driven by them (Phillips & Ritala, 2019). This implies that the study of components precedes relationships and processes. However, in relation to SEEs where value-chain frameworks have existing maps and networks of actors and organizations, the study of the processes driven by the mapped entities could be a useful starting point. It can offer insights into aspects such as, the sequence, interactions, and interrelationships among various activities. Further probe can then illuminate how the wider components connect and operate as a complex system, and help to shed light on the underlying ecosystem structure. This forms the underlying assumption of this discussion.

Conceptualising a complex adaptive systems approach for understanding the processes and mechanisms which lead to individual and collective beneficial outcomes (Audretsch et. al., 2019) would help to guide our knowledge towards, the emergence of and the conditions under which, sustainable entrepreneurial ecosystems contribute to productive entrepreneurship (Audretsch et al., 2023). A core concept in studies of complex adaptive systems and the economy is co-evolution, it

focuses attention on reciprocal cycles of adaptation among one or more elements of an economic system (Moore, 2006). That is, entrepreneurial ecosystem elements are mutually interdependent and co-evolve in a territory (Stam & van de Ven, 2021).

Complex adaptive systems share six properties: self-organization, open-but-distinct boundaries, complex components, non-linearity, adaptability, and sensitivity to initial conditions (Roundy et al., 2018). Self-organization describes the emergent outcomes a system exhibits when structured in such a way that it can be organized into a number of interacting subsystems. As a complex adaptive system, the borders of an entrepreneurial ecosystem are ill-defined, however, both geographic and socio-cultural borders exist. Complex components describe the interactions between diverse actors and elements. The non-linearity of ecosystem dynamics describes how the effects of interdependent interactions in turn depend on other features of the elements interacting. It creates feedback loops, when an activity feeds back on itself either directly or after intervening processes. Adaptability refers to the ability of a system to alter itself in response to changes in its environment so as to preserve its own existence and operation. Sensitivity to initial conditions describes the small initial competitive market conditions in a region which may through positive feedback, lead to enormous differences in outcomes between regions (O'Sullivan, 2009a; O'Sullivan, 2009b; Stam & van de Ven, 2021).

Grounded in complexity science which highlights the intricately structured interconnectedness of the world, complex adaptive systems approach holds a place for both qualitative and quantitative empirical entrepreneurial ecosystem research (Phillips & Ritala, 2019; Roundy et al., 2018; O'Sullivan, 2009a). This would help move past studying attributes of components and provide a framework that can be used for studies that connect micro- and macro-level research in entrepreneurship (Roundy et al., 2018). The next sections discuss the conceptualisation of sustainable entrepreneurial ecosystems in developing economies context using a complex adaptive systems approach.

3.2. Conceptualisation of complex adaptive systems approach

Entrepreneurial ecosystems are characterized as complex, multi-level interactions that emerge over time through multiple components and processes (Roundy et al., 2018). The development of an entrepreneurial ecosystem is restricted to geographic boundaries and is highly influenced by local geographical environments (Cohen, 2006). In complex adaptive systems, the localized context of the actions of individual elements in a system is recognized as a key aspect of how system behaviour unfolds and requires different models for each level if entities and interactions of different kind

emerge at each level (O'Sullivan, 2009a). Even though ecosystems actors are heterogenous, there is enough homogeneity in agent-types so we can assign actors in the same sector to a single category based on similarities in intentions, behaviours, and activities (Roundy et al., 2018).

