EU-SPRI ECC International Conference

PHDAYS25

Conference Proceedings

CSIC
Consejo Superior de Investigaciones Científicas

EU SPRI
European Forum for Studies of Policies for Research and Innovation

ingenio
CSIC-UPV

Universitat Politècnica de València

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Title: PhDays 2025 Conference Proceedings

Scientific Editors

INGENIO (CSIC-UPV), Universitat Politècnica de València

Publisher

2025, Editorial Universitat Politècnica de València

Cno. de Vera, s/n.

46022 Valencia (SPAIN)

www.lalibreria.upv.es / Ref.: 6814_01_01_01

ISBN: 978-84-1396-315-0

DOI: https://doi.org/10.4995/PhDays2025.2025.21171

Language: English

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ORGANIZING COMMITTEE'S PREFACE

RE-FOCUSING INNOVATION

The **EU-SPRI ECC 6th International PhDays Conference,** held in March 2025, marked an important gathering point for a diverse community of early career researchers committed to addressing the major challenges of our time. Under the theme ***Re-focusing Innovation: Governance Frames, Innovation Ecosystems and Co-creation Networks,*** the conference, organized by PhD students at INGENIO (CSIC-UPV) for international PhD students, created a relevant space for critical exchange, stimulating creation of ideas, and collective learning.

Over the course of the conference, researchers from multiple disciplines and geographies came together to share frameworks, methodologies, and experiences that speak to the urgent need for profound transformations in our societies: transformations that innovation must not only accompany, but also question and reconfigure.

The 6th edition of PhDays invited participants to critically reappraise the notion of innovation, its social nature, its uneven effects, and the ways in which policy and governance can respond to these complexities. Structured around two broad thematic pillars, *Pushing the boundaries: Redefining the limits of innovation* and *New forms of generating innovation,* the conference provided a platform for reflection on innovation's role in environmental, socio-economic, and political contexts.

The call for papers invited transdisciplinary approaches, participatory methodologies, and case studies from across the globe, encouraging reflections that connect theory with practice and local knowledge with global concerns. Participants addressed a wide array of topics, from the social and environmental impacts of innovation to emerging governance strategies, territorial transitions, and the role of knowledge networks in driving transformative change. These thematic threads were articulated through eleven parallel sessions, covering topics such as *Urban Transitions from a Justice Approach, Arts, Visual Culture and Society, Agroecological Transition and Agrifood Policies, Regional Development, Technology and Sustainability, Values in Research and Higher Education, Health Innovation, Policies and Barriers, Knowledge Circulation and Networks in Science, Environment, Innovation and Organizations, Innovation Systems and Governance, Open Science and Technology Diffusion, and Green Innovation and Global Supply Chains.* Rather than dividing the conversation, these sessions wove a rich, situated, and critically engaged tapestry of insights that reflected the complexity and interdependence of the challenges we face.

ORGANIZING COMMITTEE'S PREFACE

AT THE HEART OF PHDAYS 2025 WAS THE QUESTION: WHAT DOES IT MEAN TO RE-FOCUS INNOVATION TODAY?

The conference fostered deep conversations about the role of public administrations in enabling sustainable innovation, the importance of inclusive and collaborative governance, and the power of networks that connect universities, civil society, governments, and the private sector to drive social, ecological, and economic transformation. The contributions showcased throughout the event underscored the value of embracing complexity, learning from both success and failure, and rethinking innovation through the lens of equity and co-creation.

The keynote lectures by Melanie Walker, Adrian Smith, and Valeria Costantini offered broad and thought-provoking conceptual frameworks that resonated with many of the research papers presented. Their interventions helped to anchor the conference's commitment to critical dialogue, intellectual openness, and engaged scholarship.

This volume brings together a selection of the contributions presented during PhDays 2025. The works gathered here reflect not only the academic quality of the conference, but also a shared sensibility: one that envisions the future through a reparative, situated, and intersectional lens. A future not merely defined by technological advancement, but co-created from the ground up—through the everyday, the collective, and the possible.

We hope this publication serves as a testament to the times we are living in, and as a tool to continue opening pathways toward more just and sustainable worlds.

The conference proceedings are organized according to the thematic sessions outlined in the programme, ensuring coherence between oral presentations and written contributions. Each thematic section reflects a specific area of inquiry within the broader field of science, technology, and innovation studies, providing a structured and comprehensive overview of the debates and research shared during PHDAYS25. You can navigate through the thematic areas covered in the Conference.

We extend our warmest thanks to all keynote speakers and participants for their invaluable contributions to PHDAYS25 and for the spirit of collegiality and engagement that defined our discussions. Your adaptability and understanding in light of the necessary restructuring of the programme, prompted by the climate alert issued in Valencia, were deeply appreciated and a testament to the resilience and solidarity of our scholarly community. The insights, questions, and exchanges you brought to each session enriched the conference beyond measure, and we are sincerely grateful for your presence and participation.

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EU-SPRI ECC
International PhDays 2025 Conference
March 5th, 6th & 7th, at the INGENIO (CSIC-UPV) facilities in València

From market exclusion to Local Agrifood System's transformation: grounding public data infrastructures of Valèncian Short Food Chains

Galiana-Carballo, Cristina

INGENIO (CSIC-Universitat Politècnica de València), , crigacar@upv.es

Short bio: PhD student in agrifood system analysis, ecological economics and agrarian development, BSc Environmental Engineering and MSc Local development and project management. Currently working as research assistant in INGENIO CSIC/UPV in national and international research projects.

How to cite: Galiana-Carballo, Cristina. (2025). From market exclusion to Local Agrifood System's transformation: grounding public data infrastructures of Valèncian Short Food Chains. In *Proceedings of the 6th International PhDays Conference* (pp. 1-12). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.20935

Abstract: Short food chains (SFCs) have long garnered interest from producers and consumers due to their potential to integrate environmental, economic, and social sustainability. Yet several uncertainties and gaps remain in SFCs studies. Moreover, SFCs continue to face significant challenges related to poor performance, scalability, and economic viability when compared with their alternatives. SFCs logistic ties are characterized by high levels of transparency, cooperation and enhanced governance among local stakeholders, thus contributing to Local Agrifood System (LAFS) transformations. The city of València exemplifies an ongoing commitment to LAFS sustainability, notably through its adherence to the Milan Urban Food Policy Pact (MUFPP), which promotes local food governance and agroecological transition. València's metropolitan area encompasses highly productive agricultural land, significant fisheries, and livestock facilities that contribute to local food capacity constrained by weak SFCs, thus a bottleneck in local food supply is present. Local farmers experience market exclusion due to factors such as small-scale operations, limited access to capital, price volatility, and the dominance of large retailers in the global food supply chain. Additionally, while SFCs are often associated with positive environmental and social outcomes, empirical evidence remains inconclusive regarding their comparative profitability and sustainability. Our research aims to

contribute to the upscaling assessment of SFCs in València by systematically characterizing existing supply chains and analyzing their environmental, social, and economic impacts. By leveraging and updating local quantitative and qualitative data on food flows, costs, and losses, we seek to enhance understanding of SFC performance. Employing a mixed-methods approach that integrates Social Network Analysis (SNA) and Material and Energy Flow Analysis (MFA), our study will address critical gaps in data collection and assessment. Ultimately, our research seeks to provide local public authorities with updated 2024 data and data-driven tools to support evidence-based local food policies, fostering a more sustainable and resilient agrifood system in València.

Keywords: SFC, logistics, agrifood system, food flow.

INTRODUCTION

Short food chains (SFCs) have attracted the interest of both producers and consumers in the context of local agrifood system's transformation, yet debate over SFCs' impact in achieving certain societal goals is of contestation (Stein & Santini, 2022).

Challenges related to poor performance and scalability of SFCs persist (Bayir et al., 2022). SFCs are considered sustainable supply chains because they integrate environmental, economic, and social objectives while promoting high levels of transparency, cooperation, and shared governance among supply chain actors (Paciarotti & Torregiani, 2020), but also counterfactual impacts and uncertainties about relocalization and local alternative food systems in food security and food access, logistic optimization and carbon footprint are present in current literature (Stein & Santini, 2022).

The city of València's adherence to the Milan Urban Food Policy Pact (MUFPP) represents a public commitment to advancing alternative agrifood systems, including shifts in urban food policy toward local food governance and agroecological transitions (Sarabia et al., 2021). The metropolitan area of València (see figure 1) includes highly productive farmland (l'Horta de València), covering 21.101 hectares of agricultural land (IVE,2022), as well as fisheries producing 1.785 tons of seafood and edible fish annually (Institut Valencià d'Estadística, 2022) and livestock facilities supplying approximately 4.300 tons of meat per year (IVE, 2022). Historically, València's food supply relied on SFCs like local markets and direct sales mechanisms, some of which remain nowadays in operation.

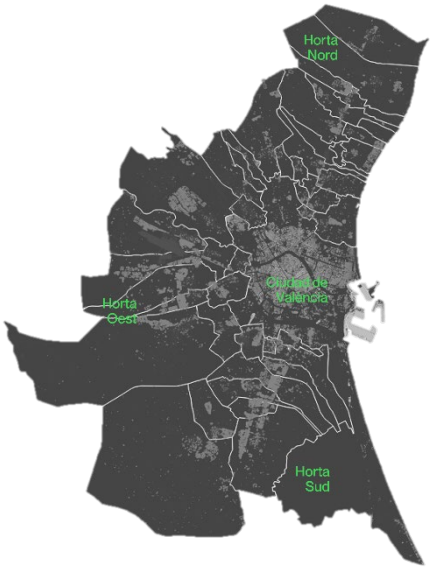

Fig. 1. *València city and metropolitan area of l'Horta (1:200000), comprising 45 municipalities and 1.635.239 inhabitants in 2024 (INE, 2025).* Source: my own with IGN geodatabase (IGN, 2013).

However, SFCs still account for only a small share of total food consumption in València: according to the 2022 Food Survey, SFCs supply an estimated 8.5% of total dietary intake in the city (MAPA, 2022). As in other contemporary cities worldwide, València's foodshed -as surrounding region with a certain potential to satisfy city's food demand according to Schreiber et al. (2021)- does not meet total food demand but it can supply of a certain amount and types of food products -mostly horticultural products according to López-García et al. (2024)- if market chains and intermediate operators achieve to re-convey those to the city.

Despite their historical significance, local food production and distribution face major challenges. The agricultural population and farmed area in València have been in decline for decades, making local food supply increasingly difficult and likely worsening local stakeholder`s food governance (López-García et al., 2021). Local farmers struggle with exclusion from food markets due to structural constraints, including small farm sizes, financial limitations (e.g., labor shortages, price instability, and capital access), and knowledge gaps in marketing and administrative skills, as several studies highlight (Mayordomo Maya et al., 2023; Nifatova & Danko, 2024; Romero & Francés, 2012). Additionally, the dominance of free-market competition in global food supply chains and the influence of large retail operators have further reduced the profitability of local food production (López-Estébanez et al., 2022). A recent review in Stein and Santini (2022) highlights that benefits of SFC are not equally spread between stakeholders, nor certain statement of environmental and social outcomes are to be directly derived from LAFS and SFCs when compared to global chains and current agrifood system's configuration (Enthoven & Van den Broeck, 2021). However, no publicly available or comparable data—either from public or private sources—definitively demonstrates whether SFCs in València are less profitable or sustainable than other food chains. Yet, extensive literature points to SFCs potential to improve both local farmer's and small food retailers profitability by reshaping local food chains and food governance (Deller et al., 2017; Enthoven & Van den Broeck, 2021)

The literature highlights major structural barriers to the scaling-up and competitiveness of SFCs compared to conventional food distribution systems. Local sustainable logistics remain a key area of study, yet research in this field is limited (Adams et al., 2021; Paciarotti & Torregiani, 2021; Todorovic et al., 2018). A significant gap in the literature concerns the lack of a challenge-oriented approach to planning, sourcing, and reverse logistics within SFCs.

Existing research often focuses narrowly on logistical operations while underestimating the importance of social and governance challenges (Bayir et al., 2022). Additionally, studies on local agrifood systems reveal a critical lack of systematic data collection and public data infrastructure (Enthoven & Van den Broeck, 2021). Food data remains fragmented, privatized, and dispersed across a large number of stakeholders.

To support the transformation of València's LAFS through data-driven policies for SFCs upscaling, we are conducting research aimed at characterizing and comprehensively analyzing existing SFCs in València. By leveraging and updating local quantitative data on food supply and food flows, costs, and losses, as well as examining governance structures and SFCs' stakeholder configurations, we will assess the environmental, social, and economic outcomes of València SFCs. Our research employs a mixed-methods approach, including Social Network Analysis (SNA) and Material and Energy Flow Analysis (MFA), to enhance data collection comparativeness and assessment. The ultimate objective is to provide local public authorities with updated 2024 data and data-driven tools to support comprehensive and evidence-based local agrifood policies.

ANALYTICAL FRAMEWORK AND BACKGROUND

The research is based on previous work on urban agrifood system metabolism in Valencian metropolitan area, to be published in 2025 and advanced in López-García et al. (2024). A summary of main research gaps identified in our previous work includes (1) data lacking on SFCs market penetration and operators (2) public data deficits in local agrifood system and food flows (3) inexistence of consistent data and methodologies to leverage costs and welfare outputs of SFCs at the study area.

Besides, previous work achieved (1) a comprehensive database on 2022 annual snapshot of food stocks and flows in the study area (2) a methodology to map food operators infrastructure and energy costs of that infrastructure in the study area (3) an assessment of LAFS capacity to supply local food demand. Specifically, a LAFS' lock-in identification relates to food last mille costs optimization, intermodality added costs and total food transport balance between SFCs and global food chains per product. This lock-in implies first a high uncertainty and lack of comparative and comprehensive data as well as a gap in current literature (Aragão et al., 2022; Enthoven & Van den Broeck, 2021; Saralegui-Díez et al., 2023; Stein & Santini, 2022).

Our research engages with current literature on food-flow urban studies, SFCs and local

agrifood systems (LAFS) configuration (Schreiber et al., 2021; Paciarotti & Torregiani, 2020; Adams et al., 2021; López-Estébanez et al., 2022). Food flow studies quantitatively track down food shipments and supply chains to estimate resources and environmental footprint embodied in food flows, commonly overlooking intermodality upstream and downstream added costs (Aragão et al., 2022; Saralegui-Díez et al., 2023). On the other side, SFCs studies focus on either food supply governance and food logistics, frecquently lacking of coherent methodologies yet providing place-based outcomes (Stein & Santini, 2022). LAFs's studies are focused on multidimensional sustainability of food networks at local scale.

Very few studies address operational food network's challenges, including the upscaling of short food chains, logistical inefficiencies, and fragmented data infrastructures that limit effective decision-making (Bayir et al., 2022). Our approach reflects contemporary calls for integrative approaches to understand the complex interdependencies in LAFs (Sarabia et al., 2021), specifically SFCs' impact over LAFs.

Regarding SFCs, Schmitt (2018) identified seven criteria for defining localness: distance, supply chain size (in terms of both operators and food miles), the number of intermediaries based on sales channel typology, the percentage of direct sales, local know-how, product territorial identity, and governance, understood as the degree of control exerted by local actors.

Figure 2 illustrates the various SFCs configurations to be analyzed in this study, which encompass different distance-based and social-based relationships between producers (local farmers) and consumers within the study area. These relationships can either be mediated by local intermediaries and retail operators or involve direct exchanges between producers and consumers. Within these configurations, logistical nodes interact through the exchange of information, value transactions, and the redistribution of chain losses and costs.

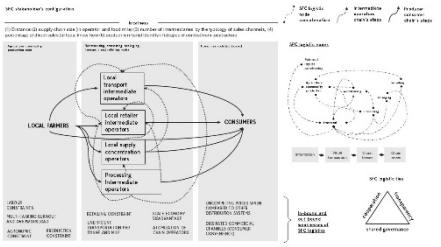

Fig. 2. *Short food chains' (SFCs) configuration, nodes, weaknesses and ties between stakeholders*. Source: our own based on Paciarotti and Torregiani (2020).

Relocalization through *localness* approach to SFCs configuration does not necessarily lead to greater LAFS sustainability (Enthoven & Van den Broeck, 2021; Stein & Santini, 2022). This statement is frecquently based on food miles reduction with respect to other food chains (Stein and Santini, 2022) yet several other factors apart from geographical arrangement contribute to food chain sustainability (Gori & Castellini, 2023). To account for 'local food paradox', as presented in Born & Purcell (2006), we conceive our approach from different dimensions, assuming that the transformations of the LAFS aligned with

societal goals like food sovereignty, food quality access, and food justice depend on specific social, economic and environmental practices and outcomes within a given locality, rather on just the scale of localness.

Material and energy flow approach of food chains aims to systematically quantify the inputs, transformations, and outputs of both materials and energy throughout the entire food system (López-García et al., 2024; Saralegui-Díez et al., 2023). This approach identifies inefficiencies, environmental impacts, and potential hotspots for improvement, thereby informing strategies for more sustainable agrifood configurations. Including stakeholder configuration and logistic ties in a short food chain study at a local scale intends to capture both the social and operational dynamics that underpin the SFC. Analyzing stakeholder configuration helps map the relationships, power structures, and governance mechanisms among producers, intermediaries, retailers, and consumers (Paciarotti & Torregiani, 2020), while examining logistic ties reveals the flow of goods, information, and value—critical for understanding efficiencies and bottlenecks (Bloemhof et al., 2015). This integrated approach enables the identification of both collaborative opportunities and structural constraints that influence sustainability, resilience, and the potential for upscaling SFCs (Bayir et al., 2022; Sarabia et al., 2021).

Assess place-based socioeconomic outcomes for stakeholders allows for a systematic evaluation of how economic benefits, workload and labor conditions, market access, and decision-making power are distributed within SFCs. This quantitative measure complements analyses of stakeholder configurations and logistic ties by identifying inequities and pinpointing areas for targeted interventions, thereby nurturing data-driven policies in local agrifood systems.

Comprehensive traceability of food flows and products relies on the diffusion of data from previous exchanges throughout the supply chain (see Figure 2). While the primary logistical objective of SFCs is to meet local food demand with locally sourced products, their distinguishing feature—compared to conventional food chains—is the emphasis on logistic ties: transparency, shared governance, and cooperation at varying levels. The upscaling of SFCs therefore depends on both strengthening these ties and addressing stakeholders' structural weaknesses within the food chains (Bayir et al., 2022; González-Azcárate et al., 2021; Gori & Castellini, 2023b).

MAIN RESEARCH OBJECTIVES

Our starting point is to consider that Valèncian LAFS data lacking is patent as well as that market exclusion of local farmers can be overriden through SFCs upscaling. Previous work in the study area (see López-García et al., 2024) highlighted the lack of consistent public databases and lack of transparency along the food chains as the main operational issues to address in order to convey data-driven local sustainable agrifood system's policies.

This research project is focused on using multi-stakeholder and multi-dimensional

data to analyze Valèncian SFCs. Research stages thus correspond to three-fold outcomes: mapping current structure of SFCs (Stage I), nurturing public data infrastructures (PDI) (stage II) and identifying lock-ins and barriers for upscaling SFCs market diffusion (stage III). The main goal is to elaborate a ground basis for public data-driven SFCs longitudinal analysis.

METHODOLOGY

Stage-sequenced methodology with a mixed-methods approach is to be applied to achieve the expected results (see Table 1). In the following table are shown the main methods in the research project.

Environmental and quantitative assessment through Material and Energy Flow Analysis (MFA), which quantifies production inputs, transformation processes, and losses (López-García et al., 2024) is to be conducted. This approach has been widely adopted to identify inefficiencies and environmental hotspots in agrifood systems (Saralegui et al., 2023), allowing researchers to pinpoint areas for sustainability improvements. To map SFC's governance and social dimensions, we will conduct a SNA to map interaction and power relations (Brinkley et al., 2021; Fuchs-Chesney et al., 2023).

Table 1. *Mixed-methods mapping in a stage-sequenced research project*

Research sequenced stages	Methods	Data outcomes
Mapping SFCs (Stage I)	Stakeholder's structured interview (exploratory-descriptive approach, predefined actor selection and snowball search)	SFC-SWOT analyses per stakeholder Knowledge and information flows Proxy data for MFA stocks and flows assignation's decision trees Node typologies for SNA analysis (Brinkley et al., 2021; Madureira et al., 2019)
	Social network analysis (SNA) through Gephi package	Size, density Nodal importance (centrality) Subgroups Sociograms Influence-interest matrix per stakeholder (Brinkley et al., 2021; Trivette, 2019)
Nurturing PDI (Stage II)	Secondary data refinement of food stocks and flows	Quantitative data for MFA (weights, distance, operation) Cadastral and geospatial information Emission factors (López-García et al., 2024)
	Data crossing in public databases	LAFS data availability matrix
	Geostatistical analysis	Food miles and local food flow costs

Research sequenced stages	Methods	Data outcomes
Lock-ins and barriers (Stage III)	MFA of SFCs	Annual snapshot on food flows, capacity and SFCs costs Internal rate of return (IRR) per stakeholder and stakeholder's localness
	SFCs Econometric analysis	Food volume per client and client type in small retailers Food affordability index compared to large retailers (McFadden et al., 2016; Stein & Santini, 2022)
	SFCs multidimensional analysis	SNA, MFA, econometric assessment

Study data leverage is based on secondary data sources and primary data sources for SFCs multi-stakeholder's characterization and analysis. Primary data sources consist in semi-structured interview, observational field data (OFD) leverage and stakeholder's operational data consultancy. This exploratory-descriptive study sample approach is designed through place-based expert criteria and snowball search. Preliminary stakeholder's summary is presented in Table 2.

Table 2. *Preliminary stakeholder's summary and expected participation in the research of València's SFCs*

Stakeholder	Sample	Primary data leverage
Farmer	5	Operational and interview data
Transport operator	2	Operational and interview data
Small retailer	5	OFD, Operational and interview data
Large retailer	1	OFD, Operational and interview data
Supply concentrator	4	Operational and interview data
Food processing operator	2	Interview data
Public-private partnership in local food logistic infrastructure	4	OFD, Operational and interview data

RESEARCH PROJECT INNOVATION TRAITS

Agrifood system's data-driven local policies are often constrained by public authorities capability to leverage field data. It is also present the difficulty to access data analysis tools as sustainability metrics are neither universal nor easy to conduct. This research proposes a multi-stakeholder and multi-dimensional approach to a LAFS intended to ground the basis for a SFC's public data

infrastructure. Contributions to literature gaps are indeed expected: material and energy in food flows, stakeholder's configuration and socioeconomic outcomes of SFCs. Such PDI is expected to enhance evidence-based policymaking, improve local operator's competitiveness against large wholesalers, and promote sustainability by retaining value within the LAFS.

KEY FINDINGS AND EXPECTED RESULTS

Expected results include SFC's analysis (mapping, multi-dimensional assessment, data leverage protocols and metrics) and LAFS snapshot annual analysis (2024), thus a 2022-2024 comparative and evolutionary analysis is posible as annual data for 2022 IS already available. Key expected findings relate to the following dimensions of Valencian SFCs and LAFS:

Stakeholder Collaboration and Governance: The study is expected to identify and characterize through different methods the SFCs stakeholder's configuration (influence, interest, information-knowledge flows and econometric analysis).

Food logistics optimization and Environmental Performance metrics: lock-ins, barriers and inefficiencies of SFCs are expected to be identified through the research. As open-source data is to be builded, manifold stakeholder's can benefit from the food data disclosure, ranging from local government, consumers. intermediate operators and farmers.

Improved Socioeconomic Outcomes Assessment: By conducting socioeconomic index, the research should highlight disparities in market access and profitability for small and medium-sized enterprises (SMEs) and local farmers. This outcome will underscore the need for targeted policies to counteract market exclusion and enhance competitiveness against large wholesalers.

Value Retention metrics across the Food Chain: The integrated data infrastructure is expected to trace the retained value within the local food system, identifying how economic benefits spread or concentrate through the food operators in SFCs.

Innovative Policy and Data Infrastructure Development consultancy: Finally, by bridging gaps in public data and sustainability metrics, the research will lay the groundwork for evidence-based local policies, addressing current public policy challenges and contributing to a replicable framework for local agrifood systems transformations.

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Democratizing Transformative Innovation Policy: a proposal from Just Transition approach

Clara Furió-Vico

INGENIO (CSIC-Universitat Politècnica de València), , cfurvic@upv.es

Short bio: Clara Furió-Vico is a predoctoral student at the Instituto Ingenio (CSIC-UPV). His main lines of research are transitions towards sustainability, just transitions, governance and the intersectional perspective.

How to cite: Furió-Vico, Clara. (2025). Democatising Transformative Innovation Policy: a proposal from Just Transition approach. In *Proceedings of the 6th International PhDays Conference* (pp.13-22). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.20934

Abstract: The objective of this research is to analyze, from the perspective of Just Transitions, the case study of the new governance model developed by the Generalitat de Catalunya "Shared Agendas" in the province of Lleida. Through the methodological proposal of the *Regional Pathways to Sustainability,* it is intended to capture complex institutional dynamics in regions through actors, networks and events in space-time and, subsequently, from the Just Transitions approach, carry out an analysis from the four models of justice: procedural, distributive, recognition and restorative. The methodology used is qualitative through documentary analysis, semi-structured interviews and participant observation.

The study will be developed over three years, structured in strategic stages that include the review of the literature, fieldwork in the province of Lleida, the analysis of results and the main conclusions. The ultimate goal of this research is to contribute to rethinking how transitions towards social and environmental sustainability are generated through key elements and actors, such as governance and public administrations.

Keywords: governance, transitions to sustainability, just transition

STATE OF ART

TRANSITIONS TO SUSTAINABILITY

The doctoral thesis "The Shared Agendas in Catalonia: a new model of governance from Just Transitions" is part of a project of the Plan

National Institute of the Ministry of Science, Innovation and Universities called: "Promoting regional transitions to sustainability through the policy of

transformative innovation: the case of the Shared Agendas".

Throughout this first point, we will briefly develop the main theoretical frameworks on which the doctoral thesis is based, going through the case studies -very relevant to understand the importance of the predoctoral stay-, together with the objectives and ending with the methodology implemented.

Thus, this research is based on three different frameworks to generate a new theoretical proposal: transformative innovation policies, Regional Pathways Sustainability and Just Transitions.

In this sense, the focus of socio-technical transitions towards sustainability offers a methodological proposal that guides societies in the initiation and management of systemic reconfiguration processes aimed at achieving long-term objectives in the environmental, social and economic spheres (Geels, 2004, 2018)

Thus, as processes that involve the restructuring of power and political relations, governance has become a key factor in transition studies and is intensively linked to these areas of study, so it is important to highlight that, as Avelino et al. (2016) put it, we are dealing with inherently political processes, a consideration that many authors are already evidencing in their works (Hinrichs, 2014; Konefal, 2015; Lachman, 2013; Markard et al., 2012; Marsden, 2013; Scoones et al., 2015)

However, despite the obvious growth and success of the field to date, it has inevitably attracted some criticism. One is that much of transition theory is underpinned by a fundamentally technology-focused, market-driven model of system change (Lawhon and Murphy, 2011) and is therefore too biased towards technological innovation as the primary mode of systemic intervention (Shove and Pantzar, 2011). 2005).

In terms of the ethical aspects of transitions, justice has been an underdeveloped element (Tribaldos & Kortetmäki, 2022) and although the main studies have focused mainly on energy transitions and more recently, on food systems, relevant considerations for justice remain scarce (Kaljonen et al., 2021; Tribaldos & Kortetmäki, 2022) and fundamental questions remain about how to determine the fairness of a mitigation process, pathway or policy, as well as what factors define it and who benefits (Tribaldos & Kortetmäki, 2022).

On the other hand, based on the field of transitions, from the field of Public policies The third generation of innovation policies emerges: transformative innovation policies that break with traditional approaches, such as innovation systems based on evolutionary economics or linear R+D policies. (Schot & Steinmueller, 2018)

Transformative innovation Policy (TIP) does not only pursue economic growth, but also addresses global social and environmental challenges with a participatory approach. This model integrates citizens and social organizations in the production of alternative solutions to local problems. Innovations seek integral sustainability and arise from the interaction between traditional and non-

hegemonic actors, which facilitates the transformation of socio-technical systems such as energy or water (Velasco & Bernal, 2023).

This approach also fosters experimental spaces where social innovations and traditional knowledge are enhanced, promotes new institutions to coordinate multisectoral policies, and reinforces the interaction between disciplines and local knowledge to transform the educational and social system.

Within this broad framework, there is a general consensus around two key points: first, the importance of understanding how innovation policy can be leveraged to tackle major societal challenges; and second, the critical role that public institutions' administrative and organizational capacities will play in enabling the implementation of such transformative policies (Karo, 2018). The transformative innovation literature has also made significant progress in shaping a renewed policy agenda and supporting the restructuring of innovation policy processes.

Regarding their main characteristics, TIPs are based on different characteristics (Haddad, 2022):

Grand Challenges and Inclusive Growth: Innovation policy is increasingly reorienting itself towards solving "grand challenges" (Amanatidou et al., 2014).

Directionality: The focus on solving grand challenges implies that transformative innovation policy has a clearer direction than in most innovation systems-based policy frameworks. Consequently, indirectness is seen as a new justification for policy intervention in the literature on transition-oriented policies (cf. Weber and Rohracher, 2012).

Multi-faceted policy intervention: On the other hand, the analysis of transition-oriented policy shows a strong influence of the concept of policy mix, which emerged already in an innovation systems policy context to reflect different types of policy measures, domains and levels of governance (Bugge et al., 2018).

Multiple global actors and networks: Kuhlmann and Rip (2018) point out that actors play an important role as assemblers and reassemblers of socio-technical configurations, opening up the possibility of new constellations of actors emerging and shifting the focus of attention from government agencies and "triple helix" constellations to a diversity of "social" partners, as well as public authorities, civil society and economic operators (Schot and Steinmueller, 2018).

Multilevel governance: When it comes to TIP interventions, the level of efforts should take into account all levels of governance, i.e., local, regional, national, and international (Amanatidou et al., 2014; Steward, 2012). This has also been evident in recent programmes that focus on major challenges and address levels other than local or national.

JUST TRANSITION APPROACH

The term "just transition" was developed by U.S. trade unions between the 1970s and 1990s, extended to global climate

negotiations (Stevis and Felli, 2015), and then incorporated into the European Green Deal (Kyriazi and Miro, 2022). Originally understood as justice for workforces in transforming industries (Stevis & Felli, 2015), the concept has spread in several fields of research, including labor studies, environmental, climate, and energy justice literature, and sociotechnical transition studies (Heffron & McCauley, 2018; Wang & Lo, 2021) and there is no explicit definition of a just transition (Vollebergh, 2023). In parallel to the realm of policymaking, the issue of a just transition has been a topic of interest in different academic literatures in the social sciences and humanities, often linked to issues related to sustainability.

Various studies discuss what the general characteristics of justice should be (Newell & Mulvaney, 2013; McCauley & Heffron, 2018; Fanghella et al., 2023, Zimm et al., 2024, among others); however, there is no explicit definition of a just transition (Vollebergh, 2023).

For our case studies, we consider the following four dimensions of justice highlighted in different combinations in the literature on justice and transition: distributive, procedural, recognition, and restorative justice (Fraser, 1998, 2010; Jenkins et al., 2016; Kaljonen et al., 2020; 2016; McCauley & Heffron, 2018).

Distributive justice is defined as ensuring that the benefits and costs (harms) of environmental decisions are shared equitably among all groups (Bennett et al. 2019; Cha 2020).

