Fostering urban short food supply chains: evidence from the Netherlands

Yuheng Zhu[1,*], *Giannis T.* Tsoulfas[2]

[1]Breda University of Applied Sciences, Academy for Build Environment and Logistics, 4817JS, Breda, The Netherlands
[2]Agricultural University of Athens, Department of Agribusiness & Supply Chain Management, 32200, Thiva, Greece

Abstract. Short urban agri-food supply chains are an effective way to promote sustainability, viability, local economy and food security. This venture requires collaboration and knowledge from different disciplines, such as agriculture, food processing, logistics, sustainable economy, social innovation, engineering and ICT. However, there are many gaps in this research field, and many grey areas in government policy and regulations. The scope of this research is to explore the concept of short urban agri-food supply chains through case-study analysis and discussion. A case study was conducted based on a Breda (The Netherlands) municipal urban farming development, which included field observation, in-depth interviews with technical and knowledge experts, and detailed examination of present developments in short urban agri-food supply chains. Currently, urban farms operate in rather small scales, partly due to limited resources, sustainability requirements, lack of infrastructure, and deficiencies in regulatory compliance policy, food quality assurance system implementation guidance, local distribution platforms, etc. Moreover, urban farming's small-scale operation form, combined with seasonal distribution patterns result in very high operational and distribution costs. Supply chain partners need targeted support in order to support and improve urban farming business operations. Emerging local-to-local business models are expected to facilitate contemporary needs and promote sustainability.

1 Introduction

By 2050, approximately 68% of the world's population will live in urban areas (FAO, 2018). This rapid urban population growth poses a critical challenge for food production and distribution in urban areas, and managing food security and safety will become ever more challenging. Traditional agriculture operates in a large scale, and produces food in an industrial process, which often leads to severe environmental impacts. Furthermore, centralized food production, and long transportation distance from rural to urban area increases air pollution and energy consumption (Srinivasan and Yadav, 2023).

The key challenges faced by current west economies are sustainability and food security, in terms of food production, distribution, consumption, and include food loss and waste as well (FAO, 2021). The traditional food supply chain has its limitations; it is difficult to realize that food travels between 1,500 to 2,000 miles to reach final customers in developed countries. Conventional food supply chains often involve many partners, include multiple nodes, and are strongly associated with negative environment impacts (Gruchmann et al., 2019). In conventional food supply chain, small to medium producers have also limited power to control prices, and cannot be independent from their supply chain partners (Morkunas, et al., 2022).

Based on Melkonyan's research in 2020, there are some general food consumption trends related with sustainable development, which can be identified in most EU countries. The increasing awareness related to sustainable food production creates a demand for urban food production and SFSC. Evidence shows local food production has the potential to increase regional economic development, food security, and reduce environment impacts (Bimbo et al, 2015). Urban farming enables growing fresh food within or near urban areas, and reduce food dependence from distant food suppliers and distributors.

By bringing food production closer to consumers, urban farming has the tendency to establish a shorter and more direct supply chain, reduce supply chain partners, minimize in-between handling process, and reducing transportation distance (Paciaroti and Torreginai, 2018). A localized food production avoids transit processes, which reduces the central role of retailers and distribution centers, provides alternative distribution channels, which can shorten food accessibility distance, and provides fresh food in regional food markets. The decentralized food production system leads to a more resilient supply chain, promotes regional economic development, ensures food security, and can reduce urban food safety risks (Peters et al., 2009).

SFSCs are recognized as an innovative option to increase sustainability and reduce problems associated with traditional long supply chain. Till now, there is no

* Corresponding author: zhu.l@buas.nl

unified definition for it, however, the "small social distance" characteristic of SFSCs has been recognized among all scholars, which includes two dimensions: i) limited players, ideally only producers and customers; and ii) close geographical relationship between producers and consumers (Peters, et al., 2012).

Generally, SFSCs are less exposed to climate change, nature disasters, and geopolitical disruptions, such as the COVID-19 pandemic from 2019 to 2022, and ongoing war in Ukraine since 2022. Urban residents can enjoy versatile fresh food products and local heirloom crops. Moreover, urban SFSCs can reduce food waste by decreasing handling processes and involved supply chain partners. It is easy to adopt market changes, since SFSCs directly connect producers with consumers (Charatsari et al., 2020).