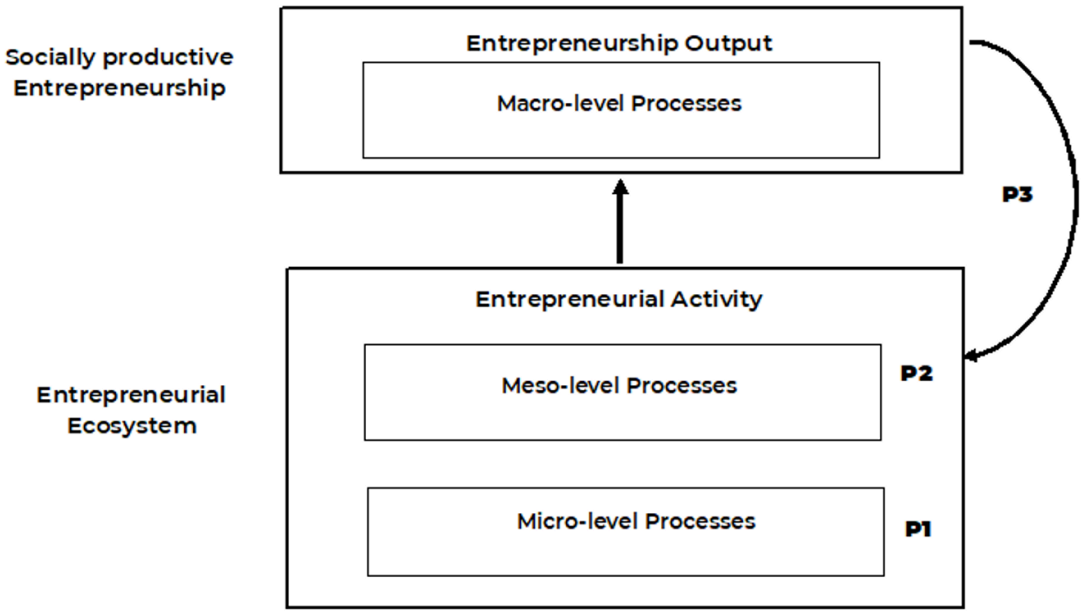

Figure 2. A conceptual model of sustainable entrepreneurial ecosystems

Adapted from: Stam & van de Ven (2021)

4. The conceptual model

A gap in the entrepreneurial ecosystem literature is a lack of consistent explanation of the coherence or the interdependent effects of ecosystem factors on entrepreneurship (Stam, 2015). This conceptual framework (Fig 1.) of sustainable entrepreneurial ecosystems in developing economies, builds upon the integrative model of entrepreneurial ecosystems (Stam & van de Ven, 2021).

It presents three processes through which entrepreneurial ecosystems emerge namely: the micro-level processes, meso-level processes, and macro-level processes (Roundy et al., 2018). These processes depict types of entrepreneurial activity (Fig 2.), in relation to the conditions that drive these processes. These conditions are shown as the commonly pursued opportunities in settings of abject poverty namely: self-employment, discovery and creation opportunities (Alvarez & Barney, 2014). The ecosystem outputs comprise three commonly explored types of entrepreneurship in developing

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economies namely: subsistence entrepreneurship, local entrepreneurship and systemic entrepreneurship (Sautet, 2013). Socially productive entrepreneurship is the ecosystem outcome encompassing value creation through all entrepreneurial activity levels (Stam, 2015; Stam & van de Ven, 2021). Sautet (2013) points out that the entrepreneurship categories are ideal types and may be difficult to identify in reality, and suggested that it might be more preferable to think of entrepreneurship as taking place along a continuum rather being a binary distinction between local and systemic entrepreneurship. This framework addressed this by considering the entrepreneurship categories as indicative of entrepreneurial outputs and entrepreneurial opportunities as conditions that drive a dynamic and non-linear sustainable entrepreneurial ecosystem. The aspects of the model are discussed in the next sections.

Figure 3. Process, opportunity type and entrepreneurship output

Source: Author

4.1. Micro-level processes

The entire entrepreneurial process evolves because individuals have entrepreneurial intentions, act and are motivated to pursue opportunities (Murimbika & Urban, 2020; Cavallo et al., 2018; Krueger, 2007). The sustainable entrepreneur acts as the focal person whose sensitivity to the initial location

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conditions, becomes the catalyst for the emergence of the ecosystem, and changes in entrepreneurial activity.

The entrepreneurial intention is to pursue profit motive with a strong sense of social responsibility (Bischoff, 2019) in a central place of distinct geographical boundary. The ultimate goal is to move an inefficient market towards general equilibrium through innovation and to do it in the most efficient, effective and profitable ways (Miles & Morrison, 2018).