Another way a just transition can achieve distributive justice is by ensuring that the benefits of a transition are concentrated in those regions and communities where the costs (e.g., job loss) are most acutely felt.

In an environmental justice context, distributive injustice is argued to occur when poorer communities and communities of color are disproportionately affected by the siting of toxic facilities.

On the other hand, recognition justice aims to ensure that the needs and concerns of all groups within society are recognized (Crowe and Li 2020). Therefore, a TJ approach should ensure that historically marginalized groups are included in decision-making processes (Goddard and Farrelly 2018), including those groups whose “diverse” characteristics are not yet fully understood.

Brown and Spiegel (2019) identify groups such as Indigenous people, migrant workers, and women as important to include, as they are often the least represented in the decision-making process.

Whereas recognition justice addresses the need for affected parties to have a “seat at the table,” procedural justice ensures that those “are at the table” are present.

Procedural justice is less concerned with the outcome achieved and more focused on the inclusiveness and fairness of the process (Hughes and Hoffmann 2020).

The literature highlights that the governance aspects of procedural justice require governments to carefully consider how decisions are made and how options and trade-offs are evaluated (Newell and

Mulvaney 2013). Participation is a key component of procedural justice, but unequal power dynamics mean that participation alone is not sufficient to ensure that stakeholders have a voice and can influence the procedural outcome (Turnhout et al. 2020).

Restorative justice is now understood more broadly, aiming to repair past harms and historical injustices (Whitfield et al., 2021) and to identify where prevention is needed to avoid future harm and address unforeseen harms during transition processes (McCauley and Heffron, 2018).

This includes not only reparations for social or environmental harms, but also has a relational focus on restoring trust and social cohesion after wrongdoing has occurred (Kaljonen et al., 2021; Timmermann, 2020).

REGIONAL PATHWAYS TO SUSTAINABILITY

Finally, the Regional Pathways to Suistanibility (hereinafter RPTS), emerge as a robust alternative to study and shape the processes of institutional change in sustainability transitions where spatial heterogeneity provides a different logic to address general objectives and values: how to capture hidden institutional dynamics, how institutional trajectories evolve in regional development paths over time, how short-term and micro-level changes contribute to breaking the dependence on trajectory, and how different actors influence these processes while at the same time being influenced by their environment (Strambach & Pflitsch, 2022). Source: Strambach and Pflitsch, 2018.

Transition topologies aim to capture processes at the micro level and connect them to long-term changes along the way at the macro level. They display a visible representation of the structure and patterns that emerge from multiple processes at the micro level that add timescale, actors, and space. They are useful for capturing complex institutional dynamics in regions, cities, or other subnational levels by integrating multiple individual narratives and establishing causal reconstruction and process analysis. Topologies map institutional changes (changes in rules and norms in various interdependent socio-technical regimes and regional governance institutions) and organizational changes in terms of temporary and permanent networks and organizations. Organizational changes seek to map how collective resources are mobilized by groups of actors who promote new social practices to break unsustainable patterns (Strambach & Pflitsch, 2018).

In this context, each framework responds to a specific research need. The approach to transformational innovation transitions and policies establishes the theoretical basis for the two case studies. Through the RPTS methodology, it seeks to generate a graphic element that visualizes the transition to sustainability from the institutional perspective of public policies at the regional scale. Finally, the just transitions framework provides the analytical tools for the proposed cases, enriching the elements provided by the RPTS.

CASE STUDIES

For this research, two cases of regional transformative innovation policies are analyzed. The concept of shared agendas has been developed in Catalonia based on the experience of the specialisation and territorial competitiveness projects promoted within the framework of the Strategy for the Smart Specialisation of Catalonia (RIS3CAT) 2014-2020.

Shared agendas articulate, through participatory governance models, the collective action of various actors in a territory to address shared challenges (often related to the Sustainable Development Goals) and their problems and opportunities.

Firstly, the Shared Agenda (hereinafter AC) of Lleida, Pirineus i Aran has focused on the economic transformation of the territory by addressing one of its greatest problems: depopulation. This proposal has made it possible to build a shared vision of the future of all the actors and has facilitated the identification of seven priority areas to make it effective. This prioritization allows the articulation of working groups and the collaborative definition of actions that address specific problems in each area with the active participation of the actors involved in the problem and in the solution.

To date, the agenda has promoted more than forty actions focused on change, which have mobilised more than 10 million euros within the framework of three territorial specialisation and competitiveness projects (PECT) of the 2014-2020 RIS3CAT: Green&Circular, Agrobiofood and Biomarkets. These three STRPs address specific issues in four of the identified priority areas: the agriculture-based bioeconomy, the forest-based bioeconomy, food value chains and renewable energies.

For their part, the Bages region (175,000 inhabitants) and its capital, Manresa (77,000 inhabitants), have very high rates of ageing and over-ageing and, as a consequence, have high rates of dependency and the incidence of chronic diseases associated with old age.

The main problem is the lack of interrelation between the responsible actors and, therefore, the information does not flow and is not accessible. This creates problems and prevents you from being able to carry out a systemic approach to people's problems and needs.

In this context, the BAGESS Shared Agenda (Big data, Analysis, Management and Strategy in Social Health), which has received financial support from the RIS3CAT and the Operational Programme of the ERDF of Catalonia 2014-2020, was born with the aim of generating coordinated responses from all these agents of the ecosystem to address the challenges of dependency and chronicity from the social and health aspects. Universities, research entities, health centers, companies, public administrations and associations of the territory collaborate in this project, which has become the shared agenda of Bages. In the agenda, the actors share objectives and resources, and generate collaborative and transdisciplinary technological solutions that respond to the needs and problems of

sick people and the people who care for them and relate to them.

MAIN OBJECTIVES

This paper attempts to answer the questions: How to graphically generate a transition towards sustainability of a transformative innovation policy at a regional scale? And how can we consider that a regional transition policy is just? Therefore, the research has one main objective and three specific ones:

O1: To analyse transformative innovation policies in the case studies of the Shared Agenda of Lleida, Pirineu i Aran and BAGESS, through the Regional Pathways to Sustainability from the perspective of just transitions.

O1.1: Develop a transition topology towards sustainability that captures the institutional and organisational changes in terms of actors, networks, temporary and permanent organisations, in space and time at the regional level that have influenced the generation of the Shared Agenda of Lleida, Pirineu i Aran and BAGESS.

O1.2: Systematize the four models of justice proposed by the literature.

O1.3: Generate prescriptive indicators to label and direct a transition to sustainability as fair.

O1.4: Compare the implementation of the PIT from the just transitions between both case studies.

METHODOLOGY

The methodology to be used is qualitative, in order to explore the perceptions and experiences of the actors participating in both case studies. In this sense, it is proposed to separate it into four blocks of differentiated actors: Administration

Public, economic actors, civil society and knowledge generation actors.

To this end, there are three techniques used: documentary analysis and digital content generated by the different actors on the case studies (I); 30 semi-structured interviews with participating and non-participating individuals and organizations (II); and participant observation of spaces (III) (forums, conferences, seminars, public presentations, events...) to analyze the formal and informal dynamics generated around each case.

To analyze the extracted data, the qualitative software Atlas.ti is used.

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Nasty pleasures: xenovisuality and schizo eroticism in trans-species pornography

Sara Méndez Lozano

University of Valencia, sara.mendez@uv.es

Short bio: Sara Méndez Lozano is a pre-doctoral researcher at the University of Valencia in the Department of Sociology and Social Anthropology. She holds a degree in Sociology (2022) from the same university and a master's degree in 'Human Rights, Interculturality and Development' from the International University of Andalusia and the Pablo de Olavide University. She has worked as a university lecturer and cultural manager in various art centers. Her doctoral thesis project currently focuses on posthumanism, xenofeminism and affective relations with other species. In her research work is dedicated to studying identities, bodies and dissident sexualities from *queer* and *cyborg* theories. She has attended and published in different national and international sociology conferences and in the spring of 2025 her first essay 'A posthuman crossroads: Orientations from a critical ecofeminist theory' will be published in the *Frontera* collection of the University of León.

How to cite: Méndez Lozano, Sara (2025). Nasty pleasures: xenovisuality and schizo eroticism in trans-species pornography. In *Proceedings of the 6th International PhDays Conference* (pp.23-32). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19575

Abstract: Trans-species pornography is challenging the binary, white, heteronormative identity of human sexuality. Following in the footsteps of French post-structuralism, *queer* and *crip* theories, Deleuze and Guattari's *schizoanalysis* and cyborg posthumanism, this study addresses the interpretation of *xeno* or *queer* sexual practices from pornographic audiovisual productions. Different spaces of porn will be put in relation, trying to identify similarities and differences linked to the social imaginaries of each one of them. Visuality is presented as a field in dispute that is fundamental for the construction of new speculative posthuman and trans-species narratives in the field of sexuality.

Keywords: Posthumanism; Sexuality; Transespecismo; Furry; Xenofeminism; Pornography.

INTRODUCTION

The appearance of non-human identities and practices in pornography is becoming increasingly common. Pornhub's annual statistics show us the growth in searches for categories such as 'Furry' or 'Sex Machines' (Pornhub, 2023-2021). We are seeing the alien, robotic and monstrous emerge as an

erotic identity confronting the human with its more radical constitutive Other. From sociology we cannot overlook these new imaginaries intimately related to the deconstruction of the classic binary identities of gender, race or species. *Queer*, *crip* and *cyborg* theories give us renewed glasses with which to understand the flashes of a booming posthuman current.

Art, literature, music, and philosophy are already taking account of the new direct interrelationship between the human and other animal and technological species. The redefinition of kinship and community ties from critical ecofeminist, socialist and queer proposals draw new symbiotic scenarios with the rest of non-human existences. The irruption of the *xeno* (weird, strange, foreign) is imminent and certainly desirable. Consequently, the transformations in erotic relations can respond to the same wave that is radically critical with human essentialism. Entering the analysis of this *xenosexualities* gives us the opportunity to study these practices in relation to new partial, abject and *nasty* imaginaries.

This research is organised along three thematic axes that interrelate and interrogate each other: posthumanism, sexuality and xenovisuality. The posthuman question emerges from the inevitable hybridisation and questioning of the material and symbolic limits of the human present in the trans-species erotic relationship. Understanding the trans-species as any practice, identity or relationship that exceeds the - socio-historically understood as - *human* (López-Guzmán, 2021), a trans-species eroticism or sexuality would include those erotic relationships that include machinic, fictitious and/or animal elements. The *xeno* (*strange*) is used in this research in an almost analogous way to the trans-species, understanding that the xeno body, the strange or unrecognisable body, is also - and inevitably - non-human.

The understanding of *humanity* as an ontological place of porous and permeable borders appears to be aided by the epistemological turn popularised and extended by the post-structuralist currents of the last decades of the last century. The new focus on the fluidity and indeterminacy of reality through the acquisition of external and/or invisibilised points of view allowed thinkers such as Luce Irigaray, Michel Foucault, Jacques Derrida, Judith Butler or Gilles Deleuze to open up and broaden the way of approaching explanations of the social and political organisation of the time. This revolution in thought, together with the anti-humanist ecological, feminist and decolonial critiques of the 1960s (Braidotti, 2015), would allow, for the first time, the rejection of humanist moral imperatives in favour of reconstituting a different, paradoxically less human, humanity. Understanding the human as historically delimited to a white, masculine and bourgeois excluding identity, there would be no other alternative than to shake all the semiotic-normative-symbolic foundations that sustain it (Braidotti, 2015; Haraway, 2020).

The radical contributions of second-wave feminism (1970s) together with the development of queer and cyborg theories would give way to a heterogenisation of

human identit(ies), validating and vindicating the place of non-binary, black, crippled and/or mad bodies (Butler, 2017). Such questioning of the symbolic apparatus of humanism has in turn been supported by quantum field theories that defend the constant interrelatedness of matter, unable to delimit its boundaries (Barad, 2023). Thus, reality is understood as sticky. In Timothy Morton's terms, we could understand the world as inhabited by hyperobjects that merge, connect and hybridise endlessly (Morton, 2021). Posthumanism thus appears as a reaction to the disenchantment of the human ideal and to recent proposals and discoveries that call into question the existence of the 'individual', 'identity' and 'unity'. The philosopher and biologist Donna Haraway develops an important part of this post-human proposal on the basis of the concept of *Chtlhucene*, which refers to a universe cohabited by constant symbiosis between living beings. Her epistemological contributions concerning string figures and a tentacular and rhizomatic thinking (Haraway, 2019) are aligned with these new sticky materialisms as the ontological basis of the posthuman being. Similarly, the *Xenofeminist Manifesto* of the "Laboria Cuboniks" collective marked in 2018 a practical-discursive line in defense of human hybridity with technology and the denaturalisation of the binary body (Hester, 2018).

The critique of this binary and white humanity as a device of power is fundamental to address an object of study that questions the boundaries of the human, desirable and agential. The recent defense of monstrosity as a profoundly insurgent signifier (Rusell, 2022; García, 2023) accompanies the focus of this research, genealogically studying the origin and evolution of what is considered monstrous in direct relation to what is considered *inhuman*. Characters such as Frankenstein's monster take on special relevance as figures of appropriation of the abject and unrecognizable for trans and queer political and artistic movements across the planet (Stryker, 1993).

Interspecies relationships, both with other animals and with technology, are also undergoing a gradual but profound transformation. The non-human animal understood as a "pet" entails a series of patterns of coexistence and truly intimate and private emotional implications, just as the cell phone or the computer accompany our daily lives as bodily prothesis. It is visible that, compared to the last 200 years, in the West today we coexist with other species in a much more intimate, emotional, bodily and even sexual way. We only have to take a look at the popularization of technological sex toys.

Recent research at the Autonomous University of Querétaro asked university students to reformulate their family trees by including every being they considered affectively part of the family (Vázquez & Fernández, 2024). In an attempt to construct *deanthropic genealogies*, the research managed to reflect the evolution and changes in the human-animal relationship based on the location of animal bodies in the household space, the degree of affective bonding and the type of service offered. To give a particularly interesting example, in the

more recent generations, a novel phenomenon emerged: pets began to have names of their own. Naming thus appears as a hinge between the passage from object to subject.

Just as naming and affective bonding contribute to the formation of a trans-species kinship, it is interesting to study these symbiotic filiations from the point of view of the erotic relationship. To do so, we will have to pay attention to the studies that have emerged on sexuality, from its relation to power and domination (Foucault, 1986) to the analysis of its affirmative, creative and nomadic power (Deleuze & Guattari, 1985). We will return to the Freudian *polymorphous perverse*, the sexual revolutions of the 20th century and the pathologisation of 'deviant' desire (Reich, 1936; Amezúa, 1975)

Xenovisuality, on the other hand, refers to new strange ways of looking and being looked at. Understanding the image as a privileged social code of high pulsional charge in what is currently known as *scopic capitalism*, the audiovisual analysis of the xeno is presented as an innovative technique appropriate to the digital context. The construction of new gazes is thus part of a political epistemology of the image that takes into account the concordance between political regimes and scopic regimes (Brea, 2005; Azparren, 2023). Image and power are indistinguishable. From critiques of the *Society of the spectacle* (Debord, 2005) to current analyses of the political influence of audiovisual content on social networks, visuality has emerged as a fundamental battlefield for the new xeno-trans-monstrous currents.

In relation to this trans-monstrous current, queer and crip theories become complicit in exposing and revealing the transformative potential of the abject, the monstrous, the unrecognisable and uncodifiable. Haraway's cyborg, Foucault's self-transforming and mutating impulse, or Preciado's *biohacking*, join forces to configure an *epistemology of disgust* that takes erotic relations out of the wardrobe of human heteronormative binarism. Therefore, the starting point is to situate the cyborg as a non-place, as a mixture, a crossbreeding between categories and bodies whose frontiers are diluted and linked in symbiogenesis with other bodies. The monstrosity of the cyborg thus makes it appear as an illegitimate existence, as Haraway calls it, a *bastard existence*. (Haraway, 2020). Unrecognisable and unclassifiable bodies, crip bodies capable of arousing rejection, terror, nausea.

Following Deleuze and Guattari - and understanding sexuality as the main index of what they call *schizoanalysis* - the object of study is understood as *schizo*. This adjective given to trans-species eroticism refers in this research to the transgressive and *deterritorialising* character of a difficult-to-interpret eroticism that escapes the codes and rigid readings of sexuality, bodies and identities. The schizophrenic in the work of these authors refers to that which goes beyond the margins, which overflows, which bursts in an unexpected and disconcerting way. In this respect, the *schizo* is associated with the ability to speak outside the code, to express from the incomprehensible, to open new creative paths. In this sense, innovation is inherent to both the content of the analysis

and the approach in line with a continuous opening and broadening of horizons.

MAIN RESEARCH OBJECTIVES AND QUESTIONS

As a result of the interrelationship or mixture between the three thematic axes (post)humanity, sexuality and (xeno)visuality, this research tries to clarify and review how the three categories have historically determined each other. To be read as a desiring subject functions as the gateway to a regime of humanity founded on the capacity to exercise domination in the erotic-symbolic relation. Offering the non-human the possibility of being, firstly, object and, secondly, subject of desire, radically reconfigures our conception of the human, its relations, its identity and its sexuality. The relocation of these elements opens the door to destabilising - as the *xeno* and *queer* movements do - deeply binary, colonial and speciesist human behaviours and structures.

Recent news reports and annual statistics from the pornography site Pornhub (Pornhub, 2021) are manifesting the rise of sexual identities and practices that exceed the human and are situated in in-between and deviant spaces. During the year 2023, a number of news reports came to light concerning a case in the UK of children identifying as animals (Gordon, 2023). It seems that this was not an isolated phenomenon, but that in some Western countries it is increasingly common to find children who understand themselves outside the traditional human label. These data, together with the popularisation of posthumanist themes in culture and art as a reflection of a social and productive system pushed to its limits, show that this is a truly topical issue. The novelty of the subject is also evident in the scarcity of scientific material dealing with it. In this sense, the void in the scientific literature becomes an impulse to begin to take small steps in its analysis.

We could come to understand these trans-species audiovisual productions as part of speculative narratives of the posthuman. Narratives that we are already seeing emerging in artistic and literary disciplines such as in the classic novels of Ursula K Le Guin, the ecosexual art of Beth Stephens and Annie Sprinkle (Sprinkle & Stephens, 2021), the "Xenovisual Studies" collective or the recent and interesting artistic research work of the Institute of Postnatural Studies based in Madrid. Speculative narratives, xenocreative, piercing in the sense that D. Haraway talks about in *Staying with the trouble* (2019): "in what way do these concave, hollowed-out things, these holes in Being, generate richer, more extravagant, fuller, inadequate, continuous narratives from the first moment; stories with a place for the hunter but which are not about him, the self-constructed Human, the human-making machine of history?" (Haraway, 2019: 73)

Therefore, the present research aims to study phenomenologically the emergence and rise of (xeno)pornographic search categories such as 'Furry', 'Xeno' and 'Anthro' in two different fields of

pornographic production: in *mainstream pornography* through the Pornhub platform and in the post-porn movement. The aim is to carry out an analysis of pornographic xenovisuality in spaces with different audiences and social reception in dialogue with the level of repression and/or cultural acceptance.

Finally, placing these three categories in a booming trans-species pornography, allows us to formulate the research question: how is the xenovisuality of trans-species pornography reconfiguring the regime of humanity and its socio-political implications?

Taking into account the currents and axes that guide the theoretical framework, the main objectives of this research are the following:

General objective: To study how trans-species erotic relationships are presented audiovisually and perceived.

Specific objective 1: To conduct an audiovisual analysis of trans-species pornographic content on the Pornhub platform, the *Deep web* and the post-porn movement.

Specific objective 2: To situate this erotic xenovisuality within the framework of an entry into crisis of the human as a cause and consequence of it.

METHODOLOGY

In order to carry out this analysis, a qualitative methodology is used, specifically oriented towards an audiovisual content analysis. This combines a qualitative analysis of visual signifiers using Atlas.ti software, where key theoretical dimensions are coded in the form of indicators. This approach allows for a systematic interpretation of hybrid images and narratives, considering their impact on the construction of subjectivities and the reconfiguration of social imaginaries. This work contributes to methodological and theoretical development and innovation by focusing on an emerging field of sociology (the posthuman / trans-species), which is also located in an emerging space (the digital).

As indicated in the first paragraphs, this audiovisual content analysis is structured around 2 different pornographic spaces related to the Pornhub web platform and the audiovisual productions of postporn. In each of the 2 spaces, 100 videos corresponding to the categories ‘Furry’, ‘Xeno’ and ‘Anthro’ will be collected in order of number of views and likes. From these 100 videos, a selection of the top 10 videos will be made for each pornographic space, resulting in a total representative sample of 20 videos.

To select this sample of 10 videos, the main criterion used is the number of views. Considering that the number of likes may not correspond to the number of views of a pornographic content, it has been preferred to select the videos with the highest accumulation of views in order to analyze the videos with the greatest impact or social influence. In this way, the selection process is structured around the three tags, once the search is filtered by the tag “xeno”, the 10 most viewed videos are selected. As for the temporal delimitation, none is

contemplated, understanding that video views are recorded cumulatively over the years and, therefore, prioritizing the most viewed content, regardless of the time of publication.

This representative sample will be subjected to the corresponding audiovisual analysis guided and organised on the basis of dimensions translated into indicators. Thus, for example, the 'human' or 'animal' dimension can be identified and studied in the videos on the basis of physiognomic and sound indicators such as 'skin colour', 'amount of hair' or 'intelligibility of the sounds emitted'. The sexual dimension, on the other hand, could be analysed on the basis of indicators related to the roles of power in the erotic relationship, the appearance or not of penetration or the incorporation of objects in the sexual act.

Fig.1. *Screenshot of xenopornography on Pornhub with 435 K visualizations.*

Once the samples have been organised and categorised we could begin to draw conclusions about how this trans-species sexuality is presented audiovisually, being able to compare the results of the 2 spaces and, therefore, studying the similarities and differences between 2 places that, symbolically, represent trans-species sexuality from places that are accepted (Pornhub) or openly in a counter-hegemonic struggle (postporn).

The long process of audiovisual analysis is understood as a constant interrelation between theoretical framework and sample, so that categories and indicators evolve in direct relation to what is observed. The research, therefore, induces terminology and the creation of indicators from what the researcher observes, at the same time as she deduces part of her analysis and her gaze from a well formulated and structured theoretical framework. Nevertheless, the research is opposed to presenting itself as closed or solid, but rather its premises or theoretical categories seek to present themselves as flexible and open to their own revision during the process.

Based on this sample and the conclusions drawn from its analysis, we will be able to frame these erotic representations in our socio-historical conditions by analysing their inevitable interrelation as a cause and consequence of these. Thus, the implications of a trans-species and *schizo eroticism* - such as the one analysed - for xenofeminism, the posthumanist current and the resignification of bodies and identities can be studied

INNOVATION AND KEYFINDINGS

This doctoral thesis project aims to draw conclusions and relevant information regarding the way in which trans-species sexual and erotic relations are presented in

pornography. The exhaustive and rigorous analysis of the selected sample aims to understand the erotic imaginary of the trans-species based on its intrinsic xenovisuality, its practices and the identities that appear in them. Obtaining this information is essential to understand the identity and bodily transformations that queer, cyborg or trans-species existences confront us with. Therefore, the extracted data can be useful and interesting for any research interested in the questioning of human frameworks, the development of technology, speciesism and, of course, transformations in the field of sexuality.

The audiovisual analysis described above aims to approach a semiological and scopic understanding of the hybridisations, kinship and erotic relations with the non-human. It is hoped to describe the sexual practices viewed in relation to the social and moral framework in which they are inserted. The place that these xenopornographic practices occupy in today's social imaginary can give us clues about the popularity of posthumanism and the role that the sexual relationship plays in this ethical-political positioning.

This research is presented as a great epistemological challenge. According to Karen Barad, every epistemology is inseparable from its ontology, so that it might be more appropriate to speak of *onto-epistemologies*. This change in terminology is neither innocent nor innocuous but forces us to redefine the way in which we understand science and the subject-object of knowledge relationship. Assuming the impossibility of separating the studied reality from the techniques and methodologies with which it is approached, a *xeno* or posthuman onto-epistemology requires us to escape from the anthropo-centered gaze (as far as possible) and to promote a methodological and terminological creativity. Therefore, this research seeks to permeate new fields critical with the classical theory of knowledge, whether from new materialisms, queer realism, feminist epistemologies or a queer phenomenology.

It is difficult, however, to predefine a clear and forceful methodological path under these onto-epistemic premises that require, finally, a more open, flexible and speculative science. In this sense, the fluidity of the study and its constant openness to new and strange views can ensure a direct access to scientific innovation, escaping from closed and stable methodologies that, although guiding and ensuring scientific results, are sometimes limiting for serendipity and unexpected, innovative discoveries.

Especially in fields such as art, humanities or social sciences, we have observed the emergence of different and innovative epistemologies that question what we have understood as *scientific, neutral* or *objective*. From epistemologies close to hermeneutics to critical and feminist epistemologies with emancipatory intentions, methods of a more interpretative and situated character are producing scientific knowledge. The body as receiver and producer of knowledge, the turn towards emotional and queer epistemologies of Sara Ahmed (Ahmed, 2019), the situated knowledge and string figures of Donna Haraway (Haraway, 2019) or the xenopoetics

and speculative science of xenofeminism (Hester, 2018).

However, not only are these fields exploring subject-object research relations, but, in the natural and physical sciences, cases such as Niels Bohr's quantum discoveries redefine the forms of scientific treatment based on a radical change in how we understand the minimum unit of analysis. From his research, he establishes that the minimum unit of analysis is not the atom, but the *relations* between matter, so that this ontological transformation derives in a new epistemological one from more relational and queer approaches - as developed by the scientist Karen Barad.

Therefore, and based on these innovative approaches with interdisciplinary implications, this study can make a substantial contribution to epistemological innovation and also in social research topics by addressing contemporary and novel themes through digital and audiovisual media, which are increasingly relevant and decisive in the configuration of social imaginaries and cultural meanings. Sexuality and visuality intersect in pornography to form a conductive mosaic of human fantasies and drives, appearing as potential guides for a reconfiguration of our biopolitical apparatuses. As Mon García tells us in *La resurrección de las monstruas* (2023): “bodies, pleasures, desires, sexualities are the challenge that the present is in crisis (...) the personal is political and the sexual as well” (García, 2023: 101).

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EU-SPRI ECC
International PhDays 2025 Conference
March 5th, 6th & 7th, at the INGENIO (CSIC-UPV) facilities in València

Community Art in Eco-Socially Challenged Territories: Co-Creating Futures in l'Horta Sud

Ruth M-Domènech

INGENIO (CSIC-Universitat Politècnica de València), , rutmuodo@upv.es

PhD student in Local Development and International Cooperation of the Universitat Politècnica de València. My thesis explores community art as a tool for eco-social transformation and the collective construction of reparative futures. My interests focus on community art, feminist studies, futures studies delving into reparative futures, action research and ecosocial transformations.

How to cite: M-Domènech, Ruth. (2025). Community Art in Eco-Socially Challenged Territories: Co-Creating Futures in l'Horta Sud. In *Proceedings of the 6th International PhDays Conference* (pp. 33-42). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19961

Abstract: Community art, as a participatory and transformative practice, offers significant potential for addressing eco-social injustices in territories shaped by historical exploitation and vulnerability. This article examines a community art process initiated in May 2024 in collaboration with the Fundació Horta Sud and twelve local associations in l'Horta Sud, a Valencian *comarca* profoundly affected by the eco-social crisis. Framed within a Feminist Action Research methodology, the project aimed to strengthen the associative fabric, foster collective reflection, and develop shared visions for the future. The process was interrupted by the devastating DANA that struck the region in October 2024, highlighting the urgency of transformative responses. This event, underscores the compounded impacts of climate change and systemic vulnerabilities linked to a socio-economic model prioritizing neoliberal growth. The project seeks to address the collective repair of the territory and the aftermath of the DANA in 2025.

This process emphasizes the role of community art as a platform for resilience, collective agency, and envisioning reparative futures. However, its transformative potential is contingent on critically addressing entrenched power structures and ensuring meaningful impacts. This article highlights the methodological value of community art in confronting eco-social crises while recognizing the challenges and limitations inherent in such initiatives. Ultimately, it advocates for sustained collective efforts and alliances that transcend artistic action, valuing the process as a critical component of systemic change.

Keywords: Community art; Participation; Reparative futures; Eco-social transformations.

INTRODUCTION

Community art, as a participatory and transformative practice, holds significant potential for addressing the multifaceted dimensions of eco-social injustices in territories marked by conflict. In regions shaped by historical processes of exploitation and vulnerability, such as the Valencian *comarca* of l'Horta Sud, community art connects artistic practices with the needs and struggles of local associations, creating pathways for collectively transforming and repairing reality.

This article examines the initial development of a community art process that serves as a driving force for a Feminist Action Research (FAI) methodology in collaboration with the Fundació Horta Sud (FHS). The process explores the role of community art as a tool for political advocacy, working alongside the associative fabric of l'Horta Sud to strengthen community networks and build a shared vision for the future. Community art emerges not only as a medium for creative expression but also as a catalyst for eco-social change, capable of addressing the intertwined crises stemming from the dominant socioeconomic and cultural paradigm.

Structured across multiple sessions designed to foster collective reflection and action using the IAF methodology, the project began in May 2024 with the active participation of twelve local associations. However, it was interrupted by the devastating DANA (cut-off low) in October 2024. With the support of the FHS and participating associations, the process is set to resume in 2025, focusing on the collective repair of the territory.

The DANA that struck on October 29, 2024, caused widespread devastation across l'Horta Sud and parts of Ribera Alta. This extreme weather event, the deadliest of its kind in Spain's history, resulted in 226 fatalities in the Valencian region, with dozens missing and thousands left without electricity, transport, or communication for days. While cut-off lows are a recurring autumn phenomenon, their intensification due to climate change underscores the growing impact of global warming.

Attributing the devastation solely to the climate crisis or governmental inefficiencies would oversimplify the systemic nature of the problem. This event reflects a broader issue tied to global collapse (Albelda Raga & Calabuig Tormo, 2023). It is the product of a Western hegemonic model that prioritizes neoliberal economic growth, unrestrained techno-scientific progress, and inadequate governance structures while neglecting care and interdependence as fundamental principles for sustaining life (Herrero, 2020).

In this context, community art offers a platform for communities to collectively process these crises, transcending reactive responses to adopt proactive, transformative approaches (Albelda Raga, 2023; Ramírez-Blanco, 2023). This proposal is thus framed as a methodological commitment to exploring the potential of community art as a means for territorial transformation and repair through the engagement of the associative fabric.

SOCIO-POLITICAL CONTEXT OF THE TERRITORY OF L'HORTA SUD

L'Horta Sud, home to 454,668 inhabitants, is the second most populous and the most industrialized region in Valencia. Historically part of *l'Horta de València* along with the current *València Ciutat* and *l'Horta Nord*, the region experienced a longstanding conflict starting in the 19th century between the expansion of *València Ciutat* and the municipal autonomy of its 20 towns and villages (Fundació Horta Sud, 2019). This conflict was institutionalized during the Franco regime with the creation of the *Corporación Gran Valencia* in 1946, which prioritized the urban development of the capital at the expense of l'Horta Sud (Selva Royo, 2015).

