

INNOVATION IN SPARSE ENVIRONMENTS: THE GEOGRAPHICAL INNOVATION DILEMMA OF THE SWEDISH FOOD INDUSTRY

Thomas Blom, Svante Karlsson¹



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Abstract: This article discusses how spatial organization can influence innovation capacity within the Swedish food industry. Although the sector is economically significant, it is characterized by relatively low levels of innovation and international competitiveness. The article argues that this pattern reflects not primarily weak innovative capabilities, but the geographical conditions under which the industry operates. To capture this, the paper develops the concept of a *geographical innovation dilemma*, referring to the tension between strong local embeddedness and limited access to external knowledge flows. Firms benefit from place-based knowledge and cumulative learning, yet their location in rural and peripheral regions may restrict access to research environments, innovation infrastructures, and broader networks associated with more transformative forms of innovation. By integrating insights from economic geography and innovation studies, the article proposes a conceptual framework for understanding innovation in geographically dispersed industries. It also highlights the need for place-sensitive innovation policies that account for the specific conditions of rural and peripheral contexts.

Keywords: agri-food industry, innovation, economic geography, rural periphery, Sweden

Highlights

- Introduces the concept of a geographical innovation dilemma.
 - Explains low innovation through spatial and institutional conditions.
 - Shows how local embeddedness supports incremental innovation.
 - Highlights constraints on access to external knowledge flows.
 - Calls for place-sensitive innovation policy in peripheral regions.
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1. Introduction

From a Swedish perspective, the food industry remains a key component of the national economy, not only through its contribution to the supply chain but also through its role in employment, regional

¹ Professor Thomas Blom, corresponding author, ORCID: 0000-0003-1847-6245, e-mail: thomas.blom@kau.se; Ass. Prof. Svante Karlsson, ORCID: 0000-0002-3105-1500, e-mail: svante.karlsson@kau.se; Department of Geography, Media and Communication, Karlstad University, Sweden

development, and the shaping of cultural landscapes. The industry is also central to national food security. The contemporary Swedish food system comprises four main segments: primary production, processing, retail and restaurant activities, and wholesale. Together, these employ over 390,000 people, making the food sector one of Sweden's largest industries (Svensk dagligvaruhandel, 2025; Tillväxtverket, 2025).

Over the past few decades, the sector has undergone significant structural transformations. The number of farms has declined, while the remaining units have increased in size and become more geographically concentrated (Brouder et al., 2015; Swedish Agency for Economic and Regional Growth, 2025), although many small and medium-sized businesses in the sector as a whole, remain located in sparse environments (Rytkönen et al., 2013; Rytkönen, 2016; Rytkönen & Oghazi, 2022). At the same time, production has become increasingly mechanized and digitized, and the workforce more specialized and in some cases export-oriented (Nordregio, 2025). The sector has also developed a growing dependence on imported inputs, while environmental and climate-related concerns have become central to both policy and production practices (Lindström, 2021). Food-related issues have also gained prominence in public debate at local, regional and national levels, with policy efforts increasingly focusing on strengthening food security, stimulating entrepreneurship, and promoting regional economic transition (Martin & Martin, 2021; Rytkönen & Oghazi, 2022).

Despite these developments, the food industry in Sweden exhibits relatively low levels of innovation and international competitiveness compared to other sectors of the Swedish economy (Sweden Food Arena, 2021). This raises an important question: how can this apparent innovation gap be understood in light of the sector's structural and geographical characteristics?

This article argues that the relatively low innovation capacity of the food industry is not primarily a consequence of weak capabilities, but rather reflects its spatial organization, particularly its localization patterns. Drawing on economic geography and innovation studies, the paper develops a conceptual framework centered on what is here termed a geographical innovation dilemma. This dilemma refers to the tension between strong local embeddedness and limited access to external knowledge flows, which together shape the conditions for innovation in geographically dispersed industries.

The purpose of this article is therefore to develop a theoretical understanding of how spatial structures influence innovation capacity in the food industry. By integrating perspectives on agglomeration, related variety, and socio-technical transitions, the paper contributes to a more nuanced understanding of how place-specific conditions shape innovation processes in relatively sparse environments.