The pre-existing systemic conditions and institutional arrangements show that self-employment opportunities are pursued and subsistence entrepreneurship is the output of entrepreneurial activities (Alvarez & Barney, 2014; Sautet, 2013; Akiode, 2021). Subsistence entrepreneurship occurs in impoverished settings where new ventures offer limited potential for significant improvement in the life of the entrepreneur or their family. These firms are typically small, family-run lifestyle businesses with minimal hiring outside the immediate family and limited growth prospects (Bruton

et al., 2015). External support of subsistence entrepreneurship (if available at all) is characterised by the strong influence of micro-lending, NGOs and government programs which does not yield a strong impact on poverty (Sautet, 2013).

Most impoverished communities are predominantly located in rural areas, specifically in villages. They are economically unsustainable, and lack seamless flow of resources and information (Akiode, 2021; Alvarez & Barney, 2014). The absence of basic amenities contributes to issues such as inadequate sanitation and deforestation. These areas also grapple with demographic challenges as younger individuals migrate to more economically robust regions. Moreover, communities with limited income are particularly at risk of environmental degradation and the adverse effects of climate change due to their adoption of unsustainable practices (Schoneveld, 2020).

The sustainable entrepreneur's ability to initiate actions is affected by existing rural (socio-economic and embedded cultural) systems that is reflective of the natural resources, local production factors (labour and capital), entrepreneurial ability, knowledge and relational skills of local actors. Entrepreneur's intentions, location factors and institutional arrangements trigger adaptive tensions which results in formulating implicit and explicit action plans. These actions lead to reframing of normative structures, creating substitutes for the resource and institutional deficiencies such as, lack of infrastructure and basic amenities, poor financial resources, ineffective government regulations, ill-defined rights, and other uncertainties (Roundy et al., 2018; Feldman & Zoller, 2012).

- ***Proposition 1: Adaptive tensions, triggered by entrepreneurs' intentions, location factors, and institutional arrangements, are the catalysts that shape sustainable entrepreneurial ecosystems around local conditions.***

4.2. Meso-level processes

The meso perspective deals with system dynamics head on in terms of structural change and open system process (Dopfer et al., 2004) and this section is based on three analytical structure trajectory namely: initial phase, learning and rivalry, and maintenance.

4.2.1. The initial phase

Inclusive Business (IB), is a new approach to capture value for the business while simultaneously creating alternative forms of value for income-constrained smallholder communities. Someone has figured out how to use a new rule and this means they are the first to pick up and understand this rule. This is where the meso level begins (Dopfer et al., 2004). The opportunities that drive entrepreneurial activity are strongly influenced by the entrepreneur's alertness and, industry and market experience (Alvarez & Barney, 2014). The introduction of a new business to a rural area creates an exogenous shock to the market through changes in technology, institutional arrangement, and changes in demographics, etc. (Shane, 2003). The disruption in the way things usually work causes people to adjust their behavior to fit the new situation. Institutionalization starts as people begin to get used to and accepting the new rules or changes (Dopfer et al., 2004). The ecosystem evolves and develops in a sustainable manner, through effective transmission of information on changes in all relevant components for balanced adaptation (Dopfer et al., 2004; Midmore & Whittaker, 2000). In developing economies, success is difficult and costly under discovery conditions but once achieved, it is easily observed and imitated (Mostafa & Klepper, 2017). The discovery opportunities being pursued require the possession and transmission of information needed to expand and exploit new products and markets (Alvarez & Barney, 2014). When entrepreneurs transfer information to others about what the opportunity is and how to pursue it, this imitation might initially legitimize an opportunity but it also generates competition (Barney, 1991). The reward structure influences the extent of competitiveness and IB entrepreneurs' actions or decisions are shaped by the potential outcomes they anticipate based on the prevailing conditions (Dopfer et al., 2004).

- ***Proposition 2a: The novel concept is established and, through effective transfer of information, promotes learning. However, it also fosters competition and increases rivalry among individuals or groups.***

4.2.2. Existing order is disturbed

Many new IB actors begin to emerge, newer concepts, ideas, and practices evolve. The defining characteristic here is change. New rules start to appear, altering the dynamics of each set of rules within the ecosytem (Dopfer et al., 2004). The first shocks that initially generated opportunity are beginning to be replaced by other shocks that will open up new opportunities (Schumpeter, 1934). The different levels within the system function in different ways and it is important to understand not only the attributes of components at each scale, but also the 'rules of the game' that determine coherence of interactions among them (Midmore & Whittaker, 2000). The expansion and exploitation of opportunities support local entrepreneurship but does not lead to economies of scale and scope beyond a certain level (Sautet, 2013). In addition, discovery opportunities require highly developed property rights, and sophisticated sources of financial capital (Alvarez & Barney, 2014). Exploiting opportunities requires the circulation of tacit knowledge and learning (Alvarez & Barney, 2014). Both are critical for managing the complex structures that emerge from increase in scale and scope of entrepreneurial activities.