The 1957 flood marked a pivotal moment. The diversion of the Turia River and the construction of a highway along its new course fragmented the territory and expropriated significant agricultural land (Domingo Calabuig & Rivera-Linares, 2022). Concurrently, the expansion of the Port of Valencia and Manises Airport cemented the region's logistical and industrial role. Industrial estates proliferated, now covering over 20 million square meters, while the agricultural workforce plummeted from 45% to less than 3% today (Fundació Horta Sud, 2019).

During the 1960s, l'Horta Sud saw unregulated urban growth alongside a wave of worker migration, leading to the development of slums and profound social transformations (Fundació Horta Sud, 2019). Much of this occurred within the fragile ecosystem of the *Albufera Natural Park*, which has faced ongoing urban pressures (Membrado Tena, 2016). Although some threats were mitigated by social mobilizations, the park's sustainability remains precarious (Cultur Plaza, 2017).

In the 21st century, the absence of coordinated supra-municipal planning has exacerbated the region's vulnerabilities, exposing it to projects like the AVE high-speed train (Castellanos et al., 2022), Valencia's tourist saturation, and housing developments in flood-prone zones, all intensified by the real estate boom. The recent DANA highlighted these vulnerabilities, as many affected homes were located in high-risk flood areas (Delgado, 2024).

The history of l'Horta Sud reflects decades of exploitation driven by a developmental model that has heightened the territory's fragility in the face of extreme climatic events. This underscores the pressing need to rethink its development paradigm to ensure greater resilience and sustainability.

THEORETICAL FRAMEWORK

The theoretical foundation of this study rests on three key pillars. The first is the *Capabilities Approach to Human Development* (CAHD), which focuses on analyzing the strengthening of collective and individual capacities throughout the community art process. The second and third pillars are the theoretical frameworks of *reparative futures* and *eco-social transformations*, both explored through the

same process, using community art as the driving language within the IAF methodology.

EMANCIPATORY PROCESSES IN COMMUNITY ART

Community art processes support the demands of social groups by empowering them and providing creative tools for political action (Palacios Garrido, 2009). These processes are inherently educational and emancipatory, emerging as tools that significantly contribute to the field of human development (Palacios Garrido, 2009).

Rather than following a linear trajectory, these processes consider various levels of interaction within the group to construct discourses that materialize in collective artistic actions (Bang, 2013). Their multidisciplinary and emancipatory approach enables communities to address eco-social issues from fresh perspectives, challenging dominant narratives and fostering civic participation (Bishop, 2012). Furthermore, by questioning conventional knowledge-production practices, these processes create spaces conducive to building collective identities, disrupting static democratic formulas (Ramírez-Blanco, 2018).

Community art thus becomes a dynamic tool for generating alternative ideas, dreams, and narratives that counter neoliberal discourses. It strengthens resistance and reinforces interdependent and collaborative social ties in a context where neoliberalism perpetuates social disconnection (Ramírez-Blanco, 2018; Wajnerman, 2009).

CAPABILITIES APPROACH TO HUMAN DEVELOPMENT

To understand the impact of community art processes, the contributions of the CAHD, an alternative to the economistic development paradigm proposed by Amartya K. Sen (1999), are particularly relevant. This framework conceives development as the enhancement of well-being through the expansion of people's capabilities—understood as real opportunities to pursue valuable activities and become who they aspire to be (Ibrahim, 2014).

The CAHD highlights the importance of considering civil society as a subject rather than an object in political decision-making (Ibrahim & Alkire, 2007). Sen's key concepts—capabilities, functionings, agency, and empowerment—serve as the foundation for this approach. *Capabilities* refer to individuals' real opportunities to achieve what they value. From a collective perspective, these capabilities translate into a community's ability to pursue shared goals. *Functionings* represent the materialization of these capabilities, while *agency* and *empowerment* enable individuals and groups to define objectives, act accordingly, and strengthen capacities to foster transformation within their contexts (Viadero Acha & Alberdi Bidaguren, 2011).

REPARATIVE FUTURES

Community art literature often intersects with futures studies, which focus on imagining and planning potential future scenarios in the present, arguing that the

perception of the future influences current behavior (Bisht, 2017).

From this perspective emerges the concept of *reparative futures*, an approach aimed at building a future that addresses and rectifies historical injustices, inequalities, and damages. This framework envisions forging a more equitable, just, and restorative future through social and political actions directly linked to social justice, historical memory, reconciliation, and human development (Sriprakash et al., 2023).

Artistic methodologies have historically played a vital role in knowledge transfer, value communication, and inspiring action (Bisht, 2017). These practices not only organize past and present narratives but also shape alternative futures, helping communities comprehend and reimagine their realities. Consequently, the artistic construction and reconstruction of narratives hold the power to shape reality itself (Milojević & Inayatullah, 2015).

Authors like Arturo Escobar (2017) emphasize the experiences of communities as the foundation for collectively envisioning futures. Critical thinking frameworks advocate designing future narratives through feminist, non-hierarchical, participatory processes rooted in care, aiming to promote community autonomy while safeguarding landscapes and territories (Escobar, 2017).

ECOSOCIAL TRANSFORMATIONS

This process is framed within the concept of eco-social transformations, focusing on the construction of reparative futures by addressing the intersection of ecological and social dimensions. These transformations serve as responses to eco-social challenges, striving to build more sustainable, equitable, and just societies (Albelda Raga et al., 2018; García García, 2006).

Eco-social transformations recognize that environmental crises are inseparable from social inequalities, necessitating profound changes in social and ecological structures (Albelda Raga, 2023). These transformations extend beyond mitigating environmental impacts to tackling issues of social justice, equitable resource distribution, citizen participation, and community empowerment. They demand rethinking and redesigning development models, economic practices, political structures, and social relations to ensure environmental preservation and improve quality of life (Albelda Raga & Calabuig Tormo, 2023).

METHODOLOGY

The methodology for this research combines a participatory-emancipatory paradigm with critical theory, adopting a transversal feminist approach. Community art serves as the central axis for processes of eco-social transformation and the collective construction of reparative futures. This approach is guided by the IAF framework, which integrates participatory artistic tools with a methodological design aimed at fostering critical reflection, strengthening community bonds, and generating meaningful political advocacy. The IAF is derived from Participatory Action Research (PAR).

The community art process, initially implemented between May and October 2024 and expected to resume in 2025 following the DANA, is structured into four main phases and detailed in the next section.

To achieve a deep and comprehensive understanding of the process's impact, various qualitative techniques are employed. During the sessions, artistic participatory techniques are used to creatively explore the group's challenges and visions for the future, creating a space for collective expression. Semi-structured interviews, conducted before, during, and after the process, provide detailed insights into participants' perceptions of personal and collective impact. Additionally, participant observation is carried out during sessions, community events, and activities organized by the associative network, enabling an analysis of social dynamics and the strengthening of community networks.

The qualitative variables selected for analysis are directly linked to the theoretical framework and the research context.

Capacity expansion is assessed by examining empowerment, agency, and the development of tools for action at both individual and group levels. *Future construction* is analyzed by exploring how art facilitates the creation of alternative narratives that not only address past injustices but also propose actionable solutions to eco-social challenges. Lastly, the impact on the associative fabric of the region is evaluated in terms of the internal strengthening of participating associations and the dynamics of network collaboration.

This research is developed in collaboration with the FHS, a leading entity promoting associationism in the region. The collaboration is formalized through an agreement that ensures the co-facilitation of the process by the principal investigator and an FHS technician. This partnership not only ensures a direct connection between the research and the community but also facilitates the integration of generated learnings into future FHS projects, thereby ensuring sustainability and long-term impact.

From an ethical perspective, participant confidentiality is safeguarded through pseudonymization of personal data and the use of pseudonyms in all records. All participants signed informed consent forms, ensuring their understanding of the research's objectives, methods, and potential impacts. Continuous feedback mechanisms were established throughout the process, including during sessions and at dedicated conferences where preliminary and final results were presented. This approach promotes transparency, builds trust, and actively incorporates participants' feedback.

THE COMMUNITY ART PROCESS

The participatory community art process constitutes the core of the methodological approach. Its specific objectives, distinct from those of the research, include the collective construction of a vision for the future of associationism in the Horta Sud region, the strengthening of collaboration networks among local entities, and the

preservation of the territory's historical memory. Through this process, participating entities identify and share actions needed to address current challenges, collectively reflecting on what they want, need, and can achieve together.

The process is structured into four phases, involving five participatory sessions, an artistic action in public space, and feedback meetings. These activities revolve around the central question: *"How do we want to build the future of associationism in the region?"* As a culmination, the group develops a collective artistic intervention that may take various forms—such as podcasts, murals, performances, or documentaries—creatively expressing their action plan as political agents of the territory.

The first phase, Diagnosis Phase, includes the sessions *"Where do we come from?"* and *"How are we?"*. The first session focuses on social memory, identifying key moments and historical conflicts that have shaped the associative fabric (Heredia & Benavides de Pérez, 2023; Momoitio Astorkia et al., 2019; Rodríguez Manotas & Hernández Cassiani, 2020). Through sharing individual and collective experiences, participants construct a shared memory, reinterpreting the past appreciatively to concentrate on eco-social conflicts that have influenced society. The second session employs participatory social mapping to chart resources, spaces, and relationships in the territory, incorporating emotions and identity links that enrich community perceptions (Barragán-León, 2019; Castaño-Aguirre et al., 2021; Habegger Lardoeyt & Mancila, 2006).

In the *"Where are we going?"* and *"Where do we want to go?"* sessions, related to Proposal Design Phase, participants design collective futures. Drawing from earlier insights, public space is proposed as a relational and political expression territory, with art as a tool for social transformation. These sessions encourage participants to imagine and structure innovative solutions to eco-social challenges, fostering inclusive narratives and positioning local collectives as central agents of change (M-Domènech & Furió-Vico, 2023).

The session *"How do we do it?"* and the artistic intervention in public space mark the third phase, Action Phase. Here, the collective action plan is finalized, and responsibilities are assigned for the artistic work's execution, with its date yet to be defined. This artistic action will publicly showcase the group's reflections and proposals, demonstrating the associative fabric's potential to collaborate for social transformation through community art (M-Domènech & Furió-Vico, 2023).

One or two sessions are dedicated to process reflection and dissemination, alongside evaluation. This final phase, Feedback and Evaluation Phase, ensures that outcomes are shared with the community, enabling further insights and discussions about the process's impact.

REFLECTIONS

The reflections on the methodology presented here were initially framed, prior to the DANA, around the premise of facing an eco-social emergency. After the DANA, the

need for transformation has not only been confirmed but has also become undeniably urgent. The current global scenario demands collective responses that drive eco-social transformation. In this context, community art emerges as a space for resilience and collective agency, enabling communities to both question the hegemonic narratives perpetuating multifaceted crises and envision and construct reparative futures.

Throughout this article, the structure of a community art process has been outlined, employing aesthetics as a catalyst for eco-social change. This approach seeks to redefine the role of dominant artistic practices, shifting them away from consumption-driven logics and reclaiming their transformative purpose. However, implementing this approach entails constant challenges in a society where commodification pervades every aspect of life.

Community art facilitates the integration of artistic practices into the everyday activities of the associative fabric, fostering spaces for dialogue and action that enhance social cohesion and amplify the community's capacity for political advocacy. Yet, critical reflection on the effectiveness of these actions is essential to truly confront entrenched power structures and ensure that the process produces tangible, meaningful impacts on the lives of participating communities.

This ongoing process underscores the urgency of further exploring community art as a methodology to address eco-social crises. At the same time, it calls for a critical evaluation of its potential and limitations, acknowledging that systemic change cannot be achieved in isolation. Such change requires sustained efforts and alliances that transcend artistic action. Consequently, this highlights the importance of valuing the process itself as much as, if not more than, the action it produces.

ACKNOWLEDGMENTS

I would like to express my deepest gratitude to the Horta Sud Foundation for its trust in this process and my admiration for its steadfast commitment to associationism. My heartfelt thanks also go to each of the participating entities; their relentless advocacy undoubtedly makes the world a better place each day.

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The FEM-Vida project: applying an innovative vision to the socio-economic viability of small agroecological farms

Judit Manuel i Martín[a] and Laia Baró Gómez[b]

[a]Researcher at INGENIO (CSIC-UPV) with a background in anthropology and philosophy. She is a doctor in experimental sciences and technology at the University of Vic-Central University of Catalonia (UVic-UCC), particularly in ecology, agroecology and food systems. Her research focus is the sustainability of small farms, as key agents in a global transition to fairer food systems, from the theoretical perspective of ecofeminism and peasant economics. Currently, she is part of different European and Spanish research projects that explore agriculture from gender and feminist perspectives and support women-lead innovations. She combines her work as a researcher with a consultancy job in the field of environmental studies, climate change adaptation and participatory processes.

[b]Researcher at the Chair of Agroecology and Food Systems for Social Transformation at the University of Vic – Central University of Catalonia (UVic - UCC). Graduated in Environmental Biology at the Universitat Autònoma de Barcelona (UAB) and with specialized studies in Agroecology through the Master of Agroecology: an approach to rural sustainability at the Universitat Pablo de Olavide (UPO). Her research experience is related to the role of rural women linked to the agrifood system and the conservation and transmission of traditional knowledge, the central theme of her final master's thesis in the Sierra de Ronda, Málaga. She is currently working on the study of the economic viability of small agroecological farms, within the framework of feminist economics, through the SWIFT and FEM VIDA projects.

How to cite: Manuel-i-Martin, Judit & Baró-Gómez, Laia. (2025). The FEM-Vida project: applying an innovative vision to the socio-economic viability of small agroecological farms. In *Proceedings of the 6th International PhDays Conference* (pp. 43-48). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19567

Abstract: This paper explores the innovative approach of the FEM-Vida project to redefine the viability of agroecological farms through a feminist economics lens. Traditional definitions centered on economic metrics fail to capture the complex socio-ecological dynamics of small-scale farms. FEM-Vida integrates reproductive labor, care work, and support networks into a holistic framework. Data was gathered from 12 agroecological farms in Spain through in-depth interviews, participant observation and time-use analysis. Farmers actively contributed to the research, emphasizing participatory methods. Preliminary findings highlight the

indivisibility of productive and reproductive tasks, the role of care work and the importance of well-being in farm sustainability.

Keywords: Agroecology; Small farms; Feminist Economy; Ecofeminism; Economic viability; Time-uses

INTRODUCTION

Conventional definitions of viability are not enough to fully explain how agroecological farm's function, are able to reproduce and sustain themselves in a socioeconomic context that is adverse for small and diverse projects (Shucksmith & Rønningen, 2011; Holt-Giménez et al., 2021). Definitions of viability that focus on monetary elements and productive work cannot grasp the reality of agroecological projects, which are akin to peasant logic (Van Der Ploeg, 2013; van der Ploeg et al., 2019). In the old question of small farm viability (Fuller et al., 2021), the integration of feminist economics allows for the widening of the definition of viability, in a way that is better suited for the examination of small and agroecological farms (Manuel et al. 2023). In using a feminist approach to viability, new elements, such as reproductive work, non-commodified resources and tasks are incorporated into the definition of labor and economic systems (Ezquerra, 2011; Federici, 2013). Furthermore, taking an ecofeminist perspective, akin in many ways to agroecology, entails that in a holistic definition of viability, the measure is not the accumulation of profit, but the reproduction and sustenance of a dignified life (Herrero, 2013; Carrasco Bengoa, 2017).

With this as a starting point, the "Socioeconomic viability of small-scale agroecological production: diagnosis and tools from the feminist economics framework (FEM-Vida)" project aims to develop a holistic understanding of the viability of agroecological farms. Such a holistic perspective should account for farm reproduction even when their financial statement would deem them unviable. Thus, the goal of the project is to develop a system of indicators to self-evaluate agroecological viability. This indicators' tool should adapt to the changing and evolving reality of farm projects. In this paper, we explain how this innovative approach to the viability of agroecological farms is implemented in a research project that is developed hand in hand with farmers.

METHODOLOGY

STUDY CASES

In FEM-Vida, research is developed through a close and continued relationship between the team of researchers and twelve agroecological women farmers whose farms and life projects function as case studies for the project. This is way, the main criteria to select the case studies was looking for farmers who had an active interest in the goals and topics addressed in the project (interest in engaging in the self-assessment of their farm's viability, "good-life" in the center...).

From there, we got in touch with four small agroecological farms in three distinct regions in Spain: Galiza (G), País Valencià (PV) and Catalunya (C), looking as well for farms self-defined as agroecological, farms led by women or with a strong presence of women in the farm.

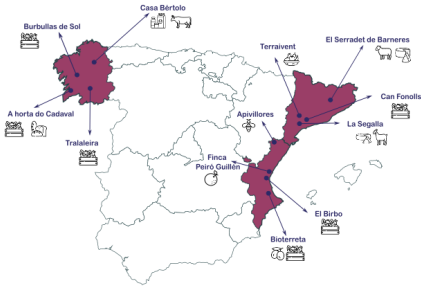

Figure 1. *Map of study cases*

Within the category of small agroecological projects that define the farms in the project, we looked for a diversity of farms, both in terms of production, including livestock farms and horticulture farms among others, and in terms of the social organization of the farm, including families, cooperatives and individual farms.

Table 1. *Characterization of study cases*

Code	Projects	Production type
C1	La Segalla	Livestock (goat)
C2	El Serradet de Barneres	Livestock (sheep)
C3	Can Fonolls	Garden
C4	Terra i vent	Fruit trees
G1	Casa Bértolo	Livestock (bovine)
G2	A horta do Cadaval	Garden
G3	Burbullas de Sol	Garden
G4	Tralaleira	Garden
PV1	Apivillores	Apiculture
PV2	Bioterreta	Garden
PV3	Finca Peiró Guillén	Fruit trees
PV4	Maria i Jordi	Garden

The goal of data gathering was not to compare farm typologies, but to build a diverse and comprehensive data set.

DATA COLLECTION

Firstly, we conducted in-depth interviews with each case, to characterize them based on certain attributes, such as the type of production, administrative and internal structure, resource availability, number of workers, and more.

Then, we initiated the main phase of fieldwork, which consisted of two weeks of participant observation for each study case. Each week of observation was scheduled during different periods of the year to ensure greater representativeness of tasks across seasons. The methodology was developed in continuous dialogue with the study cases, since it involved the close interaction and cohabitation between the researchers and the farmers, as farmers welcomed researchers to their home for two weeks to participate and observe most of their life during that time.

Methods of data collection during participant observation included

maintaining a detailed field diary and recording the time-uses by the hour. Upon completing fieldwork, all data was systematically organized into a detailed description of the different activities carried out by the farmers, which were classified based on set of typologies created iteratively. Additionally, the farmers completed a voice survey to evaluate their satisfaction with each of the tasks identified.

Finally, regarding data analysis, we have already begun processing the time-uses data. The next step will involve conducting a thorough qualitative analysis of the field diaries.

KEY FINDINGS AND INNOVATIONS

USE OF TIME AS A KEY FACTOR FOR FARM VIABILITY

The focus on time uses, organization of tasks and satisfaction of the different members of the twelve farms participating in the project as a way to examine and assess viability, as well as to develop an indicator system is part of the novel approach of FEM-Vida and a way to actualize ecofeminist and feminist perspectives on the topic of small farm sustainability.

We analyzed how each farm member allots their time throughout their day and week, putting special focus on issues such as workload, overburden or simultaneity. In terms of tasks, following an ecofeminist approach, we considered the productive and marketing aspects of the project as well as management, personal, environmental and family activities.

BREAKING BARRIERS BETWEEN PRODUCTIVE AND REPRODUCTIVE SPHERES

This comprehensive approach is well suited for agroecological farms, particularly those that are family projects, in which the indivisibility between the farm, as an economic project, the social group that manages it and the agroecosystem becomes apparent. To properly grasp and assess agroecological viability, we need to move beyond the distinction between reproductive and productive work. At the same time, one of the innovations of FEM-Vida's approach is the incorporation of care work and aspects such as wellbeing and satisfaction, as elements often overlooked and under-explained in more conventional examinations of farm viability.

TASK CATEGORIZATION

As mentioned in the methodology section, tasks observed were classified in eleven categories: formal and informal networking activities, agricultural work, income diversification, commercialization, manufacturing, knowledge exchange and acquisition, project management tasks, self-care, care of the home and project, care of others and basic needs.

This categorization allows for the analysis of task distribution and roles among farm members and its organization, highlighting issues such as flexibility or support networks. These elements are further

explored by contextualizing them within farmers' priorities, worldview and perceived enjoyment.

Table 2. *Categories used to analyzed identified tasks*

ASSOCIATIONS / SUPPORT NETWORKS
FARM WORK
INCOMES DIVERSIFICATION
COMMERCIALIZATION
TRANSFORMATION
KNOWLEDGE EXCHANGE/LEARNING
ADMINISTRATIVE MANAGEMENT/INTERNAL STRUCTURES
BASIC NEEDS
SELF-CARE
HOME/PROJECT CARE
OTHERS CARE

INCORPORATING BEYOND FIELDWORK STAGES: AN INNOVATIVE PARTICIPATORY METHODOLOGICAL PROCESS

The entire methodological process, including fieldwork, data collection and the subsequent analysis, has been developed by a transdisciplinary work team. This research team includes not only researchers from different disciplines, but the farmers themselves, as well as members from organizations and social movements linked to agroecology and social and solidarity economy. This allows the project to have a strong and comprehensive approach to the data collected and the issues at hand, but more importantly, it means that the farmers at the center of the project are not only research objects, but subjects that accompany the research project from start to finish. Basing the project on an interdisciplinary team of farmers, researchers and activists leads to making the research project and process a participatory one. Within the Fem-Vida calendar, several workshops are scheduled to encourage dialogue between agroecology and the social and solidarity economy to contribute to the development of a shared indicator tool that builds on already existing work. The first workshop, already held, served to share the first results of the research and contrast the viability factors that we have already begun to extract through the data collected.

DISCUSSION IN PROCESS

The FEM-Vida team has recently finished fieldwork and data gathering period and we have started with data analysis, using a combination of descriptive statistics, qualitative analysis and participatory tools, in which both farmers and researchers are engaged. As part of the participatory approach, the last step of fieldwork was to share with the farmers of the project the data gathered in terms of time uses, so they could validate it and start reflecting on it towards the creation of an indicators' system. These first steps in the analysis also allowed for the identification of a set of viability factors, both internal and external elements, that have an impact on the viability of agroecological farms. Moving forward and in continuous dialogue with the twelve farms in the project, FEM-Vida is going to focus on identifying the dimensions that need to be included when examining

viability from an ecofeminist and agroecological perspective and on designing an assessment tool that accounts for the needs and circumstances of agroecological farms, understanding them as complex socio-ecological systems in which reproductive (both human and ecological) and productive spheres are indivisible.

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Critical Analysis of the Common Agricultural Policy: Discursive Foundations, Historical Context, and New Agrarian Challenges

Maria del Mar Calvet-Nogués

INGENIO CSIC-UPV, , mdcalnog@doctor.upv.es

Short bio: My name is Maria del Mar Calvet Nogués, a PhD. Student in the Local Development and International Cooperation program at the INGENIO CSIC-UPV. I hold a degree in Veterinary Medicine from the Autonomous University of Barcelona (UAB), a Master's in Organic Agriculture and Livestock farming from the Pablo de Olavide University (UPO), and a Master's in Development Cooperation from the Universidad Nacional de Educación a Distancia (UNED). I work as a research technician on the European PRIMA project PASTINNOVA (Innovative Models for Sustainable Future of Mediterranean Pastoral Systems). My academic background has focused on researching women livestock farmers' role in extensive or high-mountain systems. I have also worked on analysing the impacts of the industrial and globalised agri-food system, particularly concerning the livestock sector, as well as exploring the alternatives proposed by agroecology to address the multiple crises affecting food systems.

How to cite: Calvet-Nogués, M. Mar. (2025). Critical Analysis of the Common Agricultural Policy from an ecofeminist perspective: Discursive Foundations, Historical Context, and New Agrarian Challenges. In *Proceedings of the 6th International PhDays Conference* (pp. 49-56). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19582

Abstract: This study critically analyzes the Common Agricultural Policy (CAP) through an ecofeminist lens, employing "What's the Problem Represented to Be?" (WPR) methodology. The research focuses on the discursive foundations and socio-political context of the CAP, with particular attention to its latest reform (2023–2027). By identifying the dominant discourses underpinning the policy, the preliminary results reveal a historical bias which favors industrialized agricultural models while marginalizing alternative approaches for more sustainable and fair food systems.

Keywords: Critical policy analysis; PAC; Food systems transition; WPR methodology.

INTRODUCTION

The Common Agricultural Policy (CAP) is one of the most significant policies of the European Union, having recently undergone one of its most important reforms in years (new CAP 2023–2027), aiming for greater

environmental ambition and social equity (European Commission, 2023). Previous reforms had already introduced legislative changes to advance in this direction, but these changes have not yielded positive effects for less intensive and industrialised productions, particularly in Southern Europe (SEO/BirdLife & Heinrich-Böll-Stiftung, 2019).

In the current global and EU context, there is an urgent need to shift food systems toward a paradigm where agricultural policies like the CAP support the transition to sustainable agro-food systems that promote social justice (European Commission, 2020b, 2020a). Despite European institutions acknowledging the indispensable role of agroecological practices, extensive livestock farming, and women farmers in the agro-food transition, the measures promoted by the CAP on the ground often reveal significant contradictions with the EU's social and environmental objectives (SEO/BirdLife & Heinrich-Böll-Stiftung, 2019; Zabala et al., 2017). Contrary to expectations, the CAP disproportionately benefits large-scale, intensive, business-oriented agricultural operations, while family-based productions rooted in local territories and serving local populations are left at a disadvantage regarding receiving aid. Consequently, regarding environmental sustainability, the CAP, rather than fostering a transformation of agro-food systems toward more sustainable models, appears to merely incorporate some environmental measures into agro-industrial systems (Nori, 2022).

On another note, for the first time, the new CAP has included gender equality among its objectives (European Commission, 2023). In 2009, women accounted for only 39% of the agricultural workforce in the European Union, and barely one in five women were landowners (European Commission, 2009), underscoring the urgency of addressing this situation. While previous CAP reforms were built on presumed gender neutrality, they failed to account for the structural and systemic disparities women face in the agricultural sector. As a result, these reforms have perpetuated and deepened gender inequalities, even contributing in some cases to a process of de-agrarianization among women (de Gonzalo Aranoa & Urretabizkaia Gil, 2012).

Thus, it is essential to subject the new CAP reform to critical analysis to determine whether it can facilitate or, conversely, hinder an agroecological and feminist transition of food systems in Mediterranean countries, such as Spain.

RESEARCH OBJECTIVES AND QUESTIONS

The research presented forms part of the thesis titled *"A Critical Analysis of the Common Agricultural Policy for an Ecofeminist Agroecological Transition of Spanish Food Systems."* This work addresses the concern of understanding how the narratives about agri-food systems, which underpin European agricultural policies' thought and action frameworks, influence these systems' development toward a specific model. Additionally, it

aims to analyse how these policies should evolve to promote an ecofeminist agroecological food transition.

The contribution to this conference corresponds to the first specific objective of the thesis, which seeks to identify and analyse the socio-political context that led to the proposal of the new Common Agricultural Policy (CAP) reform in 2023. The research aims to address the following questions:

- What types of agri-food systems has the CAP historically promoted?
- What kinds of discourses and measures can we expect to emerge in the Spanish CAP?
- What is the link between the prioritised issues in the legal context that shaped the new CAP and the "new agrarian questions"?

The research focuses on analysing the CAP because it is the European Union policy that has traditionally mobilised the largest budget and significantly influences European food production models, also impacting the global corporate food regime (Bonete, 1994; European Commission, 2023; SEO/BirdLife & Heinrich-Böll-Stiftung, 2019). This policy has been identified in previous studies and by small-scale agroecological farmers in Spain as one of the critical factors contributing to inequalities within the agri-food system, creating limitations to their activities (de Gonzalo & Urretabizkaia, 2012; Fernandez-Gimenez et al., 2021).

METHODOLOGY

This research is grounded in post-structural theory. Within this framework, discourses are understood as elements that shape how we construct ourselves as subjects and the lived experiences we encounter daily. Discourses—comprising actions, objects, and practices with social implications—are the central focus of this investigation (Bacchi, 2012). Specifically, we view public policies as discourses that define permissible thought patterns and actions and the boundaries of what could be thought, which could either perpetuate high levels of social inequality through dominant models or, ideally, contribute to the construction of realities that reduce forms of domination (Bacchi, 2014).

The methodology for this research is based on Professor Carol Bacchi's approach, *What's the Problem Represented to Be?* (WPR), which builds on Michel Foucault's post-structural and discourse theory. WPR provides a critical analytical tool for scrutinising public policies. It allows us to investigate how public policies (in this case, the UE Common Agricultural Policy) construct representations of specific problems and the assumptions that legitimise them. This approach also considers the historical and power dynamics that shape these constructions, emphasising that, just as problems are constructed based on certain assumptions, they can also be deconstructed. Thus, problematising and deconstructing thoughts taken for granted can build alternative

worlds where inequalities are reduced (Bacchi & Goodwin, 2016).

The WPR methodology involves six guiding questions for analysing a legal text. This research applies the WPR framework to Spain's National Strategic Plan for the CAP (PEPAC). For this presentation, the focus is limited to analysing the third WPR question: *How has this representation of the 'problem' come about?* This question examines the historical, political, and social context that has enabled the emergence of the policy under scrutiny. Also, it allows us to identify the mechanisms by which it has been socially accepted. Understanding the history of the policy is crucial to tracing the genealogy of the problem representations in the PEPAC.

To address this, the study begins by analysing the CAP's historical evolution and identifying the main events and reforms that have redefined its political framework over time. This is followed by a literature review of articles analysing the discourses used in strategic political documents or speeches preceding CAP reforms. This allowed for identifying the dominant discourses about the food production model that have existed since the policy's inception and their key characteristics.

Since the analysis focuses on the most recent CAP reform (2023–2027), the study examines the legal texts that shaped the formulation of the new CAP (the PEPAC's foundational documents). This allows for coding key themes emphasised as relevant in each document and identifying the discursive positions underlying these themes.

This analysis provides an initial picture of the problem representations likely to appear in the PEPAC and indications of whether the policy represents continuity or innovation. Furthermore, the themes identified in the PEPAC's foundational documents are linked to the inclusion or omission of new agrarian questions.

DEVELOPMENT OF INNOVATION

The contribution aligns with the field of 'New approaches to innovation policy' as the study employs an innovative methodology for critically analysing public policies: the WPR – "What's the Problem Represented to Be?". As its creator, Carol Bacchi (2012), explains, this methodology encourages policymakers to reflect on their role in how governing takes place by questioning and problematizing the policies they design. Rather than merely analysing the internal coherence of policies—such as the alignment between objectives and proposed measures—the WPR approach seeks to uncover the assumptions, types of knowledge, and imaginaries underpinning these proposals. It aims to analyse governing in a broad sense, including its historical context and the relations involved, to reveal how governing occurs. This critical perspective seeks to pave the way for policies that reduce oppression and promote greater social justice and equity (Bacchi & Goodwin, 2016).

Specifically, the presented study applies this methodology to identify the discourses and types of knowledge that form the foundation of the CAP. Simultaneously, it opens the door to reconfiguring agricultural policies through alternative frameworks, such as ecofeminism and agroecology, which are systematically marginalized in the formulation of such policies.