Although the empirical focus is on Sweden, the argument is relevant to other countries with similar geographical and institutional conditions. The article begins with a brief overview of the theoretical literature on innovation, place, and development in rural and peripheral areas. Against this backdrop, the concept of the geographical innovation dilemma is introduced and examined, with particular emphasis on its analytical and policy-related implications for rural development. Finally, the implications of the proposed framework are discussed, along with directions for future empirical research that can further develop, test, and refine its analytical validity.

2. Theoretical Points of Departure

2.1 The institutional framework

The food industry faces major challenges in terms of resource efficiency and long-term economic and environmental sustainability. Meeting these requirements calls for innovations that not only improve existing processes, but also transform entire production systems. In the food sector, innovation is therefore not only about product development and process efficiency, but also about broader issues related to sustainability, resilience, and systemic transition. AgriFood Fokus (2024:1) shows that Swedish and European innovation policy is increasingly moving away from a one-sided focus on economic growth towards promoting a socially and environmentally sustainable transition. From this perspective, innovation can be understood as a strategic driver of transformative change in unsustainable systems, rather than merely as a means of strengthening competitiveness.

Three key perspectives on innovation are particularly relevant in this context: (1) the linear perspective, where innovation is seen as a sequential process from research to market; (2) the innovation system perspective, which emphasises interaction between firms, research organizations, and institutions; and (3) the socio-technical perspective, where innovation is understood as a system-changing force capable of transforming established structures (AgriFood Fokus, 2024:1). While all three perspectives are relevant, the socio-technical approach is particularly important for understanding the need to overcome institutional and geographical barriers.

These barriers may be technological, organizational, cultural, or spatial, and often constrain innovation to incremental improvements with limited transformative potential (Schot & Geels, 2008). This suggests that the innovation capacity of the food industry is not absent, but structurally constrained. Incremental, radical, and transformative innovations are all required to address the complex challenges of the food system, including resource efficiency, reduced environmental impact, and improved socio-economic outcomes (Crippa et al., 2021; Rockström et al., 2020).

In this context, the interplay between technology, user behaviour, and institutions is crucial. Innovation not only enables more sustainable and efficient production methods but also supports new business models and strengthens system resilience. However, achieving such outcomes requires institutional conditions that support experimentation, niche development, and scaling processes.

The state and its institutions play a central role in enabling such transformations. Regional innovation policies, including the development of test beds and clusters, can help strengthen innovation capacity even in peripheral regions by facilitating knowledge exchange between academia, industry, and the public sector (Geels, 2019; Schot & Steinmueller, 2018). The significance of innovation must therefore be understood in its spatial and institutional context.

2.2 Place and innovative capacity

Research in economic geography has long highlighted that innovation is unevenly distributed geographically. Over time, research on innovation and competitiveness has primarily followed two main approaches: an internal perspective focusing on firm-level organization and management, and a geographical perspective emphasizing the importance of place, networks, and regional environments. The latter highlights that firms' location plays a crucial role in shaping their innovative capacity (Aoyama et al., 2012; Coe et al., 2019).

Building on classical contributions (Marshall, 1890; Weber, 1929; Hoover, 1937), a large body of research has demonstrated how agglomerations facilitate knowledge diffusion, learning, and innovation through proximity and interaction (Malmberg & Maskell, 2002, 2004; Boschma et al., 2009). These processes help explain why innovation tends to be more dynamic in urban regions than in rural areas.

However, this relationship is not uniform. Research also shows that small and specialized environments can exhibit strong innovation capacity, particularly where firms are embedded in long-standing local networks and interact with demanding customers (Lindgren et al., 2017). In such contexts, innovation often emerges through cumulative learning and incremental development. However, the importance of proximity should not be reduced to simple geographical co-location.

Despite its central role in the economy, the Swedish food industry appears relatively conservative, with limited levels of transformative innovation (Rytönen, 2016; Sweden Food Arena, 2021). This suggests that innovation processes are shaped not only by firm-level capabilities but also by broader spatial and institutional conditions.

The concept of related variety further highlights how innovation benefits from interactions between related but not identical industries, enabling knowledge transfer through labor mobility and networks (Boschma et al., 2009). However, such dynamics are less pronounced in geographically dispersed sectors such as the food industry, where firms often operate outside dense innovation environments.