Urban SFSCs have undoubtable benefits, such as increasing independence of small to medium size farms from intermediate parties, preserving local traditions and heirloom plant species, promote local business, etc. (Vanyi and Felfoldi, 2021). Except direct benefits for producers or growers, SFSCs can also provide healthier food to customers from a shorter range, reduce supply risk and uncertainty, increase food quality, and reduce food waste (Morkunas, et al., 2022).

However, SFSCs topic has not been thoroughly investigated in urbanized industrial countries. In those countries, the economic and social structure is constructed according to industrial food mass production system, and localized food production cannot fit in easily. Many challenges remain when considering implementing SFSCs in urban area, such as: strict food hygiene standards, product traceability, pre-financing, post-harvest management and distribution (Vanyi and Felfoldi, 2021).

In this paper we employ the single case study approach to get insights from urban SFCSs. In particular, we present the main operations of a Dutch urban biological hazelnut farm, and its supply chain configuration. Based on these observations, we explore the sustainability benefits, the challenges and limitations of urban SFSCs and we discuss the main considerations towards mainstreaming the paradigm of urban SFSCs.

2 Methodology

A single instance or case within its real-world setting is thoroughly examined in-depth as part of a single case study, a type of research methodology. This approach is very helpful for investigating intricate phenomena in its natural environment, which enables researchers to obtain a thorough grasp of the topic. A comprehensive investigation utilizing a variety of sources of information, including interviews, observations, and records, is conducted with a specific case in mind. This case may involve an individual, organization, event, or action. Researchers can obtain understanding of the larger environment and variables impacting the case by examining the case in the context of real-life events (Baxter and Jack, 2008; Yin, 2009).

Single case studies come in several varieties, such as exploratory, descriptive, and explanatory. Descriptive case studies seek to give a thorough explanation of the situation, whereas exploratory case studies investigate a phenomenon and suggest new research questions. Case studies with explanations aim to elucidate the causes of a phenomenon. Rich, comprehensive data and a thorough comprehension of the case in its actual environment are two of the single case study methodology's key benefits. It also gives researchers the adaptability to deal with new problems that arise while the study is being conducted. Single case studies do, however, come with certain drawbacks. The results obtained from a solitary case study might not be applicable to other instances or larger populations, and they might have limited generalizability. Additionally, there is a chance for bias because the study may be influenced by the researcher's viewpoints. Additionally, even a single case study may need a lot of resources and time due to the extensive data collection and analysis involved. Notwithstanding these drawbacks, single case studies are helpful for learning in-depth details about particular phenomena and are especially helpful in the social sciences, business, and medical domains (Yin, 2009).

In this paper, the descriptive case study approach has been followed. Descriptive case studies present a narrative of a real-world issue and how it was addressed, using crucial information and expert commentary to assist the audience comprehend the causes, forces, and results of the implementation. They emphasize on the main characters' perspectives, actions, solutions, and outcomes. This method provides for a thorough assessment of the solution, its efficacy, and any process changes. The ultimate goal is to share lessons learnt for comparable issues.

3 Case study: Urban biological hazelnut farm

3.1 Main operations

The biological hazelnut farm is located in a suburb area of the Netherlands, 18 minutes from a nearby city by car. It is an open environment and soil-based cultivation farm. There are about 1,700 households in that region (Government of the Netherlands, n.d.). In 1990, the grower transferred his hazelnut breeding hobby to a business; since then the owner and grower works part-time in the farm. In 2011, this urban farm extents from 3.5ha to 5.5ha. Compared to the average Dutch farm size which was 41.43ha in 2021 (Dutch government centre bureau of statistic, 2021), this is a small-scale urban farm. The land has an irregular shape, lays in between different land lots and resident properties.

All hazelnut trees grow in an ecological environment and the farm has been accredited by SKAL, a Dutch biological certificate, which is recognized by Dutch government.

They sale three different types of biological products: raw hazelnut in shell, raw hazelnut, and hazelnut oil. They distribute their products in both B2B and B2C

channels. Currently in the Dutch market, more than 75% of hazelnuts come from Turkey and Balkan region.

Despite this is a commercial farm, it aims to bring no environmental harm during production, and embrace healthy living conditions for both humans, animals and plants. The hazelnut farm also functions as an urban sustainability hub. It tries to improve local living conditions and life quality. There are various activities organized in the farm to increase public sustainable awareness, such as: birdwatching, harvest and testing day, tree planting, education about hazelnut tree species, etc.