KEY FINDINGS AND EXPECTED RESULTS

LITERATURE REVIEW ON DISCOURSE ANALYSIS IN THE CAP

The literature review found several articles about the analyses of the CAP. Still, our study was limited and focused on the analyses of the works of Erjavec, K., and Erjavec, E. These authors have made significant contributions to the analysis of discourses that have influenced the formulation of the Common Agricultural Policy (CAP). Through the review of their work, it is possible to say that three main discourses have been present in the CAP since its birth till the present moment (Erjavec et al., 2009; Erjavec & Erjavec, 2015, 2020):

1. **Neo-mercantilist or productivist discourse**: This discourse is characterised by a protectionist model and state-supported agriculture. Its primary goal is to produce a large quantity of food to supply the European population while ensuring the economic livelihood of food producers.
2. **Neoliberal discourse**: This discourse prioritises the competitiveness of agricultural products by promoting the transformation of the agricultural sector into a modern industry. Food production is oriented toward supplying the international market.
3. **Multifunctional discourse**: This discourse seeks to diversify the agricultural sector, recognising its role as providing essential services to society beyond food production. It advocates for rural development and the competitiveness of the sector.

These three discourses appear and overlap at various points throughout the history of the policy.

IDENTIFICATION AND ANALYSIS OF KEY PEPAC FOUNDATIONAL DOCUMENTS

In the analysis of the context which has allowed the new CAP to emerge and be accepted, six key texts have been identified as crucial in shaping the new Common Agricultural Policy (CAP). Those documents comprise various legal texts, such as strategies, declarations, communications or legislations. The selected documents correspond to:

- The European Green Deal (2019)
- The Farm to Fork Strategy (2020)
- The EU Biodiversity Strategy (2020)
- The European Commission's communication *"The Future of Food and Farming"* (2017)

- The European Parliament's resolution on the future of food and farming (2018)
- Articles 38 to 44 of Part III, Agriculture and Fisheries, from the Treaty on the Functioning of the EU (2016)

In these documents, a prevalence of the discourses identified by Erjavec, K., and Erjavec, E. was observed. Most texts exhibit overlapping characteristics of the three discourses, though in some cases, one discourse dominates significantly.

Each document outlines numerous issues and principles to be incorporated into the new CAP. To analyse these, seven main categories and two subcategories were proposed:

1. The State's relationship with agricultural policy
2. The international projection of the European agricultural sector
3. Orientation of food production (subcategory: *Type of food produced*)
4. Use of resources in agricultural production (subcategory: *Labor and employment in the agricultural sector*)
5. Social sustainability of agricultural production
6. Rural development
7. Technological development

The issues and principles included in the foundational documents were, in turn, re-classified according to the discourse line (productivist, neoliberal, or multifunctional) that framed the perspective on each matter.

A predominance of the multifunctional perspective was noted in addressing these issues, although typical ideas from the productivist and neoliberal streams remain present.

Moreover, emerging issues and themes not included in previous CAP reforms were identified. Examples include the promotion of the *One Health* approach, the transformation of the agricultural sector through digital tools, and the need to foster new economic models.

RELATIONSHIP BETWEEN GROUPS OF ISSUES AROSE IN THE PEPAC CONTEXT AND NEW AGRARIAN QUESTIONS

The agrarian question has long been a central theme in rural sociology. In recent years, however, new perspectives have emerged, proposing expanding the traditional agrarian question to encompass what could be termed *the New Agrarian Questions*. These new questions seek to address a broader range of conflicts arising from the intersection of capitalist development, agricultural production, and peasant livelihoods.

Drawing on articles that advocate for this rethinking (Akram-Lodhi & Kay, 2010; Constance et al., 2014; Friedmann, 2016; Shattuck et al., 2023), this research proposes using the new agrarian questions as a reference for identifying issues significant enough to be addressed by agricultural policies as comprehensive as the CAP. A comparative analysis is being conducted between the new agrarian

questions proposed by other authors and the classification groups derived from the study of the key CAP foundational documents.

The anticipated results highlight how some agrarian issues are addressed with far more emphasis than others, which have traditionally been marginalised or even rendered invisible. This analysis may uncover silences—agrarian issues not mentioned in the CAP's foundational documents—that limit the potential for transitioning toward agroecological and feminist food systems.

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EU-SPRI ECC
International PhDays 2025 Conference
March 5th, 6th & 7th, at the INGENIO (CSIC-UPV) facilities in València

Feminization of food sovereignty: Analysis of a GIAHS case

Ximena Pardo Fuentes

INGENIO (CSIC-Universitat Politècnica de València), , xaparfue@posgrado.upv.es

Short bio: Master in Development Cooperation from the Polytechnic University of Valencia, Spain (UPV); currently pursuing her PhD in International Cooperation and Local Development at INGENIO CSIC-UPV. directed by Guillermo Palau Salvador. Her research addresses issues related to social justice from an intersectional perspective, covering areas such as migration and development cooperation, particularly in relation to food sovereignty. She has worked as a staff researcher at the Institute of Philosophy of the Spanish National Research Council (CSIC), based in Madrid (Spain) in the framework of the project "Integration and belonging in institutional praxis: critical discourse analysis from a gender and intersectionality perspective" (CNS2022-135492), funded by the Ministry of Science and Innovation, the State Agency for Research and Innovation and the European Union Next Generation EU/PRTR, and directed by Maria Caterina La Barbera.

How to cite: Pardo Fuentes, Ximena. (2025). Feminization of food sovereignty: Analysis of a GIAHS case. In *Proceedings of the 6th International PhDays Conference* (pp. 57-67). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.20315

Abstract: This study explores the perceptions, experiences and ancestral knowledge of women seed guardians in Chiloé in the exercise of their food sovereignty, as well as the strategies they use to defend it. The interest of this study lies both in the need to vindicate the primordial role played by women farmers in the fight against hunger in the world included in SDG 2 of the 2030 Agenda; and to alleviate the scarcity of existing research on the fundamental work of the women seed guardinas of Chiloé in the realization of food sovereignty, who have been chosen as a paradigmatic example for this research. Likewise, the relevance of this research lies in the fact that both Chiloé and several regions of Spain have been declared as GIAHS by FAO, aspiring that the results of this study contribute to the strengthening of the work carried out in this sense in these territories.

By applying a qualitative methodology through semi-structured interviews, focus group discussions and participant observation with women seed guardians living in various communes of the Chiloé archipelago, results were obtained that showed a feminization of the exercise of food sovereignty under stress both by socio-ecological challenges and by multiple structural oppressions of fundamentally

capitalist, colonial and patriarchal roots; but which is nevertheless defended thanks to the agency of these women. It is concluded that the greater the feminization of agriculture, the greater the possibilities of feminization of rural poverty, thus intensifying the strategies of feminization of both the exercise and the defense of food sovereignty by Chiloé peasant women; in addition to the necessary joint approach of gender, hunger and environment in the SDGs and in development policies for the search for comprehensive solutions.

Keywords: Agroecology; Gender perspective; GIAHS; SDG 2; Food sovereignty.

INTRODUCTION

The aspiration to end world hunger, as set out in SDG 2 of the 2030 Agenda, seems increasingly unattainable given the fragility of agrifood systems under socio-ecological stress. This urgency becomes even more pressing considering that it is precisely women farmers—who are the main producers of food for both their families and their communities—who are most affected by food insecurity worldwide. The fact that most studies on agriculture refer to "farmers" without acknowledging the contributions of peasant women—longstanding pioneers in agroecology—hinders a proper problematization of hunger and its potential resolution through the achievement of food sovereignty. Moreover, the epistemological injustice of rendering invisible the essential role played by rural women in this struggle underscores the relevance and importance of this research.

This study has selected as a paradigmatic example the case of the women seed guardians of Chiloé—a topic scarcely addressed in the literature despite their fundamental work in realizing food sovereignty. This territory, along with several regions of Spain, has been designated as a GIAHS by the FAO, which further highlights its significance.

For the reasons outlined above, this research aims—through an exploratory study—to investigate the perceptions, experiences, and ancestral knowledge of the women seed guardians in the exercise and defense of food sovereignty in Chiloé, in order to address existing research gaps and contribute to the body of knowledge in other territories with similar characteristics.

To this end, the study will explore the conception and practice of food sovereignty by these women through the description of their experiences, perceptions, and knowledge on the subject. Additionally, it seeks to identify—through their own testimonies—the socio-ecological challenges that threaten food sovereignty and the resistance strategies they activate to defend it. In this regard, and from the interpretative-constructivist paradigm in which the study is framed, it is believed that the protagonists themselves can provide valuable insights both for understanding the issue and for identifying possible solutions that may enable the eradication of hunger and contribute to halting the collapse of

biophysical limits caused by human-induced climate change.

In line with the above, the theoretical framework draws primarily on authors situated within the post-development movement, peasant feminism, and gender perspective.

This exploratory study employed a qualitative methodology, using non-probabilistic sampling to conduct semi-structured interviews. In addition, a focus group and participant observation were carried out in the Chiloé Archipelago.

MAIN RESEARCH OBJECTIVES AND QUESTIONS

This research aims to answer the research question of how do the women seed guardians of Chiloé exercise and defend food sovereignty in this GIAHS territory in a socioecologically complex glocal context?. This research question is translated into the general objective "to explore the perceptions, experiences and ancestral knowledge of women seed guardians in the exercise and defense of food sovereignty in the GIAHS territory of Chiloé", which is specified in the following specific objectives:

1. To analyze the conception and exercise of food sovereignty in Chiloé from the perspective of the women seed guardians themselves.

2. To identify the socio-ecological conflicts that threaten food sovereignty in the GIAHS territory of Chiloé from the perspective of the women seed guardians themselves.

3. To investigate the strategies deployed by the women seed guardians to defend their food sovereignty, with special emphasis on the political implications of the declaration of Chiloé as a GIAHS territory.

4. To explore from a gender perspective the oppressions suffered by the women seed guardians of Chiloé in relation to both the exercise and the defense of food sovereignty.

THEORETICAL FRAMEWORK

In 2015, the United Nations General Assembly approved the 2030 Agenda and its 17 Sustainable Development Goals (Economic Commission for Latin America and the Caribbean [ECLAC], n.d.), among which SDG 2 aimed to achieve zero hunger through food security. However, the FAO anticipated that this aspiration would not materialize, considering that by 2023, more than 700 million people worldwide suffered from hunger (FAO et al., 2024, pp. 5-8) due to the fragility of agri-food systems in the face of climate change, economic contractions, and armed conflicts (FAO et al., 2023, p.18). Notwithstanding, the serious difficulty in ending hunger would also lie in the fact that food security is conceived from a predominantly capitalist development model promoted by agribusiness, which increases food production through scaling up and specialization without considering the imminent collapse of the planet's biophysical limits (Albelda and Calabuig, 2021; Estermann, 2006).

In contrast to the capitalist globalization model, La Vía Campesina proposes “a political alternative to a deeply unjust and predatory agricultural and food system” (Vivas, 2012, p.5) through the conceptualization of food sovereignty, which crystallized in the Nyéléni Declaration (2007) as “the right of people to nutritious and culturally appropriate food, accessible, produced in a sustainable and ecological manner, and their right to decide their own food and production systems” (FAO, 2024). Likewise, La Vía Campesina vindicates the historical epistemological and technical contribution of women, who have laid the foundations of the agroecological knowledge system that exists to this day.

Despite this, the contribution of women in this area has not received due attention, given that history has been written by men and agriculture has not been the exception. In this sense, Vandana Shiva (1996) theorizes that behind this epistemological invisibility hides the same patriarchal, capitalist and colonial violence that attacks both women and nature.

Among the consequences of this epistemological injustice is the so-called invisible work of peasant women, which includes within the concept of reproductive work the daily tasks they perform in planting, harvesting, and maintaining their vegetable gardens, animals, seeds, producing fertilizer, etc.; but which, however, is not considered as productive work per se, but as an extension of care, dismissing a priori that it should be economically rewarded. In the words of Argentinean community feminist Claudia Korol, there is "a systematic way of devaluing women's contributions that generates the patriarchal order, which is functional to the policies of expanded reproduction of capital, accumulation by dispossession, and overexploitation of labor" (2016, p.92).

Guatemalan community feminist Lorena Cabnal adds that the main victims of agribusiness are women who inhabit and/or traverse rural areas, as their health is exposed to the extensive use of agrochemicals in crops (Vega, 2024). In this sense, it is worth highlighting the conceptualization of body-territory, which refers to women's struggle in defending territory as an epistemological notion that connects different types of violence: patriarchal, colonial, and extractivist, in the bodies of women who "bear everything and, therefore, become a territory in dispute" (Cabnal, 2018; as cited in Vega, 2024).

CHILOÉ’S CONTEXT

To understand why the women, seed guardians of Chiloé are a paradigmatic example of the feminization of food sovereignty, it is essential to consider "the crucial political and military role played by the archipelago in defending the Spanish crown and against Chilean revolutionaries during the war of independence" (Mondaca, 2018, p.25). This led the inhabitants of this territory (primarily of the Williche ethnicity) to be regarded as "enemy Indians" since their annexation to Chile in 1826. From that moment, "the State postponed the archipelago, and explicitly, the official

Chilean history began to treat Chiloé as a strange, distant territory with inferior inhabitants" (Mondaca, 2018, p.27). This institutionalized state animosity at the beginning of the 20th century caused such a level of social injustice in the archipelago that waves of male migrations headed towards Argentine and Chilean Patagonia in search of subsistence, causing the feminization of peasant agriculture. This refers to "the phenomenon primarily caused by the migration of male labor seeking more 'profitable' jobs than peasant agriculture" (Zuluaga, 2011, p. 594). This situation highlights the crucial role that women in Chiloé have played since ancient times, both as providers of family sustenance and as protectors of local biodiversity, sustaining agriculture and the economy of the archipelago for decades. Notably, the work of seed guardians stands out as carriers and transmitters of ancestral knowledge about seed collection and custody to new generations. The preservation of biodiversity and ancestral agricultural practices, largely sustained by Chiloé's peasant women, led to Chiloé being declared a GIAHS (Globally Important Agricultural Heritage Systems) by the FAO in 2011 (Agüero, 2016).

Despite the global significance of conserving GIAHS, Chiloé has been and continues to be the subject of socio-ecological conflicts that can be classified as ecosocioterritorial. These conflicts arise from extractivist pressures that simultaneously harm ecological, social, and territorial aspects (Cubells, 2021), often with the connivance of the Chilean Government. Notable among these are: the salmon industry, the water crisis resulting from the overexploitation of peat bogs (key wetlands for maintaining the water cycle), the construction of wind farms, Chile's signing of the international treaty "Trans-Pacific Partnership" (TPP-11) (Cabrera, 2024; Izquierdo, 2022), and the recent Exempt Resolution 162 from the Chilean Ministry of Agriculture, which eliminated "any mention of the right to market seeds under norms adjusted to the peasant and indigenous reality" (National Association of Rural and Indigenous Women [ANAMURI], 2024), in addition to attempting to create a list of seed keepers, promoting control and monopoly over these genetic resources and their guardians, which has serious political consequences in relation to the maintenance of food sovereignty in the archipelago.

METHODOLOGY

This exploratory study used a qualitative methodology, grounded in the interpretive-constructivist paradigm. It involved semi-structured interviews with 16 women seed guardians and 4 key informants, all residing in various areas of the Chiloé Archipelago. Participants were selected through non-probabilistic sampling. In addition, a focus group with 14 participants was conducted, alongside six months of participant observation in the Chiloé territory.

The analysis of the evidence is structured around the dimensions that intersect with the objectives of this research. These analytical dimensions were addressed

transversally from a peasant feminist perspective, with particular emphasis on the feminized exercise of food sovereignty through ancestral knowledge. Furthermore, a post-developmentalist and decolonial lens was applied, enabling the identification of the glocal effects of neoliberal extractivism on this GIAHS-designated territory.

To incorporate a gender perspective of situated meaning, the narratives concerning the exercise and defense of food sovereignty by the seed guardians were examined using an intersectional approach, which is systematized as follows:

Table 1. *Dimensions of analysis*

Dimensions of analysis	Intersection
Conception sovereignty	Gender
Exercise sovereignty	Social class
Socio-ecological challenges	Age
Strategies	Ethnicity

Regarding the limitations of the research, one of the main challenges was the difficulty in defining the sample, given the absence of a public registry of women seed guardians. Additionally, although the study aimed to include individuals from the Williche ethnic group, it was not possible to access these communities due to logistical constraints and their hermetic nature. This limited the incorporation of their indigenous worldview into the research through direct sources.

KEY FINDINGS

Regarding the fulfillment of the objectives of this research, the general objective of "exploring the experiences, perceptions, and ancestral knowledge of the seed guardians in the exercise and defense of food sovereignty in the GIAHS of Chiloé", has been fulfilled through the achievement of all the specific objectives, thus answering the research question of this study.

CONCEPT OF FOOD SOVEREIGNTY

In this regard, it is noteworthy that despite the limited theoretical understanding among women seed gaurdians regarding the concepts of food security and food sovereignty, this did not hinder the observation that they embody in their daily lives the elements that uphold food sovereignty. This is achieved through their traditional system of agricultural, livestock, and fishing knowledge, inherited from their ancestors. From their practical experience, they conceive food sovereignty as the guaranteeing context that gives them the freedom to control their food production processes outside the guidelines set by the agribusiness market. Through the exercise of their agroecological and artisanal practices, they ensure that these foods are nutritious and beneficial to health. Coinciding with what Vega (2024) points out, the participants, being aware of the greater likelihood that agrotoxins could affect their health, adhere to the definition of food sovereignty enshrined in the Nyéléni Declaration, emphasizing their right to consume food free of chemicals, which they consider the cause of diseases. In this regard, they disagree with the FAO's concept of food security, which focuses on food availability but not on the production

processes based on traditional, organic, and environmentally and health-conscious practices.

Likewise, it was found that food sovereignty is not only understood in terms of the material needs they satisfy, but also as a strategy of resistance to exist outside the capitalist system that imposes what and under what conditions to consume food; in addition to a means of vindication of the island's historical memory that has confronted the abandonment and precariousness of the colonial double treatment conceptualized by Mondaca (2018):

"We have always had in mind...in the Chilote imagination, that you can survive without money from water and land...here in Chiloé you can live collecting shellfish and harvesting vegetables, even in maximum poverty, and that is what our ñañas (grandmothers), our grandparents, have always told us, that this is how they lived before" (woman seed guardian 6)

On the other hand, women seed guardians consider their role in the conservation and free circulation of native seeds to be essential, both for their own subsistence and that of food sovereignty, and to contribute to the challenge of alleviating hunger in the world contemplated in the 2030 Agenda. As Vandana Shiva understands it, the work of these women is conceived as an exercise demanding freedom:

"We do it to have free food...free from everything: from chemicals, from water privatizations, from privatizations of everything...for me that is food sovereignty" (woman seed keeper 3)

EXERCISE OF FOOD SOVEREIGNTY

As previously noted, Chiloé has long been sustained by the knowledge of the land and sea inherited from its ancestors, embodying food sovereignty long before it was formally conceptualized. However, this archipelago, which first endured the colonial onslaughts of the Spanish empire and later suffered state neglect following its annexation by Chile, was forced to do without much of the social fabric that had sustained it by the mid-20th century: men and children from Chiloé were compelled to leave their island lands and migrate to the mainland in search of family support (Mondaca, 2018).

In this context, marked by family separation and strategies to overcome precariousness, it was Chilote women who took charge of all agricultural tasks related to family subsistence, creating a feminized practice of food sovereignty that, from a gender perspective, presents some particularities that remain to this day. In this sense, it is important to highlight the perception that the participants have about their gender roles as rural women, pointing out that these roles encompass more functions than those traditionally assigned to women in urban environments, such as agricultural and artisanal production for family subsistence. A possible explanation for their expanded conception of gender roles could be found in the historical context itself, which kept the archipelago on the margins of progress understood in economic terms,

forcing these women to create strategies to compensate for it:

“Ancient people were like that: they did a little of everything. My mother made looms, she knitted our vests, she planted, she took care of the vegetable garden, she made food: she did it all! Why? Because you had no other choice... It's not that "I'm going to the corner to buy," because there simply wasn't any”. (woman seed guardian 2)

From the above, it can be seen that the gender roles the participants understand as part of their functions as rural women already involved tasks that directly contributed to the exercise of food sovereignty. However, the phenomenon of the feminization of agriculture in Chiloé, resulting from male migration, expanded and intensified these roles, adding to their traditional caregiving and agricultural work the rest of the tasks involved in maintaining family subsistence in general, and food provision in particular, as a result the sexual division of labor became blurred. Notwithstanding what has been stated, the patriarchal conception of the sexual division of labor has remained unchanged in the narratives of the participants. Despite being aware that for decades it was they who sustained life in Chiloé through their multiple tasks, especially agricultural ones, the stereotypical view that there are "men's work" and "women's work" still persists in their discourse. Among the tasks that continue to be considered "women's work" is seed keeping, which, in addition to being seen as an essential task for the existence of food sovereignty, is understood as one of the fundamental gender roles of rural women, especially in economically uncertain contexts where they were the sole responsible for the feeding and care of their children.

This entrenched discourse, in addition to perpetuating the patriarchal epistemological invisibility of rural women, maintains the capitalist devaluation of their contributions as a mechanism of accumulation through dispossession and the over-exploitation of their labor. The above highlights how the capitalist and patriarchal system appropriates and integrates the knowledge of rural women into broader structures of domination, because in addition to having overloaded these rural women in the search for strategies to overcome the precariousness to which they have been subjected, it has maintained the veil of invisibility over their epistemic and material contributions, both by naturalizing them as care tasks and by labeling the tasks they performed alone for decades as “men's work”.

These evidences allow us to affirm that the women seed guardians do not consider their agricultural work as productive labor, but rather as a gender role of rural women, given the persistence of the epistemic injustice of the capitalist, colonial, and patriarchal system that has become entrenched in their own narratives. This system continues to frame their work as one of the caregiving duties they bear as rural women, rather than as productive labor in itself.

Currently, the feminized practice of food sovereignty remains unchanged in Chiloé despite the return of men from the

mainland. A new male exodus from the Chilote countryside to the main cities of the archipelago keeps women at the forefront of family agricultural work and seed keeping, while men join extractivist companies that provide them with jobs in exchange for exploiting the natural resources of Chiloé.

In this sense, although this feminized practice of food sovereignty has allowed a redistribution of power within rural Chiloé families, it is worth highlighting that the assumption of the task of family survival through the materialization of food sovereignty has been a mission to which these women were forced due to the structural inequality that, due to gender, has marginalized them from access to the same opportunities for economic progress that men had.

SOCIO-ECOLOGICAL CHALLENGES AND STRATEGIES

Within this framework, we encounter the same underlying trajectory of economic development, which, upon reaching the archipelago through various extractivist enterprises, not only facilitated the return of men but also generated a series of socio-ecological conflicts. According to Cubells (2021), these conflicts allow for an understanding of how ecological, social, and territorial impacts are interrelated, primarily driven by anthropogenic factors, specifically human actions (chiefly those associated with corporate exploitation in complicity with the Chilean state).

In this regard, the women seed guardians identify agribusiness and the genetic modification of native seeds as the primary threats to both the conservation of biodiversity and food safety, directly affecting their right to consume nutritious and adequate food. Additionally, their narratives reveal an open critique against various organizations linked to the Chilean Ministry of Agriculture, which, despite providing technical assistance to farmers in a territory declared GHIAS by the FAO, have not only failed to specialize their technical advisors in agroecology but also promote the sale of foreign and/or genetically modified seeds among the farming population. Furthermore, they encourage the use of agrochemicals to increase agricultural production, without considering the negative repercussions on the health of these peasant women and their communities, who are more exposed to agrotoxins, as noted by Vega (2024).

In this context, these women are also concerned about potential corporate strategies that, in collusion with Chilean institutions, seek to monopolize the ancestral practice of the free circulation of seeds through patents, legislation (such as Exempt Resolution 162 from the Ministry of Agriculture), or international treaties (such as the TPP-11). Such monopolization would undermine their right to freely determine their agri-food systems, forcing them into dependence on the agribusiness market. Moreover, it embodies the inherent injustice of having to purchase seeds that their ancestors have cultivated and reproduced for generations, thus reducing this natural common good to a mere market commodity.

Notwithstanding the critical social and environmental situation in Chiloé, the same Chilote women who, despite (or precisely because of) being marginalized from economic progress, have sustained life in the archipelago, are the ones who, exercising their agency, have embodied in their body-territories strategies of disobedience and self-organization of the social fabric to contest the survival of their land and community. For, where the capitalist, patriarchal, and colonial system has denied them opportunities, they have created them against the current in a socio-ecologically strained archipelago, experiencing a crisis of its biophysical limits. These struggles can thus be considered an expression of the feminization of the defense of food sovereignty.

DECLARATION OF CHILOÉ AS GIAHS

Regarding the objective related to the implications of Chiloé's declaration as a GHIAS territory, unfortunately, neither the FAO's purpose of safeguarding this agriculturally significant heritage territory has been effective in protecting it from the harmful effects of extractivist actions supported by the Chilean state. On the contrary, the same government that has committed to this international organization to protect Chiloé's agricultural heritage is the one generating socio-ecological threats, both through the signing of laws and the endorsement of international treaties that prohibit the free circulation of native seeds, as well as supporting the agribusiness monopoly. In fact, the state's strategy of creating a highly bureaucratized and poorly disseminated GHIAS label highlights the institutional inconsistency of the Chilean government in environmental matters. This has led to the proposal of a pressure strategy to fulfill environmental obligations by requesting the withdrawal of the GHIAS declaration by the FAO:

"What would happen if someone were to say: "Dear FAO, all of this is very nice, what you do to conserve agricultural heritage worldwide and the whole GHIAS initiative, but in Chiloé, the salmon farms are killing the sea, there are no longer seaweeds for cultivation to fertilize... they are deforesting, they are plundering the area for energy, we have a water crisis, are we no longer able to maintain the agricultural traditions we once had? The same country that boasts about the GHIAS label is the one that is leaving us with nothing." (woman seed guardian 6)

CONCLUSIONS

To conclude this research, it can be said that food sovereignty in Chiloé has been and continues to be feminized because the historical context of the archipelago has led women, particularly women seed guardians, to carry out this important agroecological work in their territory. The precariousness caused by their marginalization from economic development for gender-based reasons has led them both to deploy survival strategies based on their agroecological knowledge and to create strategies to defend the primary sources of sustenance that have enabled this survival, namely water, land and, especially, their seeds. In this context, the declaration of

Chiloé as a GHIAS territory is not particularly relevant, given the Chilean state's environmental inconsistency.

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EU-SPRI ECC
International PhDays 2025 Conference
March 5th, 6th & 7th, at the INGENIO (CSIC-UPV) facilities in València

Foreign Inventors and Environmental-Related Technologies: The Case of US MSAs

Salvatore Viola[1], Rosina Moreno[1], Ernest Miguelez[1], Davide Consoli[2], François Perruchas[1]

[1]Universitat de Barcelona (AQR-IREA), [2]INGENIO (CSIC-UPV), sviola@ub.edu

Short bio: My name is Salvatore Viola and I am a PhD student in Economics at the Universitat de Barcelona School of Economics affiliated with the Regional Quantitative Analysis Group (AQR) and the Research Institute in Applied Economics (IREA). My research related to the geography of innovation and science with a particular focus on environmental-related innovation and the international mobility of inventors and scientists.

How to cite: Viola, Salvatore. (2025). Foreign Inventors and Environmental-Related Technologies: The Case of US MSAs. In *Proceedings of the 6th International PhDays Conference* (pp. 68-78). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19600

Abstract: Recent publications from the IPCC and UNEP emphasize that global efforts to adapt to and mitigate climate change often fall short while its effects continue to worsen. One important contribution made to the fight against climate change is the development and deployment of environmental-related – or green – technologies (GT). While research investigating the characteristics of GTs has been growing, many questions remain unanswered. One area in need of further investigation concerns the role of agency. That is, *who* is responsible for the production of environmental-related technologies. Over the past decade, many studies relating to innovation have focused on foreign inventors. Foreign inventors act as international carriers of knowledge, promoting the development of new and unrelated technologies, such as green technologies. The present study aims to investigate the agency of US-based foreign inventors in regional GT diffusion and diversification using patent data from the USPTO. To do so, we leverage the patenting portfolios of inventors and their countries of origin to explain variations in innovative performance and specialization across US metropolitan statistical areas between the years 1990 and 2012. Evidence from previous literature would suggest that foreign inventors drive GT diffusion, however, their role in GT diversification is less clear. At the same time, both relationships may depend on the maturity of individual technologies highlighting that the contribution of foreign inventors is particularly influential at the earliest and latest stages along the GT life cycle.

Keywords: Innovation; Regional Diversification; Green Technologies; Immigration; Technoological Life Cycle

INTRODUCTION

Recent publications from the Adaptation Gap Report from the United Nations Environmental Programme (UNEP) and the Intergovernmental Panel on Climate Change (IPCC) emphasize that global efforts to adapt to climate change and mitigate the consequences of human activity on the planet are falling short. At the same time, the effects of climate change are worsening and the resources devoted are continuously insufficient (IPCC, 2023; UNEP, 2023). In consideration of these findings, it is crucial to understand the necessary tools to build a more sustainable world. Among these tools are environmental-related – or green – innovations that aim to mitigate the impact of human activity or adapt to existing challenges posed by a rapidly changing climate. In fact, their importance has been clear for decades now. Hall and Helmers (2010) claim that "global climate change mitigation will require the development and diffusion of a large number and variety of new technologies" (p. 2), including green technologies (GT).

While research investigating the characteristics and production of these technologies has been growing, some findings require further support and many questions remain unanswered. While it may be trivial to inherently assign importance to the study of environmental-related innovation, particular aspects of these technologies suggest that they require consideration as an individual group. GTs appear to differ fundamentally from non-green ones in a number of ways including their level of complexity and pervasiveness (Barbieri, Marzucchi, & Rizzo, 2020). This implies that GTs rely on the creative recombination and reuse of existing technologies to be produced (Orsatti et al., 2020, 2024) and that this process may depend on the maturity of individual types of environmental-related technologies (Barbieri, Perruchas, & Consoli, 2020). It has also been found that they are more likely to be formed by inventor teams that are more culturally diverse (Marino and Quatraro, 2023). In light of these facts, understanding the regional conditions for the production of environmental-related technologies becomes quite important. While a number of studies have considered how variations in the level of relatedness and variety of regionally co-located technologies can explain the production of GTs and diversification into related domains, less emphasis has been placed on the actors responsible for generating these conditions. Evidence shows that international migration is at least partially responsible for the cross-border transfer of knowledge (Lissoni, 2018). In fact, some studies even show how this international knowledge transfer can determine the direction of scientific or technological change (Choudhury & Kim, 2019; Ganguli, 2015; Hornung, 2014; Moser et al., 2014). Given the spatial and cognitive reliance of green technologies (GT) on creative recombination and reuse—and the fact that this appears to be best accomplished through the collaboration of

foreign and native inventors—foreign inventors may be key actors in the diffusion of environmental-related knowledge and the diversification of regions into new, greener domains.

This paper aims to investigate this connection in three ways using the backdrop of U.S. metropolitan statistical areas (MSAs) over the period of 2000–2013. First, do foreign inventors contribute to the diffusion of green technological knowledge? Second, do foreign inventors contribute to the diversification of MSAs into GTs? Third, how do these processes differ along the life cycle of green technologies? In doing so, this study will contribute to existing literature by providing evidence on the role of foreign inventors in regional environment-related knowledge diffusion and diversification and how they may augment the relatedness of the knowledge base supporting green technologies at different stages of development.