2.3 The role of geography – the innovation dilemma of sparsely populated areas

Theories of agglomeration emphasize the importance of geographical proximity for knowledge exchange and innovation (Bathelt et al., 2004). Urban environments provide dense networks, diversified economies, and access to resources that support innovation.

In contrast, the Swedish food industry is largely characterized by small and medium-sized firms located in rural and peripheral regions (Henning, 2009; Holm et. al., 2013). This spatial structure reflects both the sector's dependence on agricultural raw materials and historical patterns of development. At the same time, it creates structural challenges for innovation.

These firms often operate in what can be described as “thin innovation environments” (Isaksen & Trippl, 2014), with limited access to research institutions, capital, and external networks. While local embeddedness provides relational capital and supports incremental innovation, it may also limit exposure to new ideas and technologies.

This paper conceptualizes these conditions as a geographical innovation dilemma, in which firms benefit from strong local embeddedness and place-based knowledge while simultaneously facing structural constraints due to limited access to external knowledge flows and innovation infrastructures. This dilemma helps explain why innovation processes in the food industry tend to be incremental rather than transformative.

Bridging this gap requires strengthening connections between local firms and external knowledge sources, for example through digital collaboration, regional innovation platforms, and partnerships with research institutions. Understanding this dilemma is therefore crucial for developing more effective and place-sensitive innovation policies.

3. Conceptual discussion: The geographical innovation dilemma

The analysis suggests that the innovation capacity of the Swedish food industry is shaped by a combination of spatial and institutional factors. Rather than reflecting a lack of innovative potential, the relatively low level of innovation can be understood as a consequence of structural conditions associated with geographical dispersion and limited integration into urban innovation systems.

The concept of a geographical innovation dilemma captures this tension. On the one hand, firms benefit from strong local embeddedness, relational capital, and place-specific knowledge, which support continuous learning and incremental innovation. On the other hand, these same conditions may limit access to external knowledge flows, advanced research environments, and innovation-supporting infrastructures, thereby constraining more radical forms of innovation.

This perspective highlights the limitations of applying urban-centered models of innovation to geographically dispersed industries. Instead, it points to the need for place-sensitive innovation policies that recognize the specific conditions of peripheral regions. Strengthening innovation capacity in the food industry, therefore, requires strategies that connect local knowledge bases with external sources of expertise.

The main contribution of this paper is the conceptualization of the geographical innovation dilemma as a framework for understanding innovation in dispersed industries. By linking spatial organization to innovation dynamics, the paper provides a foundation for future empirical research. Such research could, for example, examine how different forms of proximity influence innovation outcomes or how policy interventions can reduce the geographical innovation gap.

Future empirical research could further develop the proposed framework in several directions. Comparative studies could examine similar dilemmas characterizing the food industry in other sparsely populated regions of Europe. Case studies at the firm and regional levels could analyze how local embeddedness interacts with different forms of proximity – geographical, organizational, and institutional – in shaping innovation outcomes. Policy-oriented research could investigate which initiatives most effectively bridge the gap between rural firms and external knowledge infrastructures. Such studies would

help determine under what conditions the geographical innovation dilemma is most pronounced and how it can be strategically mitigated.

4. Conclusion

This article has argued that the innovation challenges of the Swedish food industry are best understood not simply as firm-level shortcomings, but as the outcome of a geographical innovation dilemma. Because the sector is strongly anchored in rural and peripheral environments, it benefits from local embeddedness, tacit knowledge, and cumulative learning. At the same time, these locations often provide more limited access to diversified labor markets, research institutions, specialized services, and the broader knowledge flows that support transformative innovation.

The article's main contribution is conceptual. By bringing together economic geography, innovation studies, and rural development research, it proposes a framework for understanding why geographically dispersed industries may exhibit substantial adaptive capacity while remaining comparatively limited in radical innovation. The argument also carries important policy implications. Innovation policy for the food sector cannot rely solely on models derived from dense metropolitan ecosystems. Instead, it must recognize the territorial conditions under which innovation is produced and seek to connect local knowledge bases with external infrastructures.

The Swedish food industry is therefore not best described as non-innovative. Rather, it innovates under uneven spatial conditions. Recognizing this is essential both for future empirical research and for the design of more effective rural and regional development strategies.

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