The annual output of this farm is 1,500kg/ha, but the harvest amount may fluctuate 50% depending on climate and environment factors. The grower has experienced differentiation in annual harvest from 4,000kg to 12,000kg. The harvest period starts in late September and early October and lasts about 10 days. Once hazelnuts fell from trees, the farm owner drives a small nut harvesting machine to sweep all nuts together, and then uses a big fan to blow all dirt, leaves, and twigs away. For keeping the desired quality, all nuts will go through a sieve. The next step is to wash the nuts, and immediately dry and store them in a temperature- and humidity-controlled building. The washing step needs to be completed manually in a rinse tank.

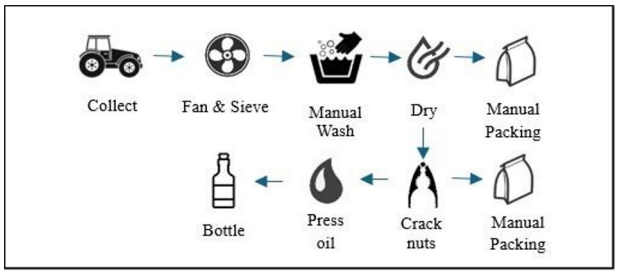

Fig. 1. Hazelnuts post-harvest handling process

For selling the whole nuts, they need to be packaged depending on customer requirements. Small plastic bags of 250g and 500g, and big jute bags of 5kg and 9kg are used. Hazelnuts can store up to 2 years with shells, but only 2 months without shells. Therefore, the step of cracking hazelnut is only done after receiving orders. Two different plastic packages are offered for peeled nuts: 150g and 500g. The packaging process requires manual work as well, which is time consuming. On average, it will take 5 minutes for packing 1kg of nuts. Furthermore, depending on customer requirements, the peeled nuts will be further processed to hazelnut oil and bottled. **Fig. 1** demonstrates the entire process of hazelnuts post-harvest handling.

The post-harvest handling process normally takes around 2 months to complete, which is by the end of November. Until than all hazelnuts should be ready for sale. Due to the popularity of local produced biological products, new harvest is sold within a year.

3.2 Hybrid SFSC for urban distribution

The hazelnuts urban farm distributes their final products to both customers and businesses. Due to limited productivity, hazelnut is a seasonal product. The owner does not have enough products to supply through the entire year, normally, they only supply their products 3 months after harvest. The farm owner organizes a simple website to promote their farm and farming activities. Customers can easily find the expected annual harvest period, open for order/sell date, product information, order process, and contact information. Local customers can give a call or email to the owner for ordering products, and later pick the hazelnuts up from their farm. The owner also offers delivery services for customers, who are not geographically close. Customers need to order by email, pay in advance through bank transfer, and then the owner will ship their orders by using parcel delivery services, and an extra sending cost is added on hazelnuts price.

For B2B distribution, the hazelnut farm has a long-term partnership with an organic wholesaler. The organic wholesaler is located about 70 km far from the hazelnuts farm. The wholesaler arranges trucks to pick up the hazelnuts. They will further distribute those nuts to different industry partners in Europe, where they will be further processed into different biological products, such as: nougat, chocolate, oil, ice cream toppings, cookies, etc. For their hybrid urban SFSC mapping, we refer to **Fig. 2**.

Manual processing individual orders and arranging small bag products requires a lot of extra time. Therefore, the farm owner prefers to sell a part of his products in bulk. The farm owner is aware of his choice's impacts, however based on operation constraints, there is no other solution till now. According to the owner, the current sales between final consumers and business partners is evenly distributed, compared with the starting phase of his farm, when the majority of hazelnuts were sold to business partners. Therefore, the development of a SFSC