LITERATURE REVIEW

Economic and technological development is often considered among the following three facts: first, at the regional level, development and growth are path-dependent (Dosi, 1982; March, 1991), often stemming from formative historical events (Dosi, 1997) which then direct certain economic decisions and the development of certain organizational forms (Capone et al., 2019; Dosi et al., 2020); second, innovative processes agglomerate in space (Asheim & Gertler, 2006; Audretsch & Feldman, 1996) and specialize over time (R. A. Boschma & Lambooy, 1999); third, in order to remain competitive and prevent decline, (regional) economies must adapt (Cantner, 2017; Xiao et al., 2018) and innovate (Chapman & Walker, 1991; Walker & Storper, 1989). The latter may often come in the form of regional diversification: the process through which economies develop specializations in new industrial or technological domains. As a facet of evolutionary economic geography, the concept of diversification is important as it helps regions escape technological or industrial lock-in and construct new growth paths (R. Boschma, 2017; Neffke et al., 2011). Achieving this, however, requires specific conditions and relies on a balance of related and unrelated economic and technological activity (R. Boschma, 2017). On one hand, the appearance of new economic and technological growth paths is most often related to those which are already spatially present (R. Boschma et al., 2015; Hidalgo et al., 2007; Neffke et al., 2011; Pinheiro et al., 2018). On the other hand, the diversification into areas that are unrelated to existing structures may yield greater economic benefits, more effectively escaping lock-in and improving economic resilience (Frenken et al., 2007; Pasinetti & Scazzieri, 2016), yet they may also be harder to achieve and maintain (Castaldi et al., 2017; Fleming, 2001; Pinheiro et al., 2022). Indeed, this constitutes a duality of regional knowledge dynamics: places must strike a balance between concentration and diversity of knowledge to sustain growth and adapt (Barbieri, Perruchas, & Consoli, 2020; R. Boschma & Iammarino, 2009; Nooteboom, 2002).

Much of the previous literature seems to reach a consensus that the emergence of new economic and technological ventures emulates those that were previously present regardless of the geographical scale (R. Boschma et al., 2015; Hidalgo et al., 2007; Neffke et al., 2011). Using patents in the setting of U.S. cities and metropolitan areas, Rigby (2015) investigates the role of relatedness in spurring diversification and the abandonment of certain technologies. They find that, while most areas transition rather slowly to new technologies, it is shaped by and highly dependent on existing knowledge. Alternatively, areas abandon—or exit—technologies that are more distant than those most present. This is supported by the notion that knowledge production is cumulative and therefore follows established trajectories (Dosi, 1988). More recently, growing attention has been given to the importance and process of unrelated diversification which, while more difficult to achieve and potentially risky, may produce greater economic returns if geographical units are well-endowed and capable of sustaining it. One recent empirical investigation of this process is conducted by Neffke et al. (2018), who leverage Swedish firm data to explore the determinants of regional transformation. Their main findings state that unrelated diversification is largely driven by ventures without a previous connection to the region where they operate.

Against the backdrop of the diversification literature are the mechanisms through which knowledge bases are augmented and recombined to establish the conditions for its emergence. A necessary precursor for regional diversification is the recombination of existing knowledge and technology. Ample evidence has shown how this process of recombination resulting in regional diversification is most prevalent in places with large knowledge bases and strong research networks (Grashof et al., 2021; Kemeny et al., 2022). As a result, firms, regions, or other actors are equipped with adequate tools to do so. In conjunction with this fact, two pathways occur: first, the variety of related knowledge and technologies facilitates the recombination of familiar components into new technology; second, unrelated variety presents more opportunities to recombine previously unrelated technologies to produce radical innovation (Castaldi et al., 2017). In line with the previously mentioned duality of regional knowledge dynamics, the former allows for related growth to take place, whereas the latter allows for more dramatic shifts in innovation. In awareness of these two processes of diversification and the different types of knowledge bases they rely on, some researchers now consider the continuity of this process. Barbieri, Perruchas, and Consoli (2020) do so in the context of green technologies. The key intuition is that the processes of related and unrelated diversification depend on the current specializations of regions and that whether they will benefit from high concentrations of specialized knowledge or a diverse base of semi- or unrelated knowledge may also depend on the maturity of these technologies.

Green or environmental-related patents have been the subject of numerous studies over the past decades. Particular aspects of these technologies suggest that they require consideration as an individual group. First, GTs are more complex, novel, pervasive, and impactful than the non-green ones (Barbieri, Marzucchi, & Rizzo, 2020) and require a high diversity of competences (Zeppini & van Den Bergh, 2011). Second, Marino and Quatraro (2023) find that patents with higher proportions of foreign inventors and greater ethnic or linguistic diversity within inventor teams are more likely to be environmentally related technologies as they creatively recombine new and non-redundant knowledge (Orsatti et al., 2020, 2024). In line with regional innovation studies, GT is similarly reliant on the relatedness of spatially collocated technologies (Montresor & Quatraro, 2020; Santoalha & Boschma, 2021). On the other hand, this relationship may only hold true during the later stages of technological development as other studies show that unrelated variety may be crucial for the emergence of GT (Barbieri, Perruchas, & Consoli, 2020). These findings highlight the overall dependence of GT on specific conditions, and, in particular, they may also differ depending on their level of maturity. Barbieri, Perruchas, and Consoli (2020) are the first to investigate this dynamic empirically. Their study builds on a conceptual framework from Duranton and Puga (2001), which details the development of firms over their life cycle depending on regional circumstances. On the one hand, younger firms benefit from diverse environments as they experiment with different technologies or forms of production. On the other hand, mature firms are favored in more specialized regions, which may provide the necessary conditions for scaling production and attracting high-skilled labor. In fact, this is what the authors find. In their case, they consider the characteristics—specifically the degree of relatedness—of regionally collocated technologies to determine the level of technological diverseness or concentration. However, the question still remains: who is responsible for generating these conditions at the regional level?

Despite the growing understanding of the dynamic conditions which support GT development and its reliance on non-redundant knowledge, less is still known about who is responsible for producing these conditions (Miguelez & Morrison, 2023). The answer may lie in another strand of the innovation literature which focuses on labor and, in particular, migration. A number of studies show that highly skilled migrants can act as conduits of knowledge as they import knowledge into their host societies. Lissoni (2018), for example, finds that immigrants boost local innovation through the dissemination of their technical and scientific knowledge into their host societies. Additionally, many researchers have studied this effect using historical examples such as the migration of Soviet scientists (Ganguli, 2015), the Huguenots (Hornung, 2014), and the migration of German Jews (Moser et al., 2014). Choudhury and Kim (2019) show how foreign inventors recombine their tacit knowledge with that of natives and reuse

their own knowledge independently to spur unrelated diversification. Given the spatial and cognitive reliance of GT on creative recombination and reuse and the fact that (at least in the case of other technologies) this appears to be best accomplished by the collaboration of foreign and native inventors, foreign inventors may be key actors in the diffusion of environmental-related knowledge and the diversification of regions into new, greener domains.

DATA

This investigation relies on patent data from both the U.S. Patents and Trademarks Office (USPTO) and the Patent Cooperation Treaty (PCT) at the World Intellectual Property Organization (WIPO). The USPTO PatentsView open data platform was officially launched in 2017 and provides detailed information on granted U.S. patents, including CPC and IPC codes and inventor and assignee characteristics such as location. The PCT was established in 1978 and aims to facilitate the protection of inventions in a number of countries worldwide. While the PCT itself does not provide patent application data, other resources such as the OECD's REGPAT database can be used to capture information recorded in these applications (Maraut et al., 2008). REGPAT primarily serves to link patent applications to regions, but it also provides other useful patent metrics such as inventor locations and patent codes similar to the USPTO PatentsView data. One crucial distinction of this data is the fact that a subset of it also records inventor nationality. Until 2013, PCT applications required that residents or citizens of a PCT contracting state were allowed to file applications. In order to check this condition, the PCT also recorded inventor nationality. As a result, we can identify which inventors in this data are foreign or native to the regions where they settle. Using the data on inventor locations and U.S. Metropolitan Statistical Area (MSA) delineations from the U.S. Census Bureau, granted U.S. patents as well as inventors from the REGPAT dataset can be linked to locations in the U.S. The resulting dataset not only yields the fractional count of patents by MSA but also provides aggregated information on a sample of inventors present in a given MSA in a given year. Environment-related patents are identified in the dataset using the most recent version of the OECD's ENV-Tech classifications, which leverage both CPC and IPC codes to identify technologies designed to mitigate human impact on the environment or improve adaptation to the resulting consequences (Haščič & Migotto, 2015). The ENV-Tech classifications consist of eight main categories and a total of 38 subcategories, which define environmental technologies at a more granular level.

METHODS AND VARIABLES

The primary aim of this investigation is to understand the role that foreign inventors play in regional environmental-related technological diffusion and diversification in the US between the year 2000 and 2013. Accordingly, we examine whether and to what extent foreign inventors and the experience they bring with them are

associated with patenting in GTs using the following model:

$$GT_{ijt} = \beta_0 ForInv_{ijt-1} + \beta_2 ForeignExpertise_{ijt-1} + \gamma_{it} + \delta_{jt} + \varepsilon_{ijt}$$

Where GT_{ijt} represents the fractional count of GT patents in Env-Tech technology j, in MSA i, and in year t. All estimations include both MSA-year and technology-year fixed effects. $ForInv_{ijt-1}$ is the lagged count of foreign inventors patenting in the same technology and MSA. The main variable of interest, $ForeignExpertise_{ijt-1}$, captures one aspect of the tacit knowledge brought by foreign inventors to their destination. It is measured as the number of foreign inventors residing in an MSA in a given year whose country of origin (as determined by their nationality) has a specialization in environmental technology.

$$ForeignExpertise_{ijt} = \Sigma_c ES_{cjt} \times M_{cit}$$

Where M_{cit} is the number of foreign inventors from country c residing in MSA i in year t. ES_{cjt} is equal to 1 if $RTA_{cjt} \geq 1$ and 0 otherwise.

$$RTA_{cjt} = \frac{\left(\frac{GT_{cjt}}{\Sigma_j GT_{cjt}}\right)}{\left(\frac{\Sigma_c GT_{cjt}}{\Sigma_{cj} GT_{cjt}}\right)}$$

This equation calculates the Revealed Technological Advantage (RTA) of a country, c, in a given green technology, for those countries corresponding to the nationalities of the foreign inventors present in the PCT data. By construction, this variable acts as a means to measure the sort of experience brought by internationally mobile inventors. Previous evidence has shown that this type of measure is useful to explain foreign inventors' role in knowledge diffusion, as it may reflect the convergence in patenting portfolios of home countries and host regions.

In addition to considering foreign inventors' roles in patenting, we also investigate whether they are responsible for determining the direction of technological diversification by adapting the previous model:

$$Entry_{ijt} = \beta_0 ForInv_{ijt-1} + \beta_2 ForeignExpertise_{ijt-1} + \beta_3 GT_{ijt-1} + \gamma_{it} + \delta_{jt} + \varepsilon_{ijt}$$

Where Entry records whether or not we observe a new specialization of MSA i in technology j in year t. In this way, it serves as a measure of regional diversification, taking the values depending on the following conditions:

$$Entry_{ijt} = 1 \; if \; RTA_{ijt} > 1, 0 \; if \; RTA_{ijt} \leq 1$$

Where the RTA in this case is calculated at the MSA level as such:

$$RTA_{ijt} = \frac{\left(\frac{GT_{ijt}}{\Sigma_j GT_{ijt}}\right)}{\left(\frac{\Sigma_i GT_{ijt}}{\Sigma_{ij} GT_{ijt}}\right)}$$

Where $\frac{GT_{ijt}}{\Sigma_j GT_{ijt}}$ is the share of environmental-related technologies in class j in MSA i in year t. $\frac{\Sigma_i GT_{ijt}}{\Sigma_{ij} GT_{ijt}}$ is the share of the

environmental-related technology in the US in the same year.

LIFE CYCLE STAGES

The conceptual understanding of the technological life cycle and its construction relies heavily on the work of Barbieri et al. (2020) who adapted theory from previous studies relating to industries. Following the approach of Barbieri et al. (2020), the life cycle stages can be constructed by combining measures of geographical ubiquity and patenting intensity. The degree of geographical ubiquity is calculated as follows:

$$Ubiquity_{jt} = \Sigma_c M_{cjt}$$

Where $M_{cjt} = 1 \; if \; RTA_{cjt} > 1$. Ubiquity counts the number of countries which have an RTA across the different technological classes j. In this sense, it measures the global presence of types of green technologies. Patenting intensity is measured as the count of patents by Env-Tech class according to USPTO data. By standardizing the values of ubiquity and patenting intensity, individual technological classes can be assigned to the various stages of technological maturity contained in the following table:

Table 1. *Life Cycle Stages*

Life Cycle Stages	**Low Ubiquity**	**High Ubiquity**
Low Patenting Intensity	Emergence (1)	Diffusion (3)
High Patenting Intensity	Development (2)	Maturity (4)

As indicated by Table 1, technologies are assigned to the emergence stage if they exhibit both low ubiquity and patenting intensity. Alternatively, technologies above average in both categories are considered mature. Then, those technologies which display either low ubiquity and high patenting intensity or low patenting intensity and high ubiquity are included in the development or diffusion stages, respectively. It is important to note that the assignment of a given environmental-related technological class is relative to the stages of other environmental-related technologies and varies from year to year.

To contextualize these stages, recall the discussion of industrial dynamics from Section 2. We would expect that more nascent technologies belonging to the emergence stage benefit from a more diversified environment.

After adding technologies to each stage, we can repeat the previous two estimations including only those technologies that belong to one of the stages. The aim of this exercise is to perform a sort of heterogeneity analysis to ascertain whether or to what extent the impact of foreign inventors differs depending on the developmental stage of different green technologies.

EXPECTED RESULTS AND DISCUSSION

In line with previous literature, we would expect to find that the count of foreign inventors and the experience they bring according to the specializations of their home countries are determinants of GT production and regional diversification. At

the same time, the expected direction of this relationship remains somewhat unclear. While the measures related to foreign inventors may be positively related to general GT production, previous evidence shows that the specializations of their countries of origin do not necessarily correspond with the specializations of the regions in which they settle (Miguelez & Morrison, 2023).

The analysis of the life cycle stages of GT will provide further insights into how this process evolves between emergent and mature technologies. In particular, we expect to observe different relationships depending on the level of maturity of green technologies. In particular, we believe that the relationship between GT and the foreign inventor metrics will be positive and strongest for those emergent ENV-TECH classes. For mature technologies, the relationship may not be present at all, considering that these technologies may no longer rely on the specific initial conditions of knowledge diversity to be produced and may benefit more from specialized environments. The contrast in findings along the life cycle may highlight the differential influence of foreign inventors, whereby their role as knowledge carries is most prevalent in the development of new technologies whereas their compliment to labor markets serves to reinforce the production of mature, existing green technologies.

Regardless of whether the obtained findings align with our expectations, the results will enhance our understanding of the dynamics of GT knowledge production and regional diversification in these areas and provide new insights into whether and to what extent foreign inventors are implicated in this process. Additionally, we hope that these findings will help to disentangle the labor force augmenting effect of foreign inventors from their role in the cross-border transfer of knowledge. Along with improving our understanding or regional knowledge dynamics, our results will aid the development of targeted policies which facilitate the international mobility of skilled individuals coming from a variety of professional backgrounds and places.

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Science Park and regional development in new understanding: The case studies of Thailand

Thanaporn Chutichoodet

Manchester Institute of Innovation Research, Alliance Manchester Business School, University of Manchester, , Thanaporn.chutichoodet@postgrad.manchester.ac.uk

Short bio: I'm Thanaporn Chutichoodet from Thailand. I'm studying at the University of Manchester, Manchester Institute of Innovation Research Division. My research interests are about innovation policy in peripheral regions. I got scholarship from Khon Kaen University Science Park (KKUSP), Thailand. After graduation, I'm going to work on development strategy for the KKUSP as well as joining the Khon Kaen Business school. My study background is related to Real estate business in my undergraduate and startup development in my master's degree.

How to cite: [Chutichoodet], [Thanaporn]. (2025). [Science Park and regional development in new understanding: The case studies of Thailand]. In *Proceedings of the 6th International PhDays Conference* (pp. 79-84). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19726

Abstract: In the literature of science park development, there is limited understanding on the evolving roles and implementation in different context. By addressing this gap, this research explores on 'how do university science parks play active roles in regional innovation policy'. This research aims to unfold the implementation of university science park (USP) mechanisms through the lens of agency concept in peripheral region. Comparative studies between Science and Technology Park, Chiang Mai University (STeP) in the Northern region and Khon Kaen University Science Park (KKUSP), Khon Kaen University in the Northeastern region.

Keywords: science park; regional development; agency; peripheral region.

INTRODUCTION

The success story of Silicon Valley enhances the popularity of science park development around the world. There is no standard development model since the implementation varies in different scales, contexts, expected purposes and stakeholders involved (Charles and Uyarra, 2011). The phenomenon of science parks remains an ongoing phenomenon with a huge amount of investment and development scale, especially in developing countries in Asia and the Pacific (ESCAP, 2019).

Many scholars scrutinise the effectiveness of science parks. Massey and Wield (2003) criticise the overestimated potential of the science park. Developing physical

infrastructures and facilities is believed to generate substantial economic benefits. More adaptable strategies in diverse environments and available resources are needed, so that there is less gap between the policy ambition and practical outcome (Etzkowitz and Zhou, 2017: Gomes et al., 2022).

Regarding the RIS literature, the evolutionary economic geography is mainly driven by firms and endogenous development process (Martin, 2010: Hassink et al., 2019). Assumably, the past industrial development shapes the future. However, the roles of other actors (policy actor, for instance) are overlooked on how they shape the innovation system (MacKinnon et al., 2019). In recent years, the agency concept has been evolved significantly in regional innovation system literature. The scholars have categorised the agency concept in many ways since the complexity was found in different context, involved actors and objectives (Benner, 2024).

The Trinity of Change agency concept, developed by Grillitsch and Sotarauta (2020), includes innovative entrepreneur, institutional entrepreneurship and place-based leadership. Instead of working in isolation, each type of agency work in combination with others to support innovation activities (Jolly et al. 2020: Sotarauta et al., 2021). In the same line with the direction of science park development, it needs to take into account the context-specific challenges and more supporting mechanisms (ESCAP, 2019). Exploring the science park mechanism through the agentic lens would be promising on how the roles of science park have developed over time of changing environment of the region.

MAIN RESEARCH OBJECTIVE AND QUESTIONS

Our research objective explores the roles of university science park through the lens of agency concept. The key research question is 'how do university science parks play active roles in regional innovation policy'. This research aims to unfold the design and implementation of university science park (USP) mechanisms in a particular context- for instance, collaborating multi-level governance and other stakeholders.

CONTEXT OF THE STUDY

Thailand is an interesting context since the government perceived the opportunities to allocate the science park schemes to other peripheral regions. Around seventy percentage of the national gross domestic product was agglomerated in Bangkok and Central region, so that it leads to the inequality challenges to other regions (Tridech, 2016). Simultaneously, the existing infrastructure and laboratories in which the government has invested in the universities so far are not effectively utilised toward commercial development. From these opportunities, the government initiated the university science park schemes in three national research universities in 2013.

We found the USP model of the country is a multilayer configuration regarding the ownership of infrastructure and management team. Although the initial investment in the infrastructures and

supporting funds comes from the Ministry of Higher Education, Science, Research and Innovation (MHESI), the managements are handled by the universities where the science parks are embedded. Then, the universities assign the roles and responsibilities of managing the science park to the faculty members within the university. MHESI is different from other ministries because it did not have formal operation units at the provincial level. It means that the government leaves some freedom and flexibility in implementing the science, technology and innovation policies to the universities. Therefore, this study acknowledges the university science park as a development agency with the support of local universities.

This research conducts the comparative study between university science parks in two places. It will give a deep understanding of how policy instruments have been implemented in different contexts and purposes over time. The two university science parks were selected because they are the oldest and the biggest scales of the country: Science and Technology Park, Chiang Mai University (STeP) in the Northern region and Khon Kaen University Science Park (KKUSP), Khon Kaen University in the Northeastern region. Both universities, in which university science parks embedded, were positioned to be the national research universities. It could mean that both universities have a similar level of research capability.

Both provinces, Chiang Mai and Khon Kaen, are holding the highest gross provincial product in the regions. Due to being peripheral region, both places have a smaller number of innovation activities, low absorptive capacity of firms and weak entrepreneurial culture. The different institutional setting requires strategies to overcome particular challenges related to resources, networks and capabilities. After a decade of implementation, we found different stage development of both two university science parks. The STeP could grow in the scale-up stage and has started to work with other investment and market actors in addition to university-industry links. In contrast to KKUSP, many challenges have remained.

METHODOLOGY

We conducted the fifty-two semi-structured interviews including university rectors, researchers, science park management team, Technology licensing office staff, provincial government and municipality staffs. Beyond the regions' boundaries, we interview the ministry-level staffs to understand the policy design process and expectation from implementing the university science parks. External actor beyond the boundary of region also included: intellectual property firm. The interview guide was designed to gain insight into strategic decisions the university science parks have made rather than daily operation. In the next section, we will present the roles of university science park and the pattern of change agencies working in combination.

KEY FINDINGS

We found the Science and Technology Park, Chiang Mai University (STeP) not being formally supported by the university in the first place. Seven faculties formed pilot project and spearheaded by the returnee research who would like to enhance university-industry links. At that time, it was difficult in both researchers and firms to collaborate. STeP attempted to educate and raise awareness in both sides. Afterwards, STeP had become a formalised unit under the structure of university. Gathering momentum beforehand convinced the university for deregulation and assigned to be strategic unit of the university. The university allow to get access the resources as well as reoriented the knowledge production. STeP plays roles of institutional entrepreneur, by reorienting the intellectual property system and setting up the mechanism of university holding company for encourage academic entrepreneurs.

After getting legitimation from the university, the university took STeP to take part in provincial development plan process. This created more opportunities of STeP to be aligned with broader regional development strategies. In stage, we found more provincial actors get involved with shared projects as well as the increasing capabilities of STeP itself. Consequently, STeP could attract more resources allocation and partners to collaborate with. Recently, promotion of STeP director to be university rector of innovation division would continuously embrace STeP to be key strategic unit of university.

In the case of Khon Kaen University Science Park (KKUSP), the university rector got engaged in the formation stage of science park. The university policy was increasing numbers of research centres and directing research agenda toward place-based challenges, health and low productivity of agriculture sector, water resource management, for instance. Transferring knowledge from the university to firm was rather dominant in this case. The initial strategy of KKUSP was attracting well-known firms to relocate to the parks. While the KKUSP gave an importance on attracting tenant, supporting for firm formation process and university-industry links was not figured out. The KKUSP encountered the difficulties of convincing the researchers to work with firm, so that limited number of interest researchers might obstruct the optimal matching partners. Some firms show lack of confidence to collaborate with matched researchers. For temporary solution, the research subsided by KKUSP needed to begin with firm collaboration. We found that the KKUSP contacted researchers in other universities in some cases, but the collaboration was in ad-hoc manners.

In a recent year, the new university management team had preference on high technology sectors. It was difficult for KKUSP to adapt to that direction since the KKUSP had focused on supporting agriculture and food sector. Some academic services under many faculties had a conflict with the science park because they shared the same innovative firms. Moreover, the KKUSP could not intervene in intellectual property process under the technology licensing office of the

university. It affected getting access innovation disclosure and orientation. As a result of these evidence, the weak coordination between KKUSP and the university made science park being stuck in difficult situation. In this case, we found the KKUSP not play any active roles related to institutional entrepreneurs.

Even though the university attempted to engage in innovation activities, setting up the act of university holding company, for instance, there was not any active mechanism. The university act for academic entrepreneurs had not been deregulated, so that the researchers hesitated operating businesses. The scope of implementation had not covered the supporting investment mechanism. No venture capitalist or university investment arm was observed. Most of scaled up firms relied on public grants. For integrating regional development agenda, we found no evidence that the university took the KKUSP to get engage in provincial policy formulation process. This case demonstrates the implementation challenges among science park- university-provincial organisation collaboration. Even though these organisations attempted to support innovation activities, it turned to be fragmented effort at the end.

CONCLUSION

The study's contribution to knowledge includes the conceptual and empirical analyses of agency concept and the implementation of science park schemes. According to the key findings mentioned earlier, we found the multiple roles and adaptations of university science parks toward evolving contexts as well as expanding more collaborative actors. Future research could study the collaborating roles between university science parks in the regions which is still under development.

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Publishing Behaviour in Health Crises: Temporal Trends in Scientific Production by Universities, Hospitals, and Industry

Erika Celene Sánchez-Rodriguez

INGENIO (CSIC-Universitat Politècnica de València), , ecsanrod@upv.es

Short bio: Erika Celene Sánchez Rodriguez is a doctoral researcher at INGENIO (CSIC-UPV), where she investigates scientific publishing behaviour during health crises. Her work focuses on the field of science, technology, and innovation (STI), particularly within the line of research on collaboration and knowledge co-creation. Erika has extensive experience in the monitoring and evaluation of public policies, the design and measurement of STI indicators, information gathering and interpretation, data analysis, and the use of econometric software.

How to cite: Sánchez-Rodriguez, Erika C. (2025). Publishing Behaviour in Health Crises: Temporal Trends in Scientific Production by Universities, Hospitals, and Industry. In *Proceedings of the 6th International PhDays Conference* (pp. 85-95). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.21079

Abstract: Health crises declared as Public Health Emergencies of International Concern (PHEIC) by the World Health Organization (WHO) have generated unprecedented volumes of scientific output and prompted new forms of collaboration among universities, hospitals, and industry. However, the evolution of these collaborations over time, and the motivations driving researchers to engage with external organisations during such emergencies, remain insufficiently explored. This study addresses these gaps through a mixed-methods approach combining systematic literature review, statistical analysis of a bibliometric dataset of over 258,000 publications (2000–2023), and secondary analysis of survey data collected in 2018 and 2022.

Current research advances indicate that while publication volume increases sharply following the outbreak of a crisis, inter-institutional collaboration tends to be reactive and short-lived. The literature review reveals fragmented approaches to studying publishing behaviour in health emergencies, and the survey analysis is expected to provide further insight into the role of individual motivations in shaping collaborative decisions. The study offers empirical and conceptual contributions that may inform science policy and enhance our understanding of how knowledge production

and cooperation unfold during public health emergencies.

Keywords: Scientific Publishing; Health Crises; University–Industry–Hospital Collaboration; Researcher Motivations

INTRODUCTION

Health crises, particularly those declared Public Health Emergencies of International Concern (PHEIC) by the World Health Organization (WHO), have acted as powerful catalysts for transformation in scientific research systems. They have activated intensive flows of knowledge production and reconfigured collaborative dynamics among universities, hospitals, and indusrty. Outbreaks such as H1N1 (2009), Ebola (2014–2016; 2018), Zika (2016), and the recent COVID-19 pandemic (2020–2023) have driven unprecedented scientific responses in terms of scientific production, speed, interdisciplinarity, and international cooperation (Zhang et al., 2023; Haghani & Bliemer, 2020).

These crises have highlighted the strategic role of science when aligned with urgent health and societal needs. Research has shown that scientific systems can redirect their cognitive and organisational capacities to confront exceptional circumstances. In this regard, Yaqub, Coburn, and Moore (2024) argue that multiple legitimate forms of scientific response coexist during crises, requiring evaluative frameworks that are sensitive to epistemic plurality. Similarly, Yaqub, Luna, Moore, and Yegros-Yegros (2022) demonstrate that science can respond to one disease by mobilising knowledge and infrastructure developed for others, as was the case with Zika vaccines, which leveraged platforms originally designed for Ebola and yellow fever. Moreover, evidence from HIV research suggests that funding orientation can lead to unintended spillover effects that shape the scientific agenda in adjacent fields (Yaqub, Coburn & Moore, 2024).

Within this context, collaboration between universities, hospitals, and industry becomes structurally central. The literature indicates that such interactions intensify during health emergencies, facilitating knowledge transfer, applied innovation, and expert mobility (Azagra-Caro et al., 2017; Chiles et al., 2018). However, these collaborations do not always follow linear technology transfer models; instead, they emerge from complex relational dynamics, with interaction channels overlapping and adapting according to institutional, territorial, and thematic conditions (Azagra-Caro et al., 2022).

The responsiveness of the scientific system during crises is also shaped by regulatory frameworks, networks of trust, and socio-technical governance patterns (Barberá-Tomás & Molas-Gallart, 2014; Holman, 2021). Moreover, prior histories of institutional collaboration, social capital, and shared values among actors are key determinants of alliance effectiveness (Archibugi, 2017; Barberá-Tomás et al., 2021).

In parallel, scholarly attention has turned to the individual motivations of researchers to engage in public-interest collaborations.

Recent literature explores the psychological, emotional, and prosocial dimensions of scientific practice, highlighting that motivation extends beyond economic incentives or performance metrics (Azagra-Caro & Llopis, 2018; Hernando-Jorge et al., 2024). Lam's (2011) typology of "gold", "ribbon", and "puzzle" motivations provides a valuable lens to understand why scientists choose to collaborate with external entities, even under high-pressure and uncertain conditions.

Motivational theories such as Self-Determination Theory (Deci & Ryan, 2000) and prosocial motivation theories (Grant, 2008) elucidate how researchers reconcile internal needs (autonomy, competence, purpose) with social commitments during crises. Studies on researchers' personality traits, well-being, and emotional balance further support the idea that collaborative decisions are mediated by individual characteristics and perceived social impact (Azagra-Caro & Tur-Porcar, 2024).

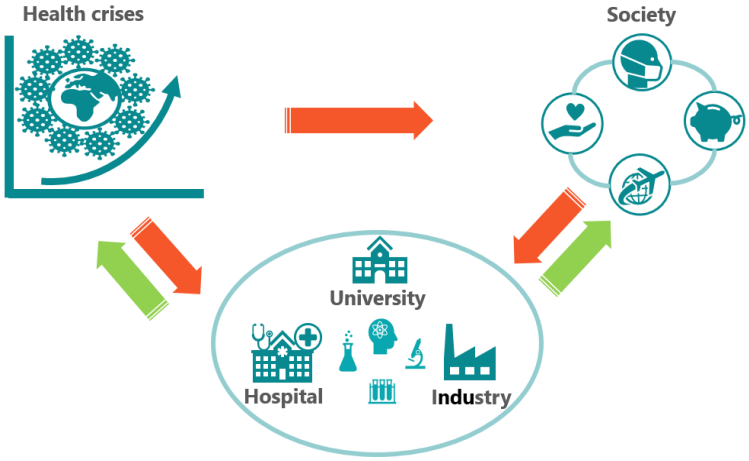
From an organisational standpoint, the concept of academic engagement—referring to interactions between researchers and non-academic organisations that do not necessarily involve commercialisation—has gained traction. Perkmann et al. (2013, 2021) have systematised this literature, illustrating the coexistence of multiple engagement modalities—formal and informal, contractual and collaborative—that vary based on institutional objectives, researcher trajectories, and environmental characteristics. This field also intersects with research on firm-based scientific production, where Rotolo et al. (2022) identify both strategic and reputational drivers for publishing in inter-organisational contexts.

Despite advances in these areas, significant analytical gaps remain. Many studies focus exclusively on the COVID-19 pandemic, neglecting comparative insights from other PHEIC events. Others examine inter-institutional collaboration without addressing researchers' motivations, or vice versa. There is thus a need for integrative research that combines bibliometric analysis of scientific production, empirical examination of university-firm-hospital collaboration networks, and investigation into the individual factors that facilitate or hinder these interactions.