- ***Proposition 2b: Change is the defining characteristic as new rules start emerging, shaping the dynamics within the sustainable entrepreneurial ecosystem.***

The challenges of the discovery condition is that the continued survival of an ecosystem depends on its ability to adapt, to continuously alter itself in response to necessary changes in order to preserve its own existence and operation (O'Sullivan, 2009a). Individual ecosystem actors' interactions improve the overall adaptability of the ecosystem (Roundy et al., 2018). Effective information flow enhances interactions, drive change, and promote adaptation as a complex adaptive system (Dopfer et al., 2004). Within an ecosystem, different participants utilize diverse options and external connections to secure access to resources. This enables them to maximize market opportunities and create/distribute value (Audretsch et al., 2019). The ecosystem actors also make changes such as, building a supportive environment, and enforcing a sustainability paradigm through entrepreneurial culture changes. Additionally, cooperation and collaboration is fostered among ecosystem actors, leading to strong linkages with large companies and other external partners (Pankov et al., 2021). A key characteristic of meso-level processes is the provisioning of resources to entrepreneurs from support organizations

(Roundy et al., 2018). This happens because the ecosystem actors are building networks and linkages, and establishing legitimacy which gives access to resources (Feldman & Zoller, 2012). The increase in entrepreneurial activities, and interactions with diverse actors and elements, help the ecosystem evolve from an uncoordinated or semi-autonomous state to having simple organizational structures (Stam & van de Ven, 2021; Roundy et al., 2018; Sautet, 2013).

- ***Proposition 2c: Effective transmission of information helps in establishing legitimacy, building new networks and linkages which leads to the injection of resources into the ecosystem.***

4.2.3. The persistent or maintenance phase

Different types of ecosystems and subsystems begin to emerge with distinctions based on focus, scope, etc. (Phillips & Ritala, 2019; Adner, 2017). The ecosystem begins to take the form of a hierarchical loosely coupled system despite its distinct boundaries, consisting of one or more levels of nested subsystems (Stam & van de Ven, 2021; O'Sullivan, 2009b). Systems and subsystems emerge where smaller parts are also part of a greater whole, which means that they can both be changed by other components, while themselves acting as a change agent (Midmore & Whittaker, 2000; Clayton & Radcliffe, 1996). The activities and interactions of change agents modify the rules of the game by refining existing practices, introducing new ways of doing business, providing environmental remedies, and seeking to protect social coherence (Akiode, 2023; Malecki, 2017). In addition, evolution occurs as a result of interactions between the scales (Stam & van de Ven, 2021; Moore, 2006; Midmore & Whittaker, 2000; Weston & Ruth, 1997), and a socially constructed local culture emerges through the interactions (Isenberg, 2010). Local culture is not static, it can be influenced by the presence of successful, innovative entrepreneurs who can spur others to follow in their footsteps (Malecki, 2017). As different levels within a system begin to function in different ways, it is important to understand not only the attributes of components at each scale, but also the 'rules of the game' that determine coherence of interactions among them (Midmore & Whittaker, 2000). The 'rules of the game' guide how decisions are made, and also determine how differences are settled among ecosystem actors (Roundy et al., 2018).

Despite the differences that exist across levels and scales, the coherence displayed between the components of a sustainable entrepreneurial ecosystem causes them to coalesce into a group (Roundy et al., 2018). Complexity introduces the possibility of disorder in the ecosystem e.g., friction can occur when a component tries to secure its identity in competition with others at the same scale, yet the

competitive process can destabilise other scales within the system on which it depends. Therefore, stability in the ecosystem refers to the ability of entities to maintain self-organisation while evolving (Midmore & Whittaker, 2000).