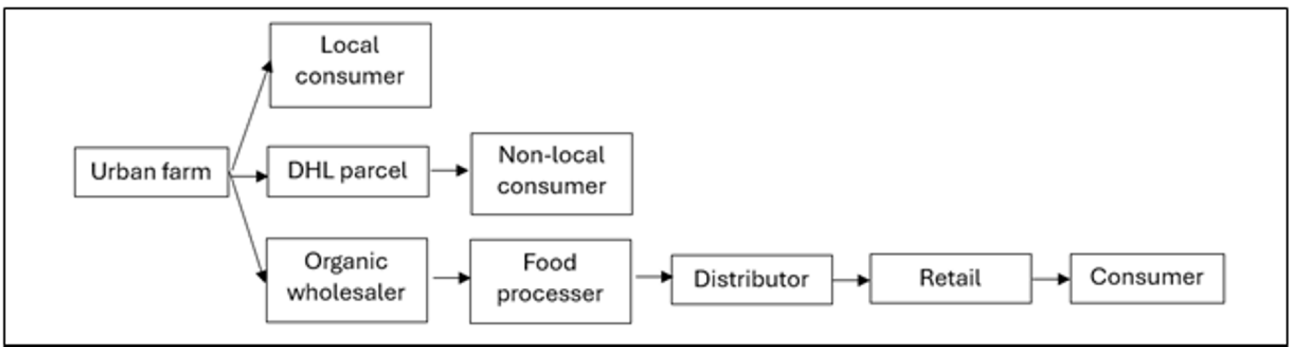

Fig. 2. Hybrid SFSC for urban distribution

is obvious.

This hybrid type of food supply chain merges SFSC approach with a traditional distributor-controlled long supply chain. It is a transition period product, caused by current operation and distribution constraints.

3.3 Sustainability benefits

This urban farm practice brings many local environmental benefits by rehabilitating nature environment and preserving arable land, among others. It also increases urban food security, decentralises food production, minizines reliance on distant food producer, enhances local self-sufficiency, and further strengthens urban resilience (Srinivasan and Yadav, 2023).

From a social standpoint, the farm owner actively promotes biological farming practices, and evolves local residents in different farming activities, to substantiality increase awareness. As a result, the urban farm provides fresh seasonal products, alternative nutritious food to consumers, and enhances their overall culinary experiences (Srinivasan and Yadav, 2023).

From a logistics viewpoint, urban farm brings food production closer to urban residents; the "local to local" business model enhances interactions and relationships between growers and consumers, which can lead to initiatives in building urban SFSCs. Eventually, this will automatically minizine the need of long-distance transportation (Paciaroti and Torreigiani, 2018).

3.4 Challenges and limitations

SFSCs require specific logistics solutions, which highly depend on products traits and distribution options. Commonly, logistics and operational constraints are the main causes for failures in SFSCs (Kneafsey, et, al., 2013).

Land in the Netherlands in very expensive, and the amount of arable land is very limited (van der Meulen and Stobbelaar, 2024). As many Dutch cities expand and urban population rises, urban land has high demand for housing, commercial, and infrastructure (Srinivasan and Yadav, 2023). Currently the hazelnut urban farm is a very small-scale farm, and there is no possibility to expand. Therefore, economies of scale in production cannot be realized. Mechanizing all post-harvest processes will not bring any remarkable economic advantage. The price of hazelnuts sold in this urban farm is twice the price of imported hazelnuts from Turkey.

Furthermore, limited space also restraints other value-added logistics processes, such as space for drying and processing hazelnuts, temperature and humidity controlled storing space. The owner does not have enough storage capacity to keep a steady hazelnuts supply through the entire year. He needs to reduce his stock by selling bulk to wholesalers. Consequently, it is difficult for him to serve the local consumer market, and to focus on fostering an urban SFSC.

Associated with food quality, there are strict food hygiene standards in the Netherlands. Moreover, biological products need to follow the guidelines and regulations to perform a series of processes that ensure product quality, safety, and environment requirements (EU, Agriculture and rural development). The hazelnuts farm owner needs to follow those rules for receiving product certification. This reduces his time and energy to focus on short distance distribution network building. Lack of machinery during post-harvest process creates bottlenecks in operation and hiring extra personnel is not a viable option.

Often the small and medium-sized farms are unable to access food trade channels independently (Diofasi and Freund, 2022). Large supermarkets are not willing to accept small scale local produced food, and it is difficult for local producers to create differentiated supply strategies, control product quality, adjust their product range based on seasonality, and arrange customized logistics (Reisch et al., 2013).