This study seeks to address that gap through a mixed-methods approach that combines literature review, bibliometric modelling, expert interviews, and survey analysis. By integrating multiple sources of evidence and levels of analysis, the research aims to generate a broader understanding of how scientific collaboration and knowledge production unfold during global health emergencies.

As illustrated in Figure 0, the study is conceptually grounded in the interactions triggered by health crises across institutional and societal domains. These crises activate dynamic relationships between universities, hospitals, and industry, which in turn generate outcomes that influence and respond to broader societal needs.

Figure 0. *Conceptual interaction between health crises, institutional collaboration, and societal impact.*
Source: Author's elaboration



RESEARCH PREMISES AND OBJECTIVES

This article is grounded in the premise that health crises generate significant shifts in the dynamics of scientific production and collaborative practices between universities and external organisations. These shifts are reflected in the volume and focus of academic publications, as well as in how universities interact with other actors, including industry and hospitals.

It is assumed that, in public health emergency scenarios, the production of scientific knowledge geared towards urgent problem-solving intensifies, fostering specific patterns of publishing and inter-institutional collaboration. Furthermore, it is posited that common factors can be identified that motivate researchers to establish connections with external actors, as well as characterise the nature of these interactions.

Drawing on these premises, the study sets out three core objectives, each corresponding to a different level of analysis and collectively aiming to illuminate the dynamics of scientific production and institutional collaboration in the context of health crises:

- Identifying theoretical approaches, trends, knowledge gaps, and research opportunities concerning scientific production during PHEIC-designated events.
- Characterizing and explaining the patterns of collaboration in scientific publishing among universities, industry, and hospitals during a health crisis.
- Determining the motivations that drive academic researchers to engage with external organisations in times of health crisis.

METHODOLOGY

This study adopts a mixed-methods design, structured across three interrelated phases that correspond to the core objectives of the research. Each phase applies a distinct methodological approach, enabling a multi-perspective analysis of scientific production and inter-institutional collaboration during health crises.

PHASE 1. SYSTEMATIC LITERATURE REVIEW

This phase employs a qualitative methodology based on a systematic review of academic literature. The aim is to rigorously analyse scientific output related to knowledge generation in health crises. This will involve defining search protocols, inclusion and exclusion criteria, and consulting specialised databases such as Web of Science. The retrieved literature will be analysed thematically to identify recurrent approaches, theoretical gaps, and emerging research agendas.

PHASE 2. BIBLIOMETRIC DATABASE ANALYSIS AND EXPERT INTERVIEWS

This phase combines quantitative and qualitative methods to characterise and analyse collaborative behaviour in scientific publications between universities, industry, and hospitals during health crises. A bibliometric dataset will be constructed based on scientific publications related to diseases declared PHEIC by the WHO, retrieved from databases such as Scopus and Web of Science. This dataset will be analysed using descriptive statistics and multivariate regression models in STATA to detect patterns of collaboration between universities, industry, and hospitals. In parallel, semi-structured interviews will be conducted with expert researchers identified through the literature review. These interviews aim to validate, contextualise, and enrich the findings of the analysis.

PHASE 3. SURVEY ANALYSIS

The third phase involves a quantitative approach through secondary analysis of a survey conducted in 2018 and 2022 with academic researchers from various disciplines. The aim is to identify the motivational factors that influence engagement with external organisations during health crises. Descriptive and multivariate statistical techniques will be employed to explore relationships between individual motivations and different forms of collaborative behaviour with actors such as industry and hospitals.

KEY RESEARCH ADVANCES & NEXT STEPS

This research has generated important empirical insights into the dynamics of scientific publishing and collaboration in the context of global health crises. Two components of the study have been advanced: the analysis of a bibliometric database using statistical tools, and a systematic literature review.

The first component involves the analysis of a bibliometric dataset comprising approximately 258,000 scientific

publications indexed between 2000 and 2023. Applying descriptive statistics and multivariate regression techniques, the study examines how publication trends and collaboration patterns evolve around major disease outbreaks classified as Public Health Emergencies of International Concern (PHEIC) by the World Health Organization.

As illustrated in Figures 1 and 2, two core trends are observed across outbreaks such as H1N1, Ebola, COVID-19 and Zika:

- Total publication volumes rise substantially following an outbreak. Although publication levels tend to decline over time, they remain consistently higher than pre-crisis baselines.
- The probability of co-publication between universities, hospitals, and industry follows a distinct trajectory. Collaborative activity intensifies in the initial years after a health crisis but subsequently decreases, suggesting that these partnerships are largely reactive and time-bound.

Figure 1. *Number of publications and co-publication probability for H1N1 and Ebola (2000–2023).*
Source: Author's elaboration

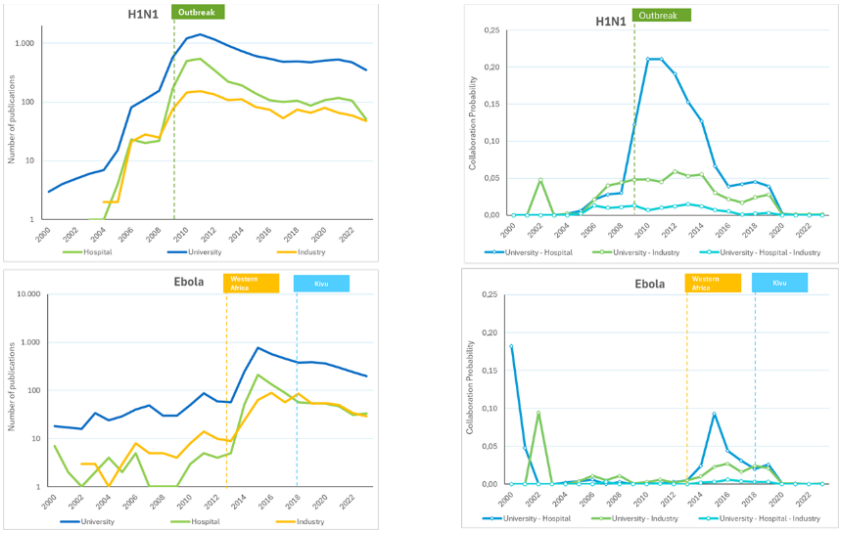
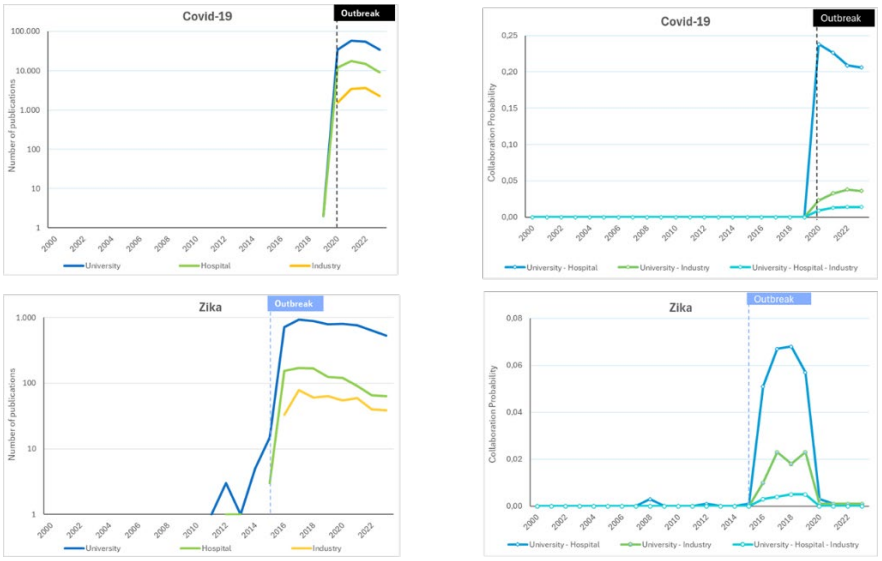


Figure 2. *Number of publications and co-publication probability for Covid-19 and Zika (2000–2023).*
Source: Author's elaboration



These figures also show that while collaboration decreases, individual institutions often maintain relatively stable publication outputs beyond the emergency phase. This highlights the need to distinguish between episodic collaboration and sustained institutional productivity.

As shown in Figure 3, a second line of work concerns the systematic literature review, which is being developed using predefined search terms applied in both Web of Science and Scopus databases.

Figure 3. *Search Terms to Identify Studies on Publishing Behaviour and Health Crises.*
Source: Author's elaboration

Publishing behaviour or patterns		Health Crises		AJG 2023 expanded
publi* behavi*		health cris*		*Research area of*
research behavi*		health emergenc*		*innovation field journals*
publi* dynamic*		PHEIC		*in Academic Journal*
research dynamic*		pandemic*		*Guide 2023 expanded*
publi* pattern*	*AND*	epidemic*	*AND*	
scientific publi*		disease outbreak*		
research publi*		outbreak response*		
research output*		viral disease*		
publi* trend*		virus infection*		
research dissemination*				

The search strategy combines two groups of terms: those related to publishing behaviour and patterns (e.g., publishing dynamics, research output), and those associated with health crises (e.g., pandemic, disease outbreak, PHEIC). To ensure academic rigour and relevance, the selection of sources is filtered according to the Academic Journal Guide 2023 Expanded.

Together, these research advances provide a solid empirical and conceptual foundation for understanding how academic publishing responds to public health emergencies, and how inter-institutional collaboration evolves in relation to such events.

Building on these advances, the upcoming stages of the project will focus on the following key actions:

- Conducting semi-structured interviews with expert researchers to validate and contextualise statistical results, and to refine the search parameters used in the literature review.
- Applying regression models to deepen the analysis of collaboration patterns across different types of institutions and crisis timelines.
- Expanding the corpus of scientific publications included in the review, ensuring greater disciplinary and temporal coverage.
- Developing a conceptual framework to explain the behaviour of scientific publishing and collaboration under conditions of health emergency, integrating both institutional and motivational dimensions.

These steps aim to strengthen the empirical contribution of the study and to inform broader debates on research responsiveness, institutional cooperation, and science policy during public health crises.

EXPECTED CONTRIBUTIONS

This study is expected to provide both empirical and conceptual contributions to the field of science, technology, and innovation studies, particularly with respect to academic responses to health crises. By investigating how scientific publishing behaviour and inter-institutional collaboration unfold during and after such events, the research will offer new insights into the mechanisms that shape institutional coordination, continuity, and responsiveness in knowledge production.

A key contribution lies in the integration of macro-level analysis—through statistical examination of a large bibliometric dataset—with micro-level insights into researcher motivations and collaboration practices. This multi-level approach seeks to overcome the persistent fragmentation observed in the literature, where structural analysis is often separated from the understanding of individual decision-making.

The mixed-methods design employed in the study contributes methodologically by combining database modelling, qualitative interviews, and survey analysis. This integration supports a more robust interpretation of publishing dynamics and enables the triangulation of findings across distinct sources of evidence. In doing so, the

study engages with ongoing debates about methodological pluralism in the evaluation of science and its institutional contexts.

From an applied perspective, the study's findings may serve as a basis for designing policies and institutional strategies to strengthen scientific collaboration in times of uncertainty. By identifying patterns in collaboration emergence, decline, and institutional persistence, the research offers guidance to funding agencies, universities, and healthcare institutions seeking to build more resilient research ecosystems.

Finally, this work contributes to broader theoretical debates about how research systems adapt under stress. By highlighting the interaction between institutional configurations, individual motivations, and crisis-triggered dynamics, the study proposes a more comprehensive framework for understanding the behaviour of scientific publishing in health emergency contexts.

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Public and Private Healthcare Paths for Menstrual Pain

Sara Sanchez-Lopez

INGENIO (CSIC-Universitat Politècnica de València), , sasanlo@upv.edu.es

Short bio: Sara Sánchez López is a doctoral researcher at INGENIO (CSIC-UPV), where she investigates menstrual health from a gender and public health perspective. is a doctoral researcher at UPV. Her work focuses on the social and institutional dimensions of menstrual health, particularly stigma, medical responses, and equity. With a background in engineering, Sara has extensive experience in interdisciplinary and international research projects, including work in international development focused on water, sanitation, environment, and gender equity. She combines technical knowledge with a social science approach to contribute to more inclusive and responsive health and innovation systems. Her work is guided by a strong commitment to equity, visibility, and the integration of gender perspectives in research, policy, and practice.

How to cite: Sanchez-Lopez, S. (2025). Public and Private Healthcare Paths for Menstrual Pain. In *Proceedings of the 6th International PhDays Conference* (pp.96-101). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19742

Abstract: This study explores how individuals in Spain navigate public and private healthcare systems when seeking care for menstrual discomforts. Based on data from a national online survey (n = 1,165), the qualitative research examines perceived barriers in access, continuity of care, and satisfaction with medical responses to menstrual symptoms. Respondents reported difficulties obtaining referrals within the public system, long waiting times, and limited follow-up, often leading them to seek care in the private sector. Despite this shift, many experienced similar limitations across both systems, including standardized treatment —mainly the prescription of hormonal contraceptives— and a perceived minimization of symptoms.

The study also considers the broader implications of these experiences, highlighting fragmented care pathways and the need for a more comprehensive approach to menstrual health. National data support the findings, with over half (52.7%) of gynaecological consultations in public healthcare in 2021 being first-time visits, suggesting systemic issues in long-term care. These results underline the importance of improving access, continuity, and clinical responses to menstrual health concerns. The study calls for healthcare system and policies that acknowledge the complexity of

menstrual experiences and ensure adequate support across, particularly in public systems.

Keywords: Menstrual Health, Gender Pain Gap, Menstrual Pain, Private healthcare, Public healthcare, Healthcare pathways.

INTRODUCTION

Menstrual discomforts—encompassing symptoms such as abdominal or pelvic pain, bloating, fatigue, and mood disturbances—are common among women and people who menstruate. These symptoms can significantly affect daily life, influencing physical, emotional, social, and occupational well-being (Davis et al., 2021; Armour et al., 2019). Despite their high prevalence and impact, menstrual discomforts often remain under-discussed, and their relevance is frequently underestimated in both medical and societal contexts (Seear, 2009; Fernández-Costa et al., 2023).

The persistence of taboos, cultural silences, and misconceptions surrounding menstruation continues to limit how menstrual experiences are communicated, interpreted, and addressed (Bobel, 2019; Kissling, 2006). This limited visibility may affect not only access to information but also the ways in which symptoms are perceived and managed—both individually and within healthcare systems.

This study explores the complex and multidimensional nature of menstrual discomforts in Spain, based on data collected through a national survey. We examine the diversity of symptoms experienced, the ways in which pain is reported, and the challenges faced when seeking diagnosis and treatment. Particular attention is paid to the psychological and social dimensions of menstrual discomforts, as well as the barriers encountered when accessing medical care.

In addition, we analyse women's interactions with healthcare professionals, identifying factors that may influence their experience of care. Previous studies have documented that pain related to menstruation is often minimized or dismissed in clinical encounters, which may delay diagnosis or reduce treatment options (Bernardes et al., 2020; Roberts et al., 2020). Gender biases, lack of training, or a tendency to offer standardized treatments such as hormonal contraception without further exploration have also been noted (Johnston-Robledo & Chrisler, 2020).

By focusing on these elements, this research contributes to a broader understanding of menstrual health and highlights the need for comprehensive approaches that address its physical, emotional, and social dimensions. Ultimately, we aim to inform and improve support systems and healthcare responses, in order to better meet the needs of those affected by menstrual discomforts

METHODOLOGY

This study is based on an exploratory online survey conducted between May 2021 and January 2022. The questionnaire combined quantitative and qualitative components to capture diverse experiences and

perceptions related to menstruation in Spain.

The target population included individuals over 14 years old, of any sex, living in Spain or its territories, with particular attention to those who currently or previously menstruate. A total of 4,028 valid responses were collected. The sample aimed to reflect the age and geographic distribution of the Spanish population. Although the online format could favor younger respondents, specific efforts were made to ensure sufficient representation of older age groups.

Geographic representativeness was also prioritized by adjusting the distribution of responses according to regional population data, particularly the proportion of women in each area.

The survey consisted of 43 items and was administered via the Typeform platform. It included a mix of question types (single- and multiple-choice, Likert scales, dropdowns, and an open-ended question), and was designed in clear, accessible language. The distribution strategy combined convenience and snowball sampling, using digital channels such as WhatsApp and social media to reach a wide and diverse audience.

Although there was an overrepresentation of participants with university education, the survey successfully captured a broad range of demographic profiles across age and socio-economic groups.

The questionnaire covered five main areas: demographic data, menstrual information, access to healthcare, menstrual discomforts, and a final open-ended section for personal accounts. Questions were adapted to respondents' age and sex to ensure relevance. A pilot test with 45 participants and expert review led to refinements, and the final version demonstrated good internal consistency (Cronbach's alpha = 0.81).

The study was approved by the Research Ethics Committee of the Technical University of Valencia (approval no. P01_24_03_2022, April 29, 2022). All participants provided informed consent.

RESULTS

Several participants reported turning to private healthcare despite the cost, due to perceived or experienced limitations in the public system. The reasons mentioned included delays, difficulties in obtaining referrals, and lack of follow-up or diagnostic clarity.

Access to gynecologists in the public health system requires a referral from a primary care physician. Some participants described difficulties in obtaining this referral or delays in securing appointments, tests, and results. Others reported challenges in accessing follow-up visits.

"It can't be that I have to wait 3 years until the next visit to the gynecologist to see how my treatment is going." (R2444, YOB (Year Of Birth 1992, Comunidad Valenciana)

Some respondents indicated they were not referred to a gynecologist despite reporting significant symptoms. Others described receiving limited information or treatment options when they were seen.

"Every time I've mentioned to my primary care physician about referring me to a gynecologist, I've been told: 'Why bother if you're young and all girls have painful menstruations.'" (R1388, YOB 1998, Islas Canarias)

Perceptions of greater accessibility and quality of care in the private system led some to seek services outside the public pathway. In some cases, participants sought out specialists such as pelvic floor physiotherapists, endocrinologists, or nutritionists, who were not offered to them within the public system.

"Unfortunately, I had to resort to paid consultations to find a gynecologist who really wanted to treat my pains." (R1029, YOB 1996, Galicia)

"A primary care doctor advised me to change my pad more often when I told him that my periods were very heavy. A private gynecologist diagnosed me with an endometrial polyp." (R1752, YOB 1977, Comunidad Valenciana)

"To this day, the only treatment offered to me is the contraceptive pill. […] The only solution left for me is to seek a specialized nutritionist and trainer and save up to be able to afford it." (R879, YOB 1995, Madrid)

In addition, some participants expressed concern about the quality of interaction with healthcare professionals in the public system. These concerns appeared to be a sort of shared concerned that was based on their own past experiences or those of others.

"At the public health service, I'm afraid that I won't feel comfortable with the gynecologist, as I've heard countless stories of situations I don't want to go through." (R1066, YOB 1998, Extremadura)

Finally, regardless of whether care was accessed through the public or private system, some recurring experiences were reported: feeling that their symptoms were minimized, receiving standardized treatments, and a lack of individualized attention.

DISCUSSION

This study highlights the fragmented and often unsatisfactory care pathways experienced by individuals seeking help for menstrual discomforts. Participants described moving between public and private services and consulting different types of professionals in search of adequate attention or diagnosis—a pattern consistent with other studies on complex care itineraries (Casacio et al., 2022).

Many reported barriers within the public healthcare system, such as difficulty accessing specialists, lack of follow-up, and experiences of their symptoms being minimized. These accounts echo findings from Windrim et al. (2024), who documented how women seeking care for abdominal pain often felt dismissed, which delayed diagnosis and treatment.

National data support this trend: in 2021, 52.7% of gynecological consultations in Spain's public healthcare system were first-time visits, suggesting limited continuity of

care. This may point to structural challenges where system pressures lead to the deprioritisation of non-urgent or non-malignant conditions, despite their significant impact on well-being and quality of life (Windrim et al., 2024).

These findings underscore the importance of improving access, continuity, and the recognition of menstrual symptoms within healthcare systems.

CONCLUSIONS

The results of this study reveal significant barriers in accessing and navigating menstrual healthcare in Spain. Difficulties in obtaining referrals, long waiting times, limited follow-up, and a perceived lack of diagnostic or therapeutic responses within the public system led many participants to seek private care. However, even across systems, experiences of standardized treatment and the minimization of symptoms were commonly reported.

These findings suggest a need to improve the recognition and management of menstrual discomforts within healthcare, ensuring that symptoms are addressed beyond a biomedical or one-size-fits-all approach. Strengthening continuity of care, expanding access to specialized services, and acknowledging the social and psychological dimensions of menstrual health are essential to improve care pathways and quality of life.

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EU-SPRI ECC
International PhDays 2025 Conference
March 5th, 6th & 7th, at the INGENIO (CSIC-UPV) facilities in València

Biocomposites innovation system. Implications of advanced biomaterials in the implementation, development and projection of a circular bioeconomy model

Eliana Fernández Fortunato[1], Fernando Jiménez-Sáez[1], and Eloy Hontoria Hernández[2]

[1]INGENIO (CSIC-Universitat Politècnica de València), Engineering Projects Department, Universitat Politècnica de València, eufer@doctor.upv.es (correspondence), fjimenez@ingenio.upv.es

[2]Business Economics Department, Technical University of Cartagena, eloy.hontoria@upct.es

Short bio: Industrial Designer from the National University of Córdoba, Argentina (2005). Holds a Master's degree in Design, Management and Development of New Products from the Universitat Politècnica de València (UPV), Spain (2014). She has over ten years of experience in strategic design management and in coordinating design and development projects for industrial SMEs. Currently, she is a Doctoral Candidate in the Design, Manufacturing and Management of Industrial Projects programme at the UPV. Her research is linked to collaborations with several research centres, including the Design and Manufacturing Institute (UPV, Spain, 2013), the Design & Sustainability Center (NDS, UPRF, Brazil, 2015), and the Management of Innovation and Knowledge Research Institute (INGENIO, UPV-CSIC, Spain, 2018–2025). She has been a Professor in the Industrial Design programme at FAUD-UNC since 2009.

How to cite: Fernández Fortunato, Eliana, Jiménez-Sáez, Fernando, & Hontoria Hernández, Eloy (2025). Biocomposites Innovation System. Implications of advanced biomaterials in the implementation, development and projection of a circular bioeconomy model. In *Proceedings of the 6th International PhDays Conference* (pp. 102-116). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19736

Abstract: The depletion of non-renewable resources and the ongoing ecological crisis underscore the urgent need for a profound transformation of the production system. Reducing the extraction of non-renewable raw materials and addressing the challenges posed by industrial waste have become critical priorities. In this context, the bioeconomy (BE) emerges as a valuable alternative, offering a pathway to transition from a traditional extractive model to a sustainable paradigm of production and consumption.

This study examines the potential of biocomposites (BC) as advanced biomaterials to foster the development of a biomass-based industry and to support the implementation, development, and projection of the BE within the bioplastic composites sector in the European Union (EU). To this end, the Delphi Method (DM) was employed, leveraging expert knowledge, experience, and assumptions through an iterative and anonymous exchange process based on the principles of collective intelligence. This approach aims to build consensus on future-oriented subjective assumptions.

Transitioning to a sustainable future requires fundamental shifts in the current development paradigm, a process that depends on collective action among stakeholders through the establishment of robust innovation systems (IS). In this transformation, public administration (PA) plays a pivotal role, capable of catalysing change through the adoption of sustainable policies. The study also discusses the potential of design to contribute to the definition of future scenarios that can be used by policymakers and industry.

Keywords: Circular Bioeconomy; Biocomposites; Innovation System; Delphi Method.

INTRODUCTION

The need to reduce the use of petrochemical products, address the ecological crisis, increase the availability of renewable materials, and promote the development of regional economic systems and structures has consequently made the BE one of the primary objectives of the EU's public policies (European Commission, 2018a).

According to a report issued by the International Advisory Council of the Global Bioeconomy (2024), BE is conceptualising as the "sustainable production, utilization and conservation of biological resources, encompassing knowledge, science, technology, and innovation, to deliver sustainable solutions across all economic sectors and facilitate a transition to a sustainable economy" (Dietz et al., 2024: p.3). The BE model is regarded as a promising alternative, with the potential to catalyse the transition from a fossil-based economy to a biomass-based economy (Usmani et al., 2021).

In this context, the focus is on the *use of living organisms, biotechnologies, biomaterials and bioprocesses, to develop new products and services* (Adamowicz, 2017). From this perspective, the transition can be achieved through the implementation of advanced biomaterials, such as BC, which create new opportunities for the design and development of industrial products with positive socio-economic and environmental impacts (Fernández Fortunato et al., 2023).

BC are composite materials composed of natural fibre reinforcement and biopolymers in matrix form. They are 100% biodegradable and exhibit physical properties comparable to those of synthetic composites (Gholampour & Ozbakkaloglu, 2020). BC have the potential to contribute to reducing

the extraction of non-renewable raw materials and addressing the issue of waste production, particularly within the agro-industrial sector (Yaashikaa et al., 2022). Indeed, the volume of agro-industrial waste biomass exceeds the volume of economic production (European Commission, 2018b).

In this context, PA, through the implementation of sustainable innovation policies, has the potential to act as a dynamic agent in the transition from a linear economic model to the circular BE paradigm, thereby accelerating its consolidation (European Commission, 2017).

The main goals of this communication are:

(1) To examine the potential of BC as advanced biomaterials and determine their capacity to contribute to the development of a BE within the composite plastics sector in the EU.

(2) To demonstrate the feasibility of establishing a BC-IS by identifying the relevant actors and components involved, and by analysing the role of PA as one of its key actors.

This research is guided by a set of questions aligned with the two main dimensions of the study. Firstly, it is necessary to consider *whether industry can mitigate the ecological crisis through the large-scale implementation of BC*. Secondly, it must be assessed *whether PA are capable of promoting and facilitating the transition to a circular BE model in the EU*.

This study contributes to the field of socio-technical and consumption systems transformation towards a sustainable economy, based on the premise that economic growth can be decoupled from the use of non-renewable resources. By employing an innovative methodology—the Delphi method—this communication identifies the barriers and opportunities arising during the transition and proposes a strategic pathway that offers a vision of a paradigm shift towards a BE model based on BC. In this context, the IS approach provides an appropriate framework for the empirical study of innovation within the composite plastics industry (Edquist, 1998).

METHODOLOGY

DELPHI METHOD

This study incorporates prospective perspectives that outline medium- and long-term scenarios in relation to both the research questions and the stated objectives.

Given this, the DM was selected as the main approach for conducting the study. This allowed us to identify levels of probability for the implementation and development of the BE model, driven by the implementation of BC in the medium term (between three and ten years) and its long-term projection (more than ten years). Furthermore, the results of the interviews should be used to identify the key actors involved in the potential BC-IS and the PA role into the system.

> *The Delphi method allows us to 'see the future and make projections'*

As a foresight technique, the DM is based on the utilisation of experience, knowledge,

and assumptions gathered through interviews with a group of experts on a topic for which there are insufficient theoretical or empirical references (Reguant-Álvarez, 2016).

The initial applications of the DM[1] focused on technology forecasting, with the objective of "predicting" probable inventions, novel technologies, and the social and economic consequences of technological change (Lilja et al., 2011).

Through a recursive and anonymous exchange process, the method is grounded in the concept of "collective intelligence," aiming to reach a consensus on subjective assumptions about the future (Jaimes, 2009).

PROCESS, STAGES, SAMPLING AND SELECTION OF EXPERTS

The DM is employed to obtain valuable qualitative and quantitative data (Von Der Gracht, 2012) regarding the various dimensions of this study, to identify key trends and challenges, and to address the proposed objectives and research questions.

The execution of the DM was based on a "contingent approach" (López-Gómez, 2018), in which questions are finalised between rounds, based on the answers received. It is important to note that the method does not follow a fixed structure from the outset but is instead characterised by the integration of participants' responses into the formulation of questions for the subsequent phase. This *iterative and collaborative* approach (Reeb, 2023) highlights the dynamic and interactive nature of the process.

Process design

The process was carried out in accordance with the following schematic steps: 1) Thematic axes were defined to guide the formulation of questions; 2) The questionnaire was developed and designed, comprising general questions for the initial phase and an outline of specific questions for the subsequent phases; 3) The expert panel was formed by identifying and inviting participants; 4) Questionnaires and summaries were distributed iteratively; 5) The responses were analysed, and a document summarising the results was drafted (see Fig. 1).

The questionnaires were structured around the study's primary themes: the potential of the BE as a new economic paradigm; the industrial application of BC through design intervention; and public policies as tools to encourage the transition from the extractive model to the BE model. Questions regarding the role of social demand in this transition process were also included.

It is important to note that the entire process was conducted virtually, through email

[1] The US RAND Corporation adopted the term 'Delphi' for its research, which was initially focused on national security issues. Sponsored by the United States Air Force, 'Project Delphi' was led by Norman Dalkey and Olaf Helmer in 1948. Following its introduction to the public in 1963, the technique was used in various studies on non-military issues (Von Der Gracht, 2012).

exchanges, with questions posed via the *Typeform* platform.

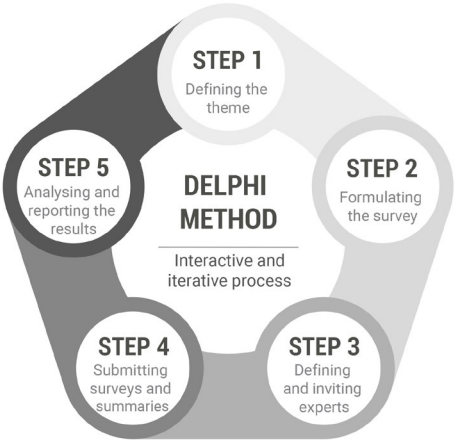

Fig. 1 *Delphi Process*.
Source: Adapted from Reeb, S. (2023)

Stages of the method

To facilitate reflection and responses to the proposed questions, the experience was structured into three stages.

A preliminary phase was established to invite the panellists through a document outlining the purpose and dynamics of the method, with emphasis placed on the anonymous nature of the entire process.

A total of 14 questions were posed: five general questions addressed to all panellists in the initial round, four specific questions posed to each of the two groups in the subsequent round, and one general question in the concluding round (see Fig. 2).

The role of the moderator is a key component of the method, as this person is responsible for overseeing the various phases of the process. The moderator's functions include providing participants with an overview of the previous responses, sending out new questionnaires, and communicating the objectives of the next phase. Additionally, the moderator ensures that time constraints are met.

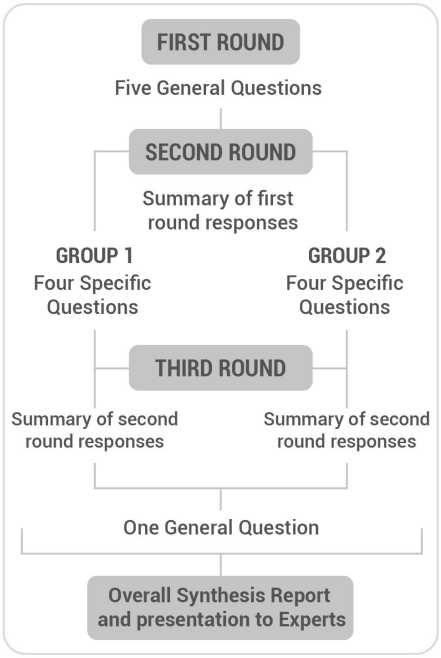

Fig. 2 *Delphi Question Stages*.
Source: Own elaboration

To ensure the objectivity of the responses, the anonymity of participants was maintained throughout the entire process, including the dissemination of results from each of the three stages. This is a key characteristic of the DM, which allows for uninhibited responses and the potential incorporation of differing perspectives from other panellists in subsequent rounds

(Grime & Wright, 2016). The identity of each participant was known only to the moderator.

