From Collaboration to Knowledge Flow: Mapping Government-Funded Agri-Tech Networks

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Abstract

Knowledge diffusion is crucial for innovation, allowing actors to exchange ideas, build on existing research strengths, and develop new technological capabilities. However, the efficiency of knowledge exchange depends on the structure of the network—whether it is well-connected, fragmented, or overly reliant on redundant ties (Chang et al., 2023; Lee et al., 2010). Understanding these network characteristics is essential, as they directly impact knowledge flow and overall network performance.

This study analyses the connectivity of knowledge networks using government-funded project collaboration data, particularly in the Agri-tech sector. The Agri-Tech sector, defined as "any technological or science-based innovation utilised to improve the productivity and sustainability of agriculture, horticulture, aquaculture, and forestry, including on-site storage and processing of food and non-food products" (Department for International Trade, 2021), presents a compelling case for studying the formation of collaboration and knowledge networks through public R&D funding.

The UK Agri-tech sector has witnessed significant growth in recent years, encompassing a wide range of sub-sectors including plant and animal science, precision agriculture, aquaculture, and disruptive technologies like robotics and drones. As of June 2024, the sector comprised 1,277 businesses operating across 4,297 geographical locations, with the majority (73%) being microbusinesses with fewer than 10 employees. These businesses are distributed across twenty-one clusters throughout the UK, with varying concentrations in different regions and technology areas (Innovation & Research Caucus, 2025).

The UK government has made sustained investments in Agri-Tech, beginning with the Agri-Tech Strategy in 2013, which led to the establishment of the Agri-Tech Centres in 2016 (UK Government, 2013). The 2018 Industrial Strategy further reinforced this commitment with a £90 million investment in transforming food production (UK Government 2018). In 2023, Innovate UK announced plans to merge its three Agri-Tech Centres into a single entity, aiming to create a more integrated capability to drive better outcomes across innovation, commercialisation, and adoption in the Agri-Tech sector (UKRI, 2023).

Despite these efforts, recent research has identified significant barriers to commercialisation in the sector, including: access to finance, particularly for scaling up; skills and expertise gaps; collaboration issues between technology developers and end-users; slow adoption rates among farmers; and regional disparities in infrastructure availability. While there exists a rich constellation of soft and physical infrastructure supporting Agri-tech activities, there is greater strength in lower Technology Readiness Levels (TRLs) and more limited facilities supporting innovations closer to market. The identification of these barriers provides crucial context for our network analysis approach, as they suggest potential structural weaknesses in how knowledge flows through the sector's innovation ecosystem. By applying the social network

analysis approach, we can identify whether critical knowledge bridges are missing between research institutions and commercial entities, potentially explaining the documented difficulty in translating innovations to market. Furthermore, our analysis of redundant versus efficient bridges will help determine if resources are being allocated optimally across the Technology Readiness Levels, potentially explaining the imbalance between early-stage research support and commercialization capabilities.

To conduct this analysis, we utilise the Gateway to Research (GtR) database, covering the period from 2006 to 2024 and containing 161,660 projects. This dataset allows us to map collaboration patterns in government-funded Agri-tech projects. Since Agri-tech projects are not explicitly categorised, an LLM-based classification is used to identify relevant projects by analysing project descriptions and keywords, with validation from domain experts and policy documents. To enhance accuracy, Data City's keyword library is incorporated directly into the LLM prompt, allowing for more precise filtering of relevant projects. Additionally, firms within the Agri-Tech sector are flagged, and their involvement in projects is examined to complement the main filtering method. A collaboration network is then constructed, where nodes represent participating organisations and edges denote project-based collaborations.

This study aims to provide a framework to construct a knowledge network identification process, based on co-publications, co-patents, and citation flows, and applying network science and percolation analysis to examine:

- Overall network structure: Is the network fragmented or well-connected?
- Bridging sufficiency: Are there enough structural bridges facilitating interregional knowledge diffusion?
- Redundant and inefficient bridges: Do some connections fail to contribute to effective diffusion?
- Potential bridges: Which new interregional connections could enhance connectivity and improve knowledge flow?

Using betweenness centrality, structural hole analysis, percolation threshold testing, and weighted link analysis, we will identify critical, redundant, and missing bridges in the regional network. Additionally, we will explore how related variety—the presence of complementary knowledge domains—affects diffusion dynamics. By simulating the impact of new and removed bridges, we will provide policy insights for targeted interventions to improve network efficiency and interregional knowledge exchange.

This study contributes to the literature on knowledge systems, knowledge networks, and spatial diffusion by offering a data-driven framework to optimize regional connectivity. The findings will provide policymakers with actionable strategies to strengthen knowledge exchange, enhance collaboration networks, and ensure resilient knowledge diffusion pathways, ultimately fostering innovation.

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