It is not easy to let regional mainstream food logistics system focus on sustainability, and adopt short distances delivery (Engelseth, 2016). Currently, urban farm growers need to solve their products' distribution issues in isolation. As many urban farming products' characteristics are described as seasonality, perishability, and small batch sizes, the majority of logistics service providers refuse to handle such complex cases with little profit margin. Logistics costs are very high, sometimes even higher than the product's value (Paciarotti and Torregiani, 2020).

As discussed earlier, it is very difficult for urban farm products to reach mainstream food selling points and alternative distribution channels, such as local food stores. In addition, food markets have not shifted their business emphasis on local products and SFSCs. Information is rarely provided in local stores and markets, urban farms' products have not been promoted locally, and collaborations between local entrepreneurs have not established (Melkonyan, et, al., 2020).

In the urban hazelnuts farm, all private orders have been arranged by phone calls or emails, in the absence of an online ordering system. Customers' information has not been properly collected and kept, crucial data is not organized and analysed. The final delivery destinations, and main markets' geographic region are unknown. This makes structuring and managing a supply chain even more difficult (Gruchmann, et. al., 2019).

4 Discussion: Mainstreaming the paradigm of urban short food supply chains

There is a growing popularity towards sustainable way of living, healthier eating habits, and fair trade. SFSCs offer many opportunities for both producers and consumers in establishing a new sustainable economy. Vice versa, those new changes create opportunities for boosting SFSCs development.

Although current economy form and social infrastructure are not fully prepared for accelerating SFSCs in urban areas, many initiatives have been taken by different social stakeholders. Entrepreneurs' minds are not locked, constant innovative ideas inspire SFSC

developing in different future directions. Schaltegger and Wagner's study in 2011 indicates, when small entrepreneurs incorporate sustainable aspects into their company core strategies, they often trigger market sustainable innovations.

Producing food in a sustainable way, and distributing them locally through decentralized SFSCs, coherence with United Nations 17 Sustainable Development Goals (SDGs) (UN, 2023), and European Union Green deal (EU, 2020). In the past several years, numbers of studies indicated solid willingness from different local stakeholders to participant in "local to local" movement, and actively distribute their product in a SFSC, nearly half amount of farms show interests to directly sale their products to end customers (Vanyi, and Felfoldi, 2021). The Eurobarometer survey in 2020, shows relative strong interest in consuming local food products, and creating decentralized SFSCs for local market. Additionally, according to research from Melkonyan, et al. (2020), consumers show increasing awareness and openness towards sustainability topics in urban farming and "producer to consumer" concept.

Some general food consumption trends can be found in recent research across Europe. Those trends are relevant to sustainable development, they express the growing needs for local, organic, seasonal, and fair-trade food (Melkonya, et al., 2020; EU, 2018; EU, 2020). Consumer awareness increasing impacts on food production and system, which directly results sustainable food market's expanding (Berti and Mulligan, 2016).

Many researchers have investigated sustainable supply chain coordination and there is enough knowledge can be used in creating different types of collaboration in SFSC. Gruchmann, et al. (2019) have stressed the importance of information, skills and resources sharing in supply chain coordination. Transparency is crucial in creating long-term partnerships in SFSCs, and address issues such as product origin, processing information, and label. Trust-based relationships can enhance SFSC's performance, and increase supply chain coordination effectiveness (Gruchmann et al., 2019). Melkonyan, et al., (2020) have showed in their research, that coordination of SFSC is a complex decision-making process, which requires a holistic approach. Their research concludes different logistic designs based on environment, profit, and distribution network options: pick up point option for centralized distribution; home delivery option for decentralized distribution. Regional food hubs can act like 3rd party to facilitate SFSCs, as they are businesses or organizations that manage food distribution, and support producers trade in different platforms and channels (Diofasi and Freund, 2022). Establishing collaboration with different local food producers and logistics services providers is also a potential solution to optimize SFSC's efficiency.

In the literature there are a few cases reported on urban SFSCs. MercaTiAmo in Parma (Italy) is a farmers' market initiative that connecting 14 local producers directly with urban consumers in Parma. Filippini et al. (2023) analysed its economic impact and concluded that the initiative has generated not only positive economic effects for the local area, but also the economic sustainability of local food system. One of their hypothesis validates that to achieve large turnovers, farms may need to establish formal relationships with local businesses. Filippini et al. (2023) also pointed in their study that it is difficult to access appropriate data, especially when investigating small-scale farms or part-time farmers, they often lack of analytical accounting systems.