Each ecosystem tries to maintain relative stability as the boundaries, structures and relationships are more explicitly determined (Phillips & Srai, 2018). If imbalances occur between the constituent elements, they result in unfavourable conditions for entrepreneurial actions and growth (Lafuente et al., 2018). While there might be cohesion within an ecosystem, there are overarching frameworks or systems within an economy that determines the structure of rewards or payoffs for different actions (Dopfer et al., 2004). Complex and shifting policies, and compliance regulations targeting the agriculture sector, have the potential to disrupt even the most stable ecosystem. When the rules are favorable, entrepreneurs engage in actions that result in socially productive entrepreneurship. This involves innovating while efficiently utilizing resources like time, money, and human capital. This leads to both short and long term benefits or rewards for the society. However, when the rules are unfavourable, entrepreneurial actions taken may be rent-seeking, and the entrepreneurial opportunities are explored through actions that benefit individuals rather that the society (Sautet, 2013; Baumol, 1990).

The 'rules of the game' shape both the reward structure within an economy and the distribution of entrepreneurial activity. This is because entrepreneurship is not inherently productive or unproductive, it is the available rewards that make entrepreneurship socially productive or unproductive (Sautet, 2013; Baumol, 1990). Developing economies though are not uniform, may be characterized by some common markers such as, institutional voids, weak and less established markets, and unstable institutions specifically in terms of weak enforcement (Murimbika & Urban, 2020). Strong enforcement of the 'rules of the game' will help to fill the institutional deficiencies. Giving access to the human capital, property rights, and financial capital needed for wealth creation (Akiode, 2021: Alvarez & Barney, 2014). The rules continue to be reinforced through constant repair and maintenance (Dopfer et al., 2004) to ensure effective resources allocation, employment and incentive alignment (Williamson, 2000).

- ***Proposition 2d: The 'rules of the game' determine the coherence of interactions among ecosystem components.***

4.3. Macro-level processes

Systemic entrepreneurship is linked to creation opportunity and it depends on an efficient institutional environment and governance mechanisms. Explicit regulatory processes such as, rule-setting, monitoring, and sanctioning shape the institutional environment (Scott, 2014). Governance involves creating order to reduce conflict and achieve mutual benefits (Williamson, 2000). The entrepreneurial activity at the micro and meso level involves large volumes of market transactions, leveraging the substantial gains from trade and innovation. Complex organisational structures or institutions are required to effectively co-ordinate the scale and scope of activities occurring at the meso level. In addition, deep accumulation of capital, and impersonal and formal relations are needed (Alvarez & Barney, 2014). To comprehend the scale and range of entrepreneurial activity at the meso level, it must be accurately and effectively captured and analysed. According to Phillips & Ritala (2019), patterns of agents' interactions at a meso- or micro-level emerge as the macro-level patterns (Phillips & Ritala, 2019). Dopfer et al. (2004) point out that the macro level is not a sum of micro behaviors; instead, it provides a holistic view of the meso level as a complete system (Dopfer et al., 2004). Therefore, systemic entrepreneurship involves capturing opportunities that are wide enough to exist over an extended space, one that goes beyond the immediate community in which the ecosystem is located (Sautet, 2013).

- ***Proposition 3a: Entrepreneurship output at macro level describes the patterns of entrepreneurial outputs at the micro and meso level.***

4.4. The integrative model of socially productive entrepreneurship

There is the need to adopt an integrative systems approach to studying sustainable development (Midmore & Whittaker, 2000). The integrative model of the entrepreneurial ecosystem (Stam & van de Ven, 2021) adapted for this paper, shows the relationship between entrepreneurial activity and entrepreneurship outcomes in developing economies (Alvarez & Barney, 2014; Sautet, 2013). Local entrepreneurship which dominates many African countries, refers to socially productive entrepreneurial activities constrained to serve a limited local market (Murimbika & Urban, 2020). Sautet (2013) points out that the distinction between local and systemic is not clear-cut and the former must not always come before the later, some systemic entrepreneurial discoveries are systemic from the start. The fundamental distinction between local and systemic entrepreneurship refers more to the scope of the opportunities available in the market than to their nature. Now, let's conclude with

the question: What then are creation opportunity, systemic entrepreneurship and socially productive entrepreneurship?