The entire process—including the invitation and the three rounds—spanned seven months (May–October 2024). Prior to this period, approximately six months were dedicated to the study of the method, the formulation of the questions, and the development of the first-round questionnaire. A subsequent four-month period was allocated to clustering and analysing the results, along with the preparation of the final document.

Sampling approach

The subject under study is multi-dimensional, which is why a panel of experts was assembled to address its various themes. Each member of the panel possessed the necessary breadth of knowledge to respond to both general and specific questions.

In line with the principles of the DM, and following a comprehensive evaluation, participants were selected according to the following criteria: a sufficiently large number of panel members – panel size; a high level of expertise in their respective fields – level of expertise; a broad perspective on the multiple dimensions of the study – level of interest; and diverse geographical backgrounds – level of heterogeneity (Beiderbeck et al., 2021). The issue of gender equality was also addressed, with a significant proportion of the invited experts being women, accounting for 40% of the total.

Search for committee of experts

The composition of the expert panel reflects the breadth and diversity of expertise, with members representing prestigious academic institutions, technology centres, industrial sectors, design disciplines, and PA bodies. The panel includes representatives from Spain (Valencian Community), Italy, the Netherlands, Germany, and Sweden, ensuring a comprehensive and diverse international perspective.

A total of 31 experts were invited to participate in the Delphi experience through a progressive selection process, aimed at maintaining a balance across the different areas of interest of the research. Following this process, 12 experts were ultimately included in the panel[2].

DEFINING THE QUESTIONS

The questions were developed and structured according to four categories,

[2] While there are no specific rules regarding the number of MD participant (Steurer, 2011, in Lopez-Gomez, 2018), it should be noted that the final sample size of the expert panel pool always represents a compromise between practical needs and the requirements dictated by reliability and scientific principles (Lilja et al., 2011). According to Landeta (1999, in Reguant-Álvarez, 2016), the number of people required to obtain quality responses and manage feedback during the development process varies between 7 and 30, depending on the subject being discussed. In contrast, Delbecq (1975, in Lopez-Gomez, 2018), posits that a sample size of between 10 and 15 is adequate for the purpose of acquiring qualitative data from an expert panel (Shariff, 2015).

which align with the main themes of the study: (A) Bioeconomy, (B) Industry and Design, (C) Biocomposites and (D) Public Policies (see Fig. 3).

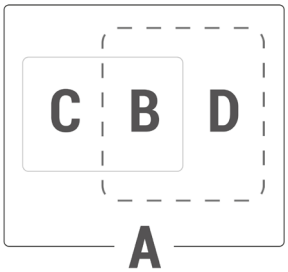

Fig. 3 *Systemic relationships of four categories*. Source: Own elaboration

In the first category (A), the questions were designed to encourage reflection on the following: the probability of the BE encouraging authentic sustainable development; the levels of profitability that BE could offer, rendering it appealing to business investment in biotechnologies and biomaterials; and the potential of BC to drive the BE model used to develop large-scale products.

The second category (B) focused on the following key questions: the possibility of a new production paradigm emerging through the development of a "biodegradable industry"; and the barriers and opportunities for industry to adopt and consolidate this new production model.

Furthermore, it explores the potential of *design* to facilitate the shift from an extractive industry to a Bio-based one, and the role of *social demand* in encouraging a production paradigm shift that would lead to new consumption patterns.

The third category (C) explores the latest innovative developments in BC research and development, and their growth in relation to sectors and applications over the next ten years. Other questions focus on their strengths and weaknesses regarding Life Cycle Analysis.

The fourth and last category (D) poses the question of the role of PA in promoting innovation in biotechnologies and biomaterials, thus encouraging the transition from a linear economic model to a BE model, and what strategies and instruments it can use to promote the development of a sustainable industry in the long term.

RESULTS OF THE SURVEYS

The responses obtained were analysed according to the following criteria: *consensus, majority, plurality, polarity,* and *disagreement* (Dajani et al., 1979 in Von Der Gracht, 2012). This classification enables a dual approach, facilitating both qualitative and quantitative analysis, from which conclusions can subsequently be drawn.

The results obtained are presented below, organised according to A-B-C-D categories.

BIOECONOMY

As a preliminary response to the issue raised, the concept of the "limit" in terms of vision and assessment of the depletion of non-renewable resources is a key consideration for some of the experts. It is evident that there is a growing *consensus* among the panellists that the implementation of the BE model hinges on

the involvement of a few key components and agents, whose role is to facilitate the transition process from one model to the other in a viable manner.

The political and economic situation in each region will have an impact on the development of the new model, which cannot be implemented homogeneously on a global scale. However, it may be possible within a medium-term European framework. Nevertheless, despite the differences between the central and peripheral countries, the implementation of the BE model will have several implications for companies, which they will have to recognise and address to achieve change.

One of the most significant challenges to the implementation of the new model is the socio-technological "roots" that maintain the extractive industries. Conversely, a transformation is required not only in the material aspects, but also in the individual and collective mentality and values.

At this point in time, experts in the field have reached a *consensus* that such changes can be implemented, but only in the medium-to-long term. It is only when the result of productive developments, which are tending towards the BE model, are no longer considered as an "added value" but as the "core value" that companies will be able to achieve a differentiating character which favours competitiveness.

Another perspective from some experts is that the evolution between models is driven by the necessity and imminence of change, which is short-term and transcends the profitability disparities between models. The key factors to be considered are the challenges to be faced, their repercussions and contributions from industry.

The *majority* of the panellists expressed a favourable opinion on the potential for BC to achieve greater recognition across various industrial sectors but only if they highlighted their positive socio-environmental impact throughout their life cycle.

In the plastics sector, where large-scale production is possible, BC can play a significant role in promoting the BE model. They can also contribute to achieving some of the Sustainable Development Goals.

In contrast, certain *minority* perspectives adopt a more cautious approach, highlighting potential obstacles that could delay the integration of BC in industry. These obstacles include social awareness, the demonstration of their productive viability, and the optimisation of their performance.

INDUSTRY, DESIGN AND SOCIETY

There is a *consensus*, of the ´yet, but... ´type, on the necessity of certain prior contexts or variables for a sustainable industry to develop and consolidate. It is important to note that the "renewable" industry is more comprehensive than the "biodegradable" industry, as the latter focuses exclusively on the end-of-life cycle.

The consideration of the entire life cycle for the sustainable character of a new production paradigm is once again part of the reflections. It is imperative that the industry recognises its role as a responsible

agent and ensures that most impacts during the cycle are positive.

There is a *consensus* amongst experts that economics is one of the most significant barriers, due to both the incorporation of biotechnologies and biomaterials, and competition from non-renewable materials. However, a *plurality* of views exists on other barriers related to the intervention or "non-intervention" of different actors, such as administrations (political decision-making), the market (society) and different interest groups (stakeholders).

Regarding the opportunities for industrial companies, two factors have the potential to provide incentives for industries to adopt sustainable materials and processes. Firstly, there are internal factors, such as capitalising on government, tax and/or R&D incentives, as well as on technological improvements resulting from the change. In addition, the use of design to visualise new possibilities for materials and the associated business and consumption patterns is also a key factor.

Secondly, external factors must be considered. The new model situation permits the admission of new "players" who would not be included in the current model. Furthermore, there has been an increase in societal awareness and the establishment of user and consumer communities. This paradigm shift represents a significant opportunity to address emerging sensitivities and to transform citizens' demands into opportunities.

Conversely, a *consensus* has been reached concerning the pivotal function of design in the transition from the linear economy to the BE. It is acknowledged by all experts that design must assume a fundamental role. This role involves the collaboration in the definition of prospective scenarios that can be used by policymakers, as well as the proposal of concrete lines of implementation for industry. Design can be considered as a mediator, a guide and/or a strategic tool.

As a final aspect in this category, the experts take a *polarised* position on social demand intervening in the transition process. One group claim that, once a certain percentage is reached, social demand will define a new direction in the consumption of sustainable products. This will "push" the industry towards change.

The other group has a different opinion on the matter. They argue that social demand alone is not sufficient to drive change towards the new production paradigm. The argument is posited that social demand is frequently distorted by the system, and while it may be possible to stimulate positive consumption dynamics, this will only be feasible in the long term.

BIOCOMPOSITES

According to experts in the field, significant advancements have been made around BC, with implications for a transformation of the current production model.

Among the recent advances in BC R&D, the experts highlight the following aspects: new polymer matrices derived from renewable resources (e.g. lignin, vegetable oils, styrene substitutes, etc.); renewable reinforcement

fibres offering materials with high mechanical, thermal, chemical and environmental performance; and, in particular, the transformation of bionanocomposites with far-reaching possibilities in various industrial sectors, among others.

The potential applications of BC are a subject upon which experts have reached a *consensus*: it is extensive. The sectors that stand to benefit from its use include: the biomedical and agricultural sector, the automotive and aeronautics sectors, the electrical sector and construction, interior and street furniture. Another area with significant potential for growth is the use of BC in packaging.

However, BC have yet to overcome several obstacles to establish themselves as an "instrument" for the transformation of the production model in the plastic composites sector, to be truly competitive materials and to project themselves in the long term.

In this regard, experts analyse various barriers and opportunities for BC considering a Life Cycle Analysis.

In terms of strengths, the positive socio-environmental impact and technical capabilities of BC can be highlighted, contributing to the privileged position of biocomposite-derived products and to the achievement of some of the Sustainable Development Goals. Additionally, its lightweight and versatility in adapting to different applications are notable advantages.

Conversely, the challenges associated with recycling, despite the biodegradability and the associated costs, represent significant weaknesses. The availability and/or logistics of renewable raw materials must be considered, as must geographical differences impacting environmental directives and policies, which will not be applied in the same way in all countries, leading to differences in the market.

Furthermore, the use of different bio-sources (some countries use agricultural fibres and others forest fibres) must be considered, leading to different biocomposites and therefore exports require selection prior to recycling.

PUBLIC POLICIES

The panellists are in *consensus* that the implementation of the new BE model places the PA at the centre of the transition process, since it is a regulatory agent, a prescriber and a major exemplary consumer.

The necessity of both public and private investment is emphasised, as well as the indispensable interconnection between the technology sector and universities. This is driven by legislation that aims to stimulate the sector, thereby making it an optimal means of achieving the BE model.

From a *plurality* of perspectives, the experts propose several strategies. Some of these are more conventional, while others are more “disruptive” in nature. These include the following: sustainable policy guidelines, networking among different stakeholders, the redefinition of rights, the rethinking of

ministerial structures, policies to promote R&D, and public-private collaboration.

At this juncture, experts recognise the crucial role of states and their administrations, given the substantial impact they can have in setting an example and legitimising biomaterials. The panellists offer guidance on the implementation of incentive and disincentive tools that PA can use to manage change.

In terms of incentives, the following stand out: tax exemptions for biomaterials, loans with favourable conditions, tax breaks linked to R&D activity, research calls focused on public-private collaboration, incentives for social communication of social and environmental benefits among others.

Regarding disincentives, the taxation of extracted materials is a key consideration, as are materials that are more difficult to recycle and use, and the elimination of harmful environmental subsidies.

The following section provides a summary that links the four categories studied to present a conclusion on the matter under discussion.

KEY FINDINGS

As is evident from the perspectives offered by the experts, companies can assume an active and significant role in the achievement of sustainable development as a profitable and competitive alternative, thereby *contributing to the mitigation of the ecological crisis*.

In essence, they hypothesise that the establishment of a new sustainable economic model using advanced biomaterials, such as BC, may be possible if certain factors and actors associated with scientific and technological advances are involved.

The implementation of political strategies that maintain environmental measures (e.g. the prohibition of the use of toxic materials and processes of any kind) and investments by private entities together with sustainable social demand, is the fundamental basis for change. It is argued that this will serve as the foundation to confront the challenges posed by a novel economic paradigm based on a “renewable industry”. This will be achieved through the attainment of satisfactory levels of profitability, with the objective of superseding the prevailing extractive economic model in the medium term.

One of the most effective strategies identified is the use of *public procurement* to set an example and encourage the private sector to engage in rethinking its role as a renewable industry over the medium and long term.

Furthermore, a noteworthy expert observation is that the industry requires a vision of the future that does not leave it isolated in the transition to a new production model. In this sense, *design* can be a valuable ally and a useful tool for visualising future scenarios, identifying opportunities that have not yet been created and transforming them into concrete goals

to be pursued. Industry needs a successful example to follow and be inspired by[3].

Regarding BC significant progress has been made, and all of these are important as they propose a change in the production model.

It is important to emphasise that BC should not be considered as a substitute for fossil composites. Industry should explore new processes, design dynamics and narratives to incorporate BC, rather than suggesting substitution as a strategy. A new industry could find a way to conquer an old market.

One alternative suggested is that the market penetration of BC can be accelerated through the establishment of a national BC platform. This would be led by a team of professionals capitalising on existing knowledge in the field, with clearly defined objectives and a medium-term timetable. In order to achieve this, a clear national industrial policy and public funding are required.

It is imperative that a robust system be established around BC to progress with a view to modifying the current production model in the industrial composite sector. Strong economic and regulatory incentives are indispensable. However, in the absence of such measures, it is expected that companies will not assume the risks associated with this new production model.

We recognize that from the process of becoming aware of the current problematic situation, the need to shape a new way of relating between agents must emerge. This can be understood as a new IS (see Fig. 4), or as the progressive evolution of the existing idea of an IS, towards one that reflects new relationships and new reasons for relating between agents accordingly[4].

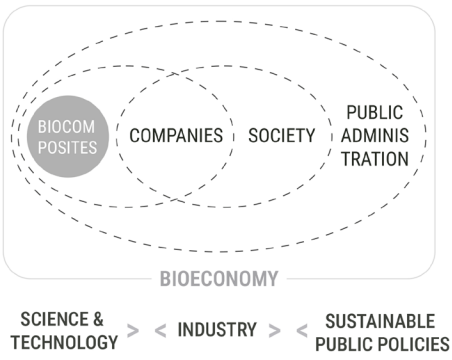

Fig. 4 *Preliminary approach of the Biocomposites Innovation System.* Source: Own elaboration

It is essential for industry to move from superficial measures to profound structural changes *to mitigate the ecological crisis*, as some experts have suggested. The

[3] It should be noted that there are currently 31 projects ongoing within the HORIZON EUROPE (2023-2027) Specific Programs: "Food, Bioeconomy, Natural Resources, Agriculture and Environment" and "Bio-based Innovation Systems in the EU Bioeconomy" https://bit.ly/HORIZON-JU-CBE

[4] There are currently two bio-based industry consortia in Europe: the "Bio-based Industry Consortium" in the EU (biconsortium.eu), and the "Bio-based and Biodegradable Industries Association" in the UK (bbia.org.uk). BIC is a founding member of the "European Bioeconomy Alliance" (bioeconomyalliance.eu)

relationship between biodiversity and industry must be based on a balanced coexistence to achieve sustainability, with industry making a tangible and long-term commitment.

The shift of companies towards the implementation of more sustainable and efficient business models is of considerable benefit. Transitioning to more sustainable and efficient business models not only has significant environmental benefits but also provides a competitive advantage by generating significant cost savings and creating new jobs that offer opportunities for workers and entrepreneurs (European Commission, 2017).

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the experts for their invaluable contribution and for their patience. In alphabetical order:

Vicente Amigó *(Full Professor and Researcher at the "University Institute of Materials Technology" at the Polytechnic University of Valencia, Spain*); Martín Ávila *(plus Senior Lecturer "Design for Sustainable Development" at Konstfack University, Sweden):* Rafael Antonio Balart Gimeno *(Full Professor and Researcher at the "ITM" in the line "New Polymeric Materials and Ecological Composites" at the UPV, Spain);* Jan Börner *(Professor for "Economics of Sustainable Land Use & Bioeconomy" at the University of Bonn, Germany, and co-author of the report "Globalising the Bioeconomy: Recent Trends and Drivers for National Programmes and Policies" (2024), by the "International Advisory Council on Global Bioeconomy"*; Yolanda Cárcel Fons *(Head of the "Public Sector Innovation and Innovative Public Procurement Service" at the "Valencian Innovation Agency", Spain);* Kike Correcher *(Representative of the "Spanish Network of Design Associations" (READ), and of READ in the "Bureau of European Design Associations"*; Mikael Lindström *(Former head of biomaterials development at "Research Institutes of Sweden" Bioeconomy division);* Inmaculada Montes Gisbert *(Sustainability Project Manager at ACTIU "Office furniture manufacturers for companies")*; Valentina Rognoli *(Associate Professor in the "Design Department" at Polytechnic University of Milan (PoliMi) and Co-Director of the "Materials Experience Lab");* Gabriel Songel *(Full Professor of "Design" at the UPV and founding partner of "Innoarea Design Consulting");* Dilip Tambyrajah *(Initiator and founding member of the "International Natural Fiber Organization";* Eva Verdejo Andrés *(Head of the "Recycling and Environment Business Line" at the "Technological Institute of Plastic AIMPLAS")*.

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Building Sovereignty or Dependency? Two Decades of Swedish Research Capacity Building for Developmental Universities in Bolivia

Annika Ralfs[1] and Carlos Acevedo[2]

[1]Research Policy, Lund University School of Economics and Management, , annika.ralfs@fek.lu.se

[2]Unit of Technology Transfer, Universidad Mayor de San Simón, , c.acevedo@umss.edu

Short bio: Annika is a final-year PhD candidate in Research Policy at Lund University, affiliated with CIRCLE. Her research focuses on reimagining international research collaboration, addressing present scientific inequality between high-, middle-, and low-income countries. She explores themes such as collaboration motivations and barriers, the international division of labor, and how research agendas are shaped. Annika works with both qualitative and quantitative methods, drawing on interview, survey, and scientometric data. She is currently completing her dissertation and exploring opportunities for postdoctoral research in this field.

How to cite: Ralfs, Annika. & Acevedo, Carlos (2025). Building Sovereignty or Dependency? Two Decades of Swedish Research Capacity Building for Developmental Universities in Bolivia. In *Proceedings of the 6th International PhDays Conference* (pp. 117-136). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19740

Abstract: Despite its relevance for developmental universities operating in resource-constrained settings, the role of international collaboration in shaping their practices remains underexplored. This study examines how two Bolivian public universities – Universidad Mayor de San Andrés and Universidad Mayor de San Simón – position themselves within international research cooperation, specifically in the realm of research capacity building financed by Sweden's Development Aid Cooperation Agency (Sida). It investigates how these universities navigate the dual imperatives of engaging in international scientific networks while conducting research that addresses local challenges. The study explores agenda-setting processes across the Sida-supported pillars: research governance, infrastructure support, PhD education, innovation programs, and collaboration with Swedish universities. Our findings highlight a gradual shift from dependency toward more interdependent sovereignty over more than two decades of cooperation.

Keywords: Research capacity building; international collaboration; developmental

universities; academic dependency; technology sovereignty.

INTRODUCTION

Alongside climate change and environmental degradation, rising global inequality ranks among the most urgent challenges of our time (Brundenius, 2017). This issue operates on a global scale and is closely tied to dominant models of economic development. As Arocena (2024) argues, addressing inequality requires a transformation toward more inclusive and sustainable modes of production – something that is not achievable without rethinking the current role of advanced knowledge. This perspective opens the door to exploring how learning processes across different sectors of society can contribute to such a transformation.

Several scholars propose knowledge democratization as a strategy for sustainable human development in the Global South, with particular emphasis on the contributions that can arise from public universities, i.e. Trojer et al. (2014), Acevedo et al. (2017), Arocena (2017) and McCowan (2019) among others. The democratization of knowledge is presented as an ideal to guide a necessary agenda for transformation, one that promotes the agency of diverse social groups and the expansion of their capabilities (Sen, 1999). This strategy is grounded in a conception of power that emphasizes the interactions between technology and organizational structures, fostering the enhancement of capabilities and the agency of multiple social groups (Arocena, 2024).

In this context, developmental universities – self-proclaimed or externally attributed – are institutions whose mission is to foster inclusive and sustainable development through the democratization of knowledge, including the democratization of research agendas and knowledge diffusion, amongst others (Arocena et al., 2018). It is commonly acknowledged that developmental universities cannot fulfill this mission in isolation but need partners in society to successfully contribute to inclusive and sustainable development (Acevedo, 2018). While collaboration within the national context is an integral part of the concept, the relevance of international collaboration for developmental universities remains largely unexplored.

Generally, universities in the context of development need foreign partners to develop their capacities to conduct research and to make knowledge useful to society (Acevedo, 2018). There are various reasons for that. Historically, local research has not enjoyed a high social or political status in Latin America (Sutz, 2003) and continues to receive little financial investments (World Bank, 2025). There is less demand for university-generated knowledge in Latin American countries, resulting from fewer ties with the local industry and a lack of demand and confidence in local universities to solve problems. Globally, resources to conduct scientific research are distributed unequally, implying that universities in the Global South have to work with more scarce resources than universities in the Global North (Srinivas & Sutz, 2008). Against this backdrop, universities and funding agencies in the Global North can be crucial partners for

universities in the Global South to achieve their mission of contributing to inclusive and sustainable development. Universidad Mayor de San Andrés in La Paz and Universidad Mayor de San Simón in Cochabamba in Bolivia exemplify cases of developmental universities that cooperate with international partners, most notably from Sweden, in building their research and innovation capacities (Acevedo et al., 2018).

While international collaboration can offer many opportunities, it potentially creates tensions which should be considered in the strategies of developmental universities. Frequently, universities in Latin America find themselves in a tension between the need to address local problems and the need to establish links to the international research community (Sutz, 2003). This needs to be seen in the context of the colonial history and ongoing Eurocentrism of science in Latin America (Quijano, 2000).

Bolivian public universities are challenged to simultaneously build capacity in two relatively different dimensions; to link research activities and real-life problems in the country, while also complying with the traditional academic goals of global research like international recognition and prestige (Acevedo, 2018). Hence, their researchers are civil servants of a national public body at the same time that they are members of the international scientific community establishing epistemological agendas (Thoenig & Paradeise, 2016). While not always conflictive, there can be tensions between the demands of international science including forms of assessment and provision of research resources, and local experiences and knowledges (Acevedo, 2018).

Knowledge has become a major source of inequality in power relations (Arocena et al., 2015). This applies both within countries between different groups and additionally affects research collaboration between countries with unequal access to resources. Questions surrounding whose knowledges and capacities are prioritized, who defines research agendas, and how resources are distributed are frequently asked in this context (Gyberg, 2023).

This study examines the case of long-term, institutional research capacity building between the Swedish International Development Cooperation Agency and the Universidad Mayor de San Andrés and Universidad Mayor de San Simón in Bolivia, seen under the light of the developmental university ideal. It looks back on the evolution of bilateral cooperation over the past two decades. This study seeks to advance the concept of developmental universities by foregrounding the critical role of international collaboration as a key dimension in their evolution and impact. In particular, we examine how developmental universities manage the delicate balance between advancing local interests and engaging with foreign partners, as they strive for sovereignty without succumbing to dependency. In doing so, developmental universities fulfill their mission of knowledge democratization nationally, while also advancing global knowledge democratization by integrating marginalized perspectives into international science networks.

LITERATURE REVIEW

In the context of an unequal distribution of resources in global science, collaboration can be a means to redistribute resources. Even more so, research capacity building can be understood as the conscious attempt to address the unequal distribution of resources, potentially leading to more equal research partnerships. In the context of unequal research capacities between countries, research aid refers to the support of higher-income countries like Sweden to development research and research capacity building in lower-income countries like Bolivia (Gyberg, 2023). Research aid describes activities financed under the development aid budget specifically with the aim to generate, direct, and spread scientific knowledge (Nilsson & Sörlin, 2017). In that sense, research capacity building places great emphasis on equipping actors with the tools to address their challenges independently, in this case, by means of science and technology.

However, the practice of research capacity building has also received critiques (Mormina & Istratii, 2021). Increasingly, scientific relations between countries in the Global South and North are challenged for not being critical of neo-colonial structures, power relations, a lack of local ownership or a short-term focus in funding initiatives. Research capacity building can be a threat to knowledge democratization when the ideas of development as a goal and science and technology as the way to reach the goal are shaped by normative ideas of modernity (Vessuri & Cancino, 2018). In integrating into international knowledge networks, the adjustment and denial of local knowledge traditions has been observed and criticized. Another threat which the integration of developmental universities in international science networks could pose to them, is that of academic dependency (Alatas, 2003; 2022). Academic dependency refers to the influence that high-income countries have over research agendas, including the definition of problems, methods, and standards. This dependency manifests in various ways, such as the dominance of theories produced in wealthier countries, limited representation of lower-income countries in scientific publications, reliance on higher-income countries for educational technology, aid, and recognition. These mechanisms reinforce the power of dominant countries while hindering the growth and autonomy of dependent ones.

It is evident that resources available to countries to invest in science and technology exhibit large disparities. Investments in science, technology, and innovation are seen as a major key to achieve development that results in inclusive and sustainable development. While the “Sovereignty for Scientific and Technological Production with Identity” in prioritized and critical areas is stated as an explicit goal in the Bolivian National Development Agenda (Acevedo, 2018), the national investment in research remains one of the lowest in the Latin American region. In Bolivia, expenditure on research and development amounted to 0.06% of GDP in 2021, according to the Vice Ministry of Science and Technology (2023).

Technology sovereignty has been defined as ”the ability of a state or a federation of

states to provide the technologies it deems critical for its welfare, competitiveness, and ability to act, and to be able to develop these or source them from other economic areas without one-sided structural dependency" (Edler et al., 2020, p. 2). This definition directly contrasts sovereignty and dependency. At the same time, sovereignty is generally not understood as complete autarky or the isolation from international collaboration, but rather as something that can be developed in the realm of international interdependencies (March & Schieferdecker, 2023). In that sense, technology sovereignty is seen as the continuous striving to gain, regain, or retain capacities – and thus agency – in the context of international cooperation (Edler et al., 2023). Sovereignty is crucial in areas such as food security and natural resources, on whose export many Latin American countries continue to depend (Galeano, 1971).

While the understanding of threats of academic dependency is crucial, some developmental universities may lack alternatives to international collaboration in aiming to build scientific capacities and follow with their mission. This raises the question of whether, in the absence of support from national partners, developmental universities can leverage international collaboration to gain sovereignty without falling in the trap of academic dependency.

In balancing local and foreign interests, a key question concerns who sets the agenda in research partnerships and in the broader realm of research capacity building. Intellectual ownership is closely tied to the source of funding, making this a critical issue. From the Swedish side, local ownership of capacity-building efforts is a consistent priority. Sida emphasizes the importance of developing research agendas through dialogue between donor and recipient countries, and Sweden has been recognized as a pioneer in granting significant responsibility to partners in lower-income countries (Nilsson & Sörlin, 2017). Nevertheless, there remains a persistent risk of creating, maintaining, or deepening dependencies through research aid (Gyberg, 2023). On the Bolivian side, the Concept Note for Science, Technology and Innovation serve as the primary framework for aligning the National Development Agenda with the university's priorities, forming the foundation for strategic collaboration with Sida and Swedish universities.

Despite its clear relevance for institutions operating in resource-constrained settings, the role of international collaboration in the context of developmental universities remains underexplored. This study aims to investigate how two public universities, UMSA and UMSS, seen from the lens of the developmental university ideals, position themselves in the realm of international collaboration. It focuses on how these institutions balance the dual imperatives of engaging with local issues of inclusive and sustainable development while participating in international research networks. Particular attention is given to the processes through which research agendas are established within bilateral partnerships and capacity-building initiatives.

METHODOLOGY

Our study is based on an in-depth case study of Swedish research and innovation capacity building in Bolivia. The data collected include document analysis, interviews as well as ethnographic observations. We adopt an abductive research approach to generate innovative theory concerning the dimension of international collaboration for developmental universities, characterized by an iterative cycle of engagement between theory and evidence (Timmermans & Tavory, 2012). The primary goal of our abductive research strategy is to closely integrate data and theory, finding a balance between study participants' vocabulary of their lived experiences and the development of appropriate and innovative theoretical language (Gioia et al., 2013).

Documents included in the analysis encompass policy and strategy declarations at the level of the Plurinational State of Bolivia, the universities Universidad Mayor de San Andrés and Universidad Mayor de San Simón, the Swedish government, principally the Ministry of Foreign Affairs, and the Swedish International Development Cooperation Agency as well as external evaluations of the cooperation program.

The interviews have been sampled to cover a broad range of stakeholders engaged with the program since its beginning in 2000 with the aim of covering the more than twenty years of evolution as well as a plethora of perspectives. While not a longitudinal study in the sense of collecting data at multiple points in time, this research traces a long-term evolution through the accounts of participants – many of whom have been involved for decades or many years ago. By drawing on their stories that reflect different phases of the cooperation, we are able to reconstruct a trajectory of change over time. Stakeholder groups include responsibles in the functions of:

I. policy makers at Vice Ministry of Science and Technology, Bolivia,
II. university policy makers at UMSA, La Paz, and UMSS, Cochabamba,
III. Sida program coordinators for Bolivia,
IV. decision makers at the Swedish embassy in Bolivia,
V. sub-program coordinators, researchers at the universities of UMSA and UMSS as well as at the Swedish universities.

Many of the interviewees could speak for more than one of these roles in the different phases of the cooperation. Sixteen interviews were conducted between May and August of 2024 in Cochabamba, La Paz, and virtually. All but two interviews were conducted by both investigators, in Spanish or English at the preference of the interviewee and lasted between thirty minutes and two hours. Consecutively, the recorded interviews were transcribed and analyzed.

Additionally, data was collected through ethnographic observation. Ralfs, a doctoral student in Research Policy at Lund University, brought an outsider’s perspective (Gioia et al., 2013) to the practice of research capacity building during her two-month research stay at the Unit of Technology Transfer (UTT) at UMSS. Her research visit included joining daily routines and meetings

as well as visits to research centers and field sites, both at UMSS and UMSA. Acevedo provided an insider's perspective to the Sida-financed research capacity building, having been involved with the program in various roles. He was a PhD student at Blekinge Institute of Technology and UMSS between 2013 and 2018, and since 2018, he has been responsible for the UTT. Additionally, he has supervised PhD and master's theses in the program and designed and taught courses for Bolivia-based PhD education. We acknowledge that our respective identities as researchers contribute to the social interactions constructed in interviews or during visits.

CASE

First, we aim to provide a general understanding of the history and arrangement of the bilateral cooperation between Sweden and Bolivia. While formerly part of a separate authority, the Swedish Agency for Research Cooperation with Developing Countries (SAREC), it is nowadays administered through the Sida. Building research capacity in universities is embedded in Sweden's overall development aid for Bolivia.

The Swedish bilateral research cooperation with Bolivia was formally established in 2000, focused on two universities: Universidad Mayor de San Andrés in La Paz and Universidad Mayor de San Simón in Cochabamba. The cooperation aims to boost the local production of advanced knowledge, increase the number of highly qualified researchers and improve the analytical capacity in university labs. More recently, since 2007, the cooperation also fosters innovation capacity building within the context of an emerging inclusive innovation system.

Prior to this long-term, institutional arrangement, there have been smaller-scale, isolated collaborative research projects between researchers in Sweden and Bolivia. To some extent, these early collaborations with Swedish and other international partners in the 1990s determined the pre-conditions of pockets of infrastructure and expertise present in the country which were later built on in the institutional bilateral cooperation. The cooperation is currently in its fifth phase and has undergone various modifications throughout its evolution.