The case of agrifood baskets in Viseu Dão Lafões Region (VDLR), Portugal was analysed by Pato (2020). She studied promoters of agrifood basket initiatives in this region. These baskets allow urban consumers to receive regular deliveries of local farm products. The urban SFSCs provided environmental, economic, and sociocultural benefits to producers, consumers, and the region at large. The basket initiatives provide direct contact between producers and consumers, which can dramatically increase customer loyalty. Pato (2020) concluded that in the VDLR, SFSCs are still at an early stage. Despite all successes, there were some limitations in terms of improving communication and developing marketing strategy that may constrain these initiatives. Local authorities should actively support and empower all urban SFSC stakeholders, and promote trainings and other knowledge exchange activities.

Influenced by bioeconomy and related technologies development, many new urban farming solutions have emerged, which suit operating in a small size of land with relatively low costs. These include vertical and indoor farming, hydroponics and aquaponics, renewable energy sources and efficient irrigation system, etc. Those technologies improve productivity, with a smaller footprint, and meet the requirements to operate in urban and suburb areas (Zambrnao-Prado et al., 2021).

Industry 4.0 provides many new opportunities in agriculture, which can dramatically change agricultural operations across supply chains. Traditional farming is transformed to precision farming, driven by big data analysis. Remote sensing, robots, and farm management tools can automate many manual tasks, and efficient logistics networks can be established for urban farms (Kumar and Vineet Kumar, 2023).

Governments can support urban SFSCs and local products by promoting labelling and certification schemes that promote sustainable approaches within certain geographic regions. This can increase consumer recognition, promote traceable, authentic, and high quality food products. This can result increasing trust between different social stakeholders, and actively involve growers and consumers in taking initiatives to build SFSCs (Kneafsey et al., 2013).

Governments could also use existing facilities, such as local commercial centres or offices, agricultural cooperative organizations, and entrepreneur networks to provide training or information for facilitating local farms developing their own SFSCs (Kneafsey et al., 2013). Organizing local business events or farm market is an effective way to connect growers with local food business owners or consumers to stimulate short supply chain forming.

Due to urban farm space constraints, farm owners often cannot afford to hire extra personnel, which results in limited capacity for handling consumer orders and products distribution. This can be addressed by involving hobby growers as volunteers joining production process during seasonal peaks, and encouraging consumers participating in crowd shipping. This tactic can strengthen community relationships, increase sustainability awareness, and reduce environmental impacts. Therefore, increasing social interaction, in person connection, convenient fresh food accessibility are also side benefits for establishing SFSCs (Melkonyan, et al., 2020).

Local integration and consolidation of decentralized businesses should also be encouraged, since different business entities can share tools, platforms, and equipment. This practice is not only increasing resources utilization rate, but also reduces cost and environmental impacts.

5 Conclusion

Recognized by the United Nations, urban farming and SFSCs bring sustainability benefits across social, economic, and environmental issues (Kneafsey, et al., 2013). This leads many municipalities across Europe encouraging urban farming development and promoting SFSC transformation, but governmental policies and protocols are still not clearly defined.

Concluded from this case study, local authorities have not actively supported communities, entrepreneurs, and commercial centres to transfer local economy towards a decentralized food production form. Information sharing and trainings about establishing urban farming and SFSC are absent, agronomic technical supports and business administration skill educations are lacking as well (Srinivasan and Yadav, 2023).

This study identifies many challenges in operating urban farms and establishing SFSCs. Urban farms in the Netherlands have not been fully accelerated. There is no quick fix or one solution fits all. This research provides valuable insight from a case study, which demonstrates the operational complexity of SFSCs in an urban area. Moreover, this research presented sustainability benefits, challenges, and opportunities in urban SFSCs. The current hybrid form of the hazelnut urban farm is a temporary solution, which can be seen as an intermediate phase in SFSC development. However, with proper governmental support, consumer willingness, and new technology adoption, urban SFSCs may prove to be a viable solution in the near future.

There are certain limitations in this qualitative research, which are mostly associated with the limitations of a single case-study analysis. Moreover, in order to select the most appropriate SFSC collaboration format in urban areas, an in-depth understanding of requirements from key stakeholders is essential, which means that it is important not only to analyse additional cases, but also to focus on longitudinal case studies of urban SFSCs, thus studying their evolution, resilience and viability.

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