Macro level focuses on maintaining order when a new rule or set of rules fits in with the existing ones. However, this balance or order gets disrupted when a new path emerges at the meso level (Dopfer et al., 2004). We can think about the sustainable entrepreneurial ecosystem as a source of disruption through the introduction of a model that causes economic and social change. This new change shakes up the existing order, and eventually leads to new ways of organizing things (Dopfer et al., 2004). Ineffective governance structures will fail to promote adaptation (Williamson, 2000). The absence of efficient institutions and mechanisms to accurately capture change will create a negative feedback loop. While a positive feedback loop amplifies the effect of a change and triggers processes that further increase that factor, a negative feedback loop counteract or diminish the impact of a change, maintaining stability within the system (Roundy et al., 2018; O'Sullivan, 2009a; O'Sullivan, 2009b; Pohl, 1999). Environment feedback represents the principal basis for planning and decision making (Pohl,1999), when lacking or ineffective at macro level, it does not make the positive changes at the other levels obvious.

Finally, the macro level are the institution and governance structures and mechanisms put in place to coordinate the actions at other levels (Scott, 2014; Dopfer et al., 2004; Williamson, 2000). This paper takes the stance that creation opportunity, systemic entrepreneurship, and socially productive entrepreneurship are metaphorical ecosystems representations at macro level. That is, they symbolically illustrate and give meaning to the micro and meso level entrepreneurial activities in a synthesized way. This position takes us back to the introduction of this paper. When the point was made about metaphors being used without accurate references to real life issues or when mapping is inadequate (e.g., at a national level), the ability to accurately capture ecosystem outcomes becomes a challenge. Therefore, integrative model presents socially productive entrepreneurship as the overall outcome of sustainable entrepreneurial ecosystems. The outcome encompasses value creation patterns of the micro and meso levels of entrepreneurial activity.

- ***Proposition 3b: Proposition 3: Socially productive entrepreneurship represents sustainable outcomes within entrepreneurial ecosystems.***

5. Discussion

The paper explored the link between sustainable entrepreneurial ecosystems and inclusive business models, highlighting how these models involve agricultural entrepreneurs acting as development agents. They make profits while creating alternative value for smallholder communities with limited income. The study also examined the connections between value chains, often used in such scenarios, and sustainable entrepreneurial ecosystems. It discussed the complex adaptive system processes that drive entrepreneurial activity in these ecosystems.

Adaptive tensions, influenced by entrepreneurs' intentions, location factors, and institutional arrangements, shape sustainable entrepreneurial ecosystems based on local conditions. Effective information transmission aids in establishing legitimacy, forming new networks, and injecting resources into these ecosystems. The 'rules of the game' determine how ecosystem actors interact. Furthermore, entrepreneurial output defines the rewards at each level of activity, captured as patterns at macro level. Socially productive entrepreneurship represents the overall outcomes for all entrepreneurial activities of sustainable entrepreneurial ecosystems.

6. Conclusion

This paper delved into various related literatures: inclusive business, inclusive business models, sustainable business models, entrepreneurial ecosystems, sustainable ecosystems, and complex adaptive models. It contributed to literature in two significant ways: firstly, by establishing the role of inclusive agribusinesses in developing countries within the emerging literature on sustainable entrepreneurial ecosystems. Secondly, by synthesizing concepts that aid in understanding the intricate processes driving entrepreneurial activity in these ecosystems within developing economies from a complex adaptive systems perspective.

The paper suggests a future research agenda focusing on sustainable entrepreneurial ecosystems in developing countries and that will hopefully encourage scholarly and policy discourse in agribusiness and inclusive business models.

To further enrich this area of study, qualitative studies such as rapid ethnography, interviews with actors in sustainable entrepreneurial ecosystems, and focus groups (Audretsch et al., 2023) could provide valuable empirical insights to the conceptual foundations inspired by this paper. These studies can shed light on various aspects of entrepreneurial activities, including the nature of these activities,

the networks facilitating access to resources, innovation, growth, competition, collaboration, and the establishment of governance mechanisms (referred to as 'rules of the game') that shape the structures and regulate the processes within sustainable entrepreneurial ecosystems.

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