Actors on both sides have articulated their goals for the cooperation in policy documents at various levels. From the Swedish side, the goals for Sida-supported research capacity building include:

I. enhanced research capacity and sustainable research environments,
II. enhanced global, regional and national research that is of relevance to the least developed countries and regions, and
III. enhanced impact of research that is of relevance to poverty reduction and sustainable development.

It is further acknowledged that research with developing countries "contributes to the internationalization of Swedish research, Swedish universities, and higher education institutions, and builds the foundation for

broader relations through research cooperation beyond aid" (Utrikesdepartementet, 2022, p. 3). Within their strategy, Sida strongly and consistently emphasizes local ownership of research as part of its research capacity building support. A broad group of Swedish universities, including institutions like Stockholm University and Karolinska Institutet, have collaborated with UMSA and UMSS throughout different phases of bilateral cooperation.

From the Bolivian side, the goals of the research capacity building are defined by each autonomous university in a Concept Note document for Science, Technology and Innovation. This document considers guidelines from the Constitution of the Plurinational State, the Plan of National Development, the Plan of Science, Technology and Innovation, and their own Institutional Strategic Plans. Institutional Strategic Plans and Concept Notes define the overall visions of the universities which more specific research lines are derived from.

In Bolivia, investments in research are very limited and overwhelmingly stem from international cooperation and Direct Tax on Hydrocarbons (IDH), which depend on foreign demand in volatile international markets. Both UMSA and UMSS collaborate in research with international partners across North America, Europe, and Latin America, mainly. In addition to individual collaborative projects, there were similar initiatives focused on building research capacity, particularly through Belgian and Swiss cooperation. While following comparative approaches, these initiatives are smaller in scale compared to Swedish cooperation.

The Swedish-Bolivian cooperation for PhD training focuses on prioritized research areas independently identified by UMSA and UMSS, based on national or regional relevance to inclusive and sustainable development, as well as scientific significance. These areas included a diversity of fields, like Food Technology, Biotechnology, Chemical Technology, Non-Metallic Materials, Energy, Sustainability, Climate Change, Innovation and Innovation Systems, Water Resources, Health, Epidemiology, Agronomy, Economy, Habitat, Social Sciences, Gender Studies, Humanities and others. In the so-called sandwich model, PhD candidates spend part of their time at Bolivian and Swedish institutions and have supervisors in both locations. Moreover, part of the budget is also allocated to small competitive funds within the two universities that researchers from any discipline can apply to, in order to stimulate direct impact and collaboration with local social and productive partners.

The cooperation encompasses several key pillars, including support for:

I. research governance,
II. infrastructure,
III. PhD education,
IV. innovation programs, and,
V. collaboration with Swedish universities.

The next section will illustrate the preliminary findings related to each of these pillars.

PRELIMINARY FINDINGS & DISCUSSION

Our analysis examines how UMSA and UMSS, seen as developmental universities, navigate the process of building scientific and innovation capacities with foreign partners, and how, in that process, local and foreign interests are negotiated in the defining of research agendas. Overall, the evolution of bilateral cooperation between Sweden and Bolivia over the past two decades shows a shift from higher dependency to increasing interdependency. As both universities strengthen their research capacities in prioritized areas, Bolivia-based researchers play an increasingly active role in shaping research agendas, which over time become more closely aligned with local societal challenges. This can be observed in the interrelated pillars of research capacity building.

RESEARCH GOVERNANCE

The goal of developmental universities is to prioritize issues of relevance for inclusive and sustainable development in their research agendas. Effective research governance and transparent resource allocation processes are seen as essential for shaping and executing research agendas and priorities. This is even more important as developmental universities may receive funding from diverse and frequently foreign sources. Developing organizational capabilities including a research governance system can be helpful for universities in not losing sight of their priorities amidst the diversity of interests of internal and external actors (Thoenig & Paradeise, 2016).

According to those responsible, fostering research governance and management was a key component of Sida's research capacity building at public universities in Bolivia, especially in the early phases. Both UMSA and UMSS have restructured their research administration to better support research proposals and funding. This restructuring, mandated by Sida, aimed to ensure transparency and improve the efficiency of financial resource allocation of funds provided by Sida directly to both universities. It included guidelines for procurement, equipment use, and the employment of returning PhDs. The restructuring was seen as crucial for managing resource distribution within projects and overseeing Sida's competitive funds at both universities.

A Sida representative describes initial resistance to the restructuring but also highlights the challenge of balancing accountability to the Swedish government with the autonomy granted to UMSA and UMSS in managing their funds.

"So when I arrived, we had to, I don't want to say clean up, but we had to do a lot of restructuring. And not many people were very happy. I mean, we also have to report to the [Swedish] government and we have to make sure that we check funding. We have to [...] Sida never had a top-down policy to say, do things this way. We had agreements, very specific agreements that said, this fund is for that. In order to be able to, and also the Ministry of Science and Technology, to comply with those agreements, then they had to restructure a few different things." (Interview 14, Sida responsible, August 2024).

Despite initial resistance to the new research governance system, university officials at UMSA and UMSS now view the restructuring positively. Interviewees from the respective administrative units at both universities report satisfaction with the new system and improved efficiency in administrative processes. Originally introduced for Swedish cooperation, the research governance processes are now also used to manage resources from national funds like IDH and other international partners.

"I believe that the influence has been very good. Moreover, [...] the country's IDH that it gives to the municipalities and to the universities here is managed in the same way as Sida was managed. In other words, there is the money and what do we do with the money? [...] Yes, here we have formed a project review committee. We have commissions." (Interview 7, University policy maker, July 2024).

At UMSA, the Department of Research, Graduate Studies and Social Interaction (DIPGIS) oversees research, postgraduate activities, and innovation activities. With Sida's support, DIPGIS has restructured its research management processes, adding innovation as a new pillar to better align with societal needs. At UMSS, the Directorate of Scientific and Technological Research (DICyT) manages the evaluation of projects and allocation of resources, including financial and time budgets for research centers. A key goal of this unit is to reduce administrative burdens on scientists, allowing them to focus more on research and innovation, while also streamlining administrative processes. The new research governance approach also incorporates quality management processes.

This example illustrates that stronger integration of developmental universities into international networks – particularly through foreign funding – often requires adherence to international research governance practices. However, the approaches taken by UMSA and UMSS show some flexibility, reflecting what Sida understands as local ownership. The ongoing development of their organizational capabilities can help these universities to align their research with their goals of inclusive and sustainable development. This, in turn, strengthened their autonomy in managing resources according to their prioritized research agendas, financed with national or international resources. Sovereignty in research governance can foster interdependent relationships with national and foreign partners, including universities and funding agencies.

INFRASTRUCTURE

For developmental universities to contribute to the democratization of knowledge, they must be capable of generating valuable advanced knowledge. However, universities in resource-constrained contexts often lack essential infrastructure, such as laboratories and equipment, needed for scientific research, especially in technological fields and basic science. To overcome these challenges, developmental universities may rely on foreign aid. As part of its model, Sida funding was used to finance technological infrastructure and equip laboratories at both UMSA and UMSS.

In the early years of the program, laboratories at both universities were either non-existent or insufficiently equipped for material analysis, requiring study materials to be transported to Sweden for analysis. Researchers educated in the early phases report the barriers they faced in conducting their research in Bolivia:

“I mean, we have built it from the first brick, because [research center] did not have the infrastructure for research.” (Interview 16, Bolivian researcher, August 2024).

“The equipment part has also been a quite drastic change, quite strong, because as I said, at the beginning the equipment part was really very weak, we had very few resources to work with and conduct research, for that reason in those first two phases there were sandwich doctorates, but most of the time we spent there [in Sweden].” (Interview 4, Bolivian researcher, July 2024).

“For example, it was nothing more than this, and the permanent environment that we have here at the institute was very small, with very, very, very old equipment, let's call it that, and the lines of research were not very well defined.” (Interview 12, Bolivian researcher, July 2024).

Over time, investments in technological infrastructure in prioritized scientific fields have enabled researchers at UMSA and UMSS to advance their research and conduct necessary analyses on-site. A significant portion of the laboratory equipment was funded by Sida, although UMSA and UMSS were required to co-finance it, often using IDH funds. Researchers portray the development of laboratories and infrastructure over time, which they perceived as drastic:

“And then there was a very strong change in the infrastructure, the laboratory grew considerably, and this has happened in general in all the laboratories and programs that have been involved with Sweden.” (Interview 4, Bolivian researcher, July 2024).

“[PhD student] at the time, in their time, we saw, they could stay longer here than there. However, the advising was what was failing us, because [Swedish supervisor]’s head is [Swedish supervisor] ... So that was failing us a little bit. And in the beginning, when I was doing my experiments here in Bolivia, [Swedish supervisor] made me repeat everything in Sweden. When he came later, he started to trust us and he said this is validated, it's good.” (Interview 16, Bolivian researcher, August 2024).

Nowadays, the instruments enable collaboration with local companies, offering services like food testing to meet international export standards, thus strengthening collaboration with national actors. This provides companies access to specialized equipment they cannot afford and generates income for the universities, although it is not directly reinvested in the specific research centers. Additionally, researchers and administrative staff aim to optimize equipment use through better coordination between the universities and with other institutions in Bolivia. Current challenges at UMSA and UMSS include maintaining technological infrastructure due to a lack of funding and reliance on imported spare parts.

The gradual development of research infrastructure at the Bolivian universities has empowered researchers to take a more active role in other pillars of research capacity building, such as PhD education and collaboration with Swedish researchers. With functioning research facilities, developmental universities can engage in international science by conducting contextually relevant research, either independently or in partnerships with foreign counterparts. This is the fundamental prerequisite for their sovereignty and contribution to the democratization of knowledge. Research equipment plays a crucial role in shaping research agendas, particularly in the prioritized highly technological areas. These agendas often follow a path dependency, as the types of analyses possible are directly influenced by the availability of the necessary equipment.

PHD EDUCATION

One of the most central pillars of research capacity building for developmental universities is PhD education, or the formation of researchers. Several interviewees emphasized this pillar as the most important. The education of Bolivian PhDs has been set up as a joint effort between their home departments in Bolivia and a partnering department at a Swedish university. Like the other pillars of bilateral cooperation, the Sida-financed PhD education has evolved toward increasingly strong ownership on the Bolivian side.

In the early phases of the program, most of the PhD education took place in Sweden, as UMSA and UMSS lacked well-equipped laboratories and a sufficient number of PhD-educated supervisors in the relevant research areas. Time spent at the Bolivian universities primarily focused on data collection and material gathering. The descriptions provided by interviewees from the early phases offer insight into the challenges researchers faced at the time, particularly the lack of experience needed to establish local PhD education.

“At that time, we didn't have any trained doctors, they were all staff engineers and we started with those, with the cooperation part.” (Interview 4, Bolivian researcher, July 2024).

“So, I and almost most Bolivians have taken something exotic to study, basically. And no, we maybe didn't have the scientific background to know what to do with that. [...] In the first stage we have done that. Basically, we have studied something that the Swedes have proposed, and we have followed the line.” (Interview 16, Bolivian researcher, August 2024).

Gradually, PhD students began spending more time at the Bolivian universities, often supervised by PhD graduates from earlier phases of the program and utilizing the improved laboratory equipment. Researchers in the early phases of cooperation highlight the tensions they perceived between complying with the requirements of international science, while questioning the usefulness of their research in addressing social problems in Bolivia.

“Because in all aspects, if there were scientific articles and so on, and in Sweden it was fine, you could go to conferences or whatever, but not in Bolivia. I have a colleague who asked us “How am I going to

eat that? And how am I going to eat that?" I was tortured by that in my head, because what did Sida really want to do? To help people, well, through science, but to help people, but we did not reach people." (Interview 16, Bolivian researcher, August 2024).

Sida gradually adjusted its program, particularly with the introduction of the innovation program. As a result, the topics of Sida-funded PhD projects have progressively built upon one another, becoming more scientifically complex while also aligning more closely with local needs in Bolivia. The increasing scientific expertise at Bolivian universities has fostered research agendas that are not only more scientifically advanced but also more tailored to local challenges of inclusive and sustainable development.

"So, the next doctorates that were to come had to have a lot of social interaction, a lot of social impact and they also had to have innovation in making functional foods, that is to say, they had to have not only the scientific article, but also a quinoa bread that really nourishes the children." (Interview 16, Bolivian researcher, August 2024).

Over time, as a critical mass of PhD-educated researchers was reached in prioritized research centers, Bolivian supervisors took on a greater role in the educational aspect of research capacity building, initially in Sida-funded master's programs and later in Sida-funded local PhD programs at UMSS. While co-supervision of master's and PhD students between Swedish and Bolivian researchers sometimes leads to disagreements, it also highlights the growing involvement of Bolivian supervisors and, overall, an increasing trust in their expertise.

"Now the supervisors were us, the Bolivians, and they [the Swedes] were the co-supervisors, and they made it very clear ... "You have to decide, you have to decide". It was difficult." (Interview 16, Bolivian researcher, August 2024).

From 2019 onwards, the first Sida-financed local PhD programs were launched at UMSS in Cochabamba. The first PhD students have graduated from the local program in Chemistry Technology, while the PhD programs in Energy and Social Sciences are in earlier stages. Although PhD education can now be conducted at UMSS in collaboration with Swedish professors, the programs still include research stays at Swedish universities. These stays are seen as valuable for fostering connections and familiarizing PhD students with international research environments. Administrative processes related to the awarding of doctoral degrees at UMSS remain to be solved. This evolution of PhD education is seen as symbolic of the overall trajectory of the cooperation.

"If we compare now from the first phase to this last one, the fifth phase, the change has been quite radical because now we have managed to reach a sufficient critical mass of professionals trained with a doctorate degree to do a doctorate here in the faculty. We have managed to create a doctorate in chemistry technology that interestingly has involved the biotechnology center, the agrochemical center, the food center and the non-metallic center, which have all been

participating since almost the initial stage of cooperation with Sida." (Interview 4, University policy maker, July 2024).

A key challenge in the PhD education process has been the integration of graduates into stable employment at the Bolivian universities. UMSA and UMSS have adopted different strategies to address this issue. Sida officials acknowledged the difficulties associated with integrating PhD graduates and, while refraining from imposing top-down policies, strongly emphasized the benefits of ensuring stable employment for these graduates.

In sum, the PhD education model has shifted from being predominantly hosted at Swedish universities during the early stages of the program to an increasingly strong involvement of Bolivian universities, once a critical mass of PhD-educated scientists had been established in prioritized research centers in Bolivia. This shift has also been accompanied by a growing influence of Bolivia-based scientists in shaping research agendas and tailoring them to local issues of inclusive and sustainable development. However, the case also highlights that experience and knowledge in highly specialized scientific fields are prerequisites for conceptualizing research studies in the first place. For developmental universities to contribute to the democratization of knowledge, they must build scientific capacities and engage researchers that are both, internationally linked and aware of the local context of application and impact. Often, universities in resource-constrained contexts rely on foreign partners to build these capacities, which can create dependencies. Yet, the case demonstrates that over time, as capacities grow at both individual and institutional levels, the universities gain greater sovereignty, making it easier to align research with local priorities.

INNOVATION PROGRAMS

In Bolivia, as in many Latin American countries, public universities like UMSA and UMSS concentrate most of the national research capacities. Their local context is marked by a weak connection and collaboration with the productive sector, within incipient efforts to promote a National Innovation System (NIS). Sutz (2012) argues, this situation can be seen as an "innovation as learning" systemic failure due to the relative weakness of innovation process in developing countries and the lack of opportunities to learn through such processes. This failure is systemic, as it is embedded in the productive specialization of most developing countries, where the learning content of economic activities tends to be weak. In such circumstances, universities can play a key role in learning and innovation but the specific position and functions of universities and their mechanisms of interactions within NIS of developing countries are not clearly defined. They are mostly defined as a result of the NIS context dependency.

At both UMSA and UMSS, researchers navigated this challenge producing isolated efforts of collaboration with the productive sector, reaching relatively satisfactory results but sporadic. Generally, most efforts in both universities derived from an offer-driven innovation approach. Strategies coming from that perspective failed due to

the low effective demand of advanced knowledge and weak absorptive capacity in the productive side. Other institutional initiatives centered its focus on allocating research competing funds to fostering the inclusion of social and productive partner organizations as beneficiaries. This strategy reached few satisfactory results because partner organizations were usually included only at the beginning of the project to identify the problem and at the end to present results.

In 2007, the UTT at UMSS introduced a new sub-program to the Swedish bilateral cooperation agenda: the Program of Innovation and Technology Transfer. This initiative aimed to develop institutional competencies and capabilities at UMSS to study, promote, and actively engage in innovation systems and processes at the local, regional, and national levels.

The program fostered new competencies at UMSS, positioning the university as a facilitator of inclusive innovation systems in the Cochabamba region. Its main strategy involves creating open, interactive learning and innovation spaces within prioritized sectors, where academics, entrepreneurs, policymakers, and social representatives collaborate and build mutual trust. These spaces are locally known as SME Clusters and include the Food Cluster and the Green Technology Clusters. Together, the clusters engage over 200 local SMEs and around 40 researchers from various disciplines and faculties, co-creating science-based solutions and societal value. The actors and dynamics within these spaces can be viewed as seeds for emerging inclusive innovation systems.

Supported by Sida, the UTT is responsible for facilitating innovation processes, promoting learning cycles, and balancing power relations among the various actors involved. PhD training is an integral part of this program; it both accompanies and critically reflects on the diverse dimensions of local innovation processes. Within this framework, the democratization of knowledge is promoted as a key strategy for institutional transformation. More recently, the concept of the developmental university was incorporated into UMSS's strategic plan (2020–2025), shaping its vision of transformation and participation within inclusive innovation systems.

COLLABORATION WITH SWEDISH UNIVERSITIES

As developmental universities integrate into international science networks, they frequently collaborate with foreign partners. In addition to PhD education, the ongoing and general collaboration between Swedish and Bolivian researchers has been considered a crucial pillar of research capacity building, with mutual interest for both countries highlighted in policy documents.

In the early phases of the program, research proposals developed through collaborative processes at UMSA and UMSS and approved by Sida were shared as open calls among Swedish universities to find relevant collaborators. However, as research lines and collaborations became more established, many research proposals in

later phases were co-developed between Bolivian and Swedish researchers, often building on previous projects. Over time, the relationships between Swedish and Bolivian researchers have become not only closer and more trusting but also more collaborative and equitable.

“First the history, there has been a dependence, we depended and the main factor was money. [...] And back then that concept of cooperation was more of an aid concept. [...] There comes a time when you are a partner, that is the other concept. We are partners. So you are my academic partner, you are my research partner, you are my financial partner. And the relationship is one of partners.” (Interview 7, Policy maker at the Bolivian Viceministry of Science and Technology, July 2024).

The collaboration between the Bolivian and Swedish universities and researchers has evolved from a relationship characterized by dependency and a “parent–child” dynamic to one of interdependency with an “older sibling–younger sibling” dynamic (Interview 8, University policy maker, July 2024). Both UMSS and UMSA have developed capacities in selected prioritized research areas – often strategically focused on local needs and the unique conditions of Bolivia – that enable them to produce research at international standards. While many of the initial supervisor–supervisee relationships with Swedish scholars persist beyond their initial arrangements, Bolivian researchers have also proceeded to publish independently or in collaboration with other international and Latin American partners.

Reciprocity and mutual learning have been important in the collaboration between Swedish and Bolivian researchers. For Swedish researchers, this has involved learning new ways of conducting science with limited resources on one hand, and a greater emphasis on solving urgent problems on the other. For many scientists at UMSA and UMSS, engaging with non-academic stakeholders is an integral part of their work. This might include participating in rural community assemblies to build trust before conducting research or collaborating with NGOs to address issues like water filtration when their research uncovers contamination. Swedish researchers also valued the learning opportunities that arose from being exposed to new and unfamiliar cases.

“When you build this, I think, research sovereignty is needed. We have particular things that for Sweden were just new. [...] And Chuño[1]. I mean, [Swedish professor] was amazed with it because we went with him, to show how they produce it. For him it was something really fantastic that this was research from ancient times.” (Interview 12, Bolivian researcher, July 2024).

Regarding the risks of academic dependency in the context of research capacity building, it is noteworthy that this form of aid aspires to strengthen the sovereignty of universities. While the extent to which this goal is

[1] Chuño is a preserved potato product traditionally made by Quechua and Aymara communities of Bolivia and Peru.

successfully executed or ultimately achieved may be questioned, the underlying intention appears consistent. According to program responsibles, at the heart of research capacity building – particularly when characterized by strong local ownership – lies the ambition of scientific cooperation to establish the necessary conditions for a transition from dependency to interdependency.

“I think after many, many years of working in this field, I always think of that scientific research cooperation as paramount. [...] Because if you don't have local knowledge and your own research as a country, you're always going to be buying it from someone else. You're always going to be looking after what the Americans are doing, what the Brazilians are doing, what the Europeans are doing.” (Interview 14, Sida representative, August 2024).

Above all, the case of Sida-financed research capacity building in Bolivia illustrates the dynamic and evolving nature of the cooperation. On one side, UMSA and UMSS have continuously developed and expanded their scientific capacities; on the other, Sida has adapted its approach over time, responding to contextual needs.

“Developmentalism has passed, [...] but I believe that this instrument must be used, that it should not be lost as a concept and as training. There are things that no one has read in a book, no one has read in management journals, [...]. This is learned in life and that's what has happened.” (Interview 7, Policy maker at the Bolivian Viceministry of Science and Technology, July 2024).

Research capacity building presents a particularly compelling case within the broader discourse on academic dependency. While it is undeniable that foreign support entails a high degree of external influence – accompanied by expectations to conform to donor standards – research capacity building stands out in its goal to reduce structural dependencies over time. By strengthening the institutional and scientific capacities of recipient universities, it aims to enable a transition toward interdependent sovereignty. For developmental universities seeking to align their research agendas with goals of inclusive and sustainable development, clearly defining strategies for international collaboration is crucial in the face of scarce local partners. Doing so allows them to leverage external partnerships in ways that enhance, rather than compromise, their sovereignty.

CONCLUSION

The case underlines that research capacity building is a long-term and gradual process. The Swedish model of bilateral research cooperation stands out with its long-term, broad institutional process with emphasis on local ownership in several, strongly interrelated pillars. The public universities of UMSA and UMSS engage with the Swedish partners to build the research capacity to conduct research at international standards, while continuing to place a strong emphasis on their contribution to the inclusive and sustainable development in the country.

Regarding the question of who defines research agendas, the case exemplifies the

complexity and multitude of factors that have led to the shaping of the research profiles of UMSA and UMSS. The efforts of research capacity building are strongly concentrated in prioritized research areas. The choice of these areas is rooted in collaborative ties and pockets of expertise and infrastructure at UMSA and UMSS that were existent prior to the start of the bilateral, institutional cooperation in 2000. Moving forward, they have been developed in dialogue between Bolivian and Swedish partners. Some degree of path dependency appears inevitable in this process as investments in specialized infrastructure and the specialization of researchers shape the range of possible future research lines. As more scientific capacity had been built in the Bolivian universities, local researchers could engage more actively in the process of agenda setting, tailoring it to needs and specificities of the Bolivian context. This includes addressing challenges related to food security, energy, or pollution, just to name a few.

The stronger integration of a scientifically peripheral country into international science networks comes with a pressure to adhere to international norms and can lead to academic dependency. Yet, over time and with increasing capacity to shape research agendas and conduct research more independently, there is simultaneously potential for a greater democratization of knowledge on a global scale as research conducted in developmental universities in Latin America can add new perspectives and grant visibility to commonly neglected topics. Having the scientific and organizational capacities to conduct and contribute their own research provides them with more opportunities to shape the discourse around matters of relevance to their context.

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Public Health Science Communication in Bolivia: Entanglements with Traditional Practices in a Pluricultural Environment – A Scoping Review Protocol

Guidiana Landívar Paz

Universidad Complutense de Madrid, , guidilan@ucm.es

Short bio: I am a third-year PhD candidate at the Universidad Complutense de Madrid, specializing in health science communication. My doctoral research examines the diverse approaches to health science communication in Bolivia and Spain, particularly how they have evolved in the context of the recent COVID-19 pandemic. The study aims to identify potential convergences and divergences in public health communication between these countries, exploring the hypothetical "before and after" of the pandemic. Originally from Bolivia, I hold a degree in Social Communication and bring over a decade of professional experience spanning journalism, content management, and strategic communication. My background includes roles in television, marketing teams, and academic research, all of which have fueled my passion for storytelling and bridging gaps between science and society. Eight years ago, this drive led me to Spain, where I have since been deeply committed to fostering inclusive and effective health science communication.

How to cite: Landívar Paz, Guidiana (2025). Public Health Science Communication in Bolivia: Entanglements with Traditional Practices in a Pluricultural Environment – A Scoping Review Protocol. In *Proceedings of the 6th International PhDays Conference* (pp. 137-145). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19739

Abstract: This study examines the dynamics of science communication in Bolivia, a pluricultural society where modern scientific practices intersect with deeply rooted traditional knowledge systems. Framed within the context of the COVID-19 pandemic, it explores how public health communication strategies integrated indigenous practices, cultural beliefs, and scientific expertise to address a global health crisis in a localized and culturally sensitive manner. This document outlines a systematic review protocol based on PRISMA-ScR, emphasizing the inclusion of grey literature to capture the nuances of Bolivia's public health communication strategies.

Keywords: Public health communication; science communication; pluricultural; traditional medicine; COVID-19; review protocol.

INTRODUCTION

In recent years, science communication has undergone a paradigm shift, evolving from the deficit model —which focuses on addressing public knowledge gaps— to the dialogue model, which prioritizes public engagement and addresses concerns about the unequal distribution of science's benefits and risks. (Bucchi, 2021)

The COVID-19 pandemic, however, revealed critical shortcomings in knowledge-sharing systems and exposed the limitations of existing science communication strategies, particularly in pluricultural and socioeconomically diverse contexts. This study examines public science communication in Bolivia during the COVID-19 pandemic, a distinctive case where modern scientific practices intersected with indigenous knowledge systems. Bolivia's response, shaped by its sociopolitical and cultural landscape, offers insights into how transdisciplinary and pluricultural approaches can foster innovative governance strategies that reconcile global scientific norms with local epistemologies.

BOLIVIAN POLITICAL CONTEXT

The COVID-19 pandemic reached Bolivia during a period of significant political disruption. In 2016, a constitutional referendum was held to decide whether Article 168[1] of the constitution, which limited presidents and vice presidents to a single reelection, should be modified.[2] Although the "No" vote prevailed, elections still took place in October 2019, resulting in widespread controversy and massive protests. Following this contentious election and the subsequent resignation of President Morales, which some still consider a coup, the transitional government faced the dual challenges of political instability and an unfolding global health crisis. (Velasco, Ximena et al., 2021)

On March 10, 2020, Bolivia reported its first confirmed cases of COVID-19. By March 11, the World Health Organization had declared a global pandemic, prompting the Bolivian government to declare a national emergency. Measures included the implementation of a nationwide quarantine, establishing a Scientific Advisory Council composed of Bolivian experts from diverse fields, and issuing public health guidelines. Despite these efforts, Bolivia's public health response revealed significant tensions between scientific recommendations and

[1] The term of office of the President and the Vice-President of the State is five years, and they may be re-elected or re-elected only once continuously. (Political Constitution of the Plurinational State of Bolivia, 2009, art. 168).

[2] Constitutional referendum question: "*Do you agree with the reform of Article 168 of the Political Constitution of the State so that the president and the vice president of the State can be reelected or reelected twice continuously?*" (Bolivia: Ley Nº 757, 2015).

local practices. Controversial decisions, such as the inclusion of ivermectin and chlorine dioxide as potential COVID-19 treatments, underscored the challenges of aligning scientific evidence with public expectations and cultural beliefs. These tensions were further compounded by the limited presence of trained science communicators and the proliferation of misinformation, highlighting the need for more inclusive and effective communication strategies.

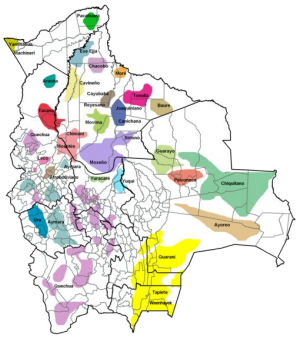

Fig. 1 *Traditional practices and indigenous knowledge: indigenous people of Bolivia* (Rojk, 2006)

During the mid-1990s, Bolivia's government introduced reforms promoting decentralized participation and multicultural recognition. Despite efforts to integrate indigenous voices through "popular participation," systemic racism and socioeconomic disparities persisted, frustrating indigenous communities. These challenges fueled movements that led to the MAS party's rise to power under Evo Morales in 2005. Morales' government redefined Bolivia as a plurinational state, integrating indigenous traditions and granting constitutional recognition to indigenous rights (Postero, 2017).

Bolivia's pluricultural identity is enshrined in its constitution, which recognizes the value of indigenous traditions and practices. During the pandemic, the government made efforts to integrate these practices into its public health response. For instance, in collaboration with the Vice Ministry of Traditional Medicine and Interculturality, the Ministry of Health and Sports developed culturally tailored protocols to support indigenous communities. These protocols emphasized the importance of traditional medicine, social practices, and community-based approaches to healthcare.

At the same time, the pandemic exposed the vulnerabilities of indigenous populations, who faced heightened risks due to socioeconomic disparities and limited access to healthcare. The government's recognition of these vulnerabilities led to the development of culturally sensitive communication strategies, including the use of indigenous languages in public health messages and the involvement of community leaders in disseminating information. However, the integration of traditional practices into the national response also raised questions about the efficacy of these approaches in addressing a modern health crisis.

HEALTH SCIENCE COMMUNICATION IN BOLIVIA

The study examines Bolivia's health science communication strategies by exploring various interconnected dimensions that

shed light on the effectiveness and inclusivity of these efforts during the COVID-19 pandemic. Together, these dimensions provide a comprehensive understanding of how Bolivia navigated the complex intersection of scientific and traditional paradigms in its health communication strategies, offering valuable insights for enhancing public health communication in multicultural settings.

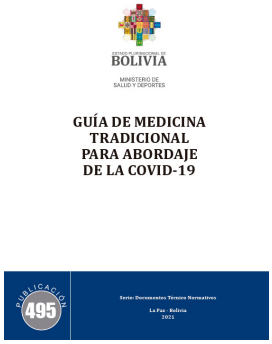

Fig. 2 *Front page. Traditional Medicine Guide for COVID-19* (2021)

The content and nature

The content and nature of communications are analyzed, focusing on the frequency and type of messages disseminated. This includes examining the balance between messages rooted in scientific frameworks and those reflecting traditional practices, as well as assessing how indigenous knowledge was represented and aligned, or contrasted, with scientific recommendations.

Channels and distribution

Used to deliver public health messages. These include traditional media outlets, digital websites, and localized community networks. Particular attention is given to the accessibility of information for diverse audiences, with a focus on ensuring outreach to indigenous populations and addressing linguistic and cultural barriers.

Engagement with experts

Exploring the role of the Scientific Advisory Council in shaping public health messaging. This includes an analysis of the interplay between expert recommendations and political decision-making, such as the controversial promotion of ivermectin despite opposition from the scientific community.

METHODOLOGY

The research employs a scoping review method based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension for Scoping Reviews (PRISMA-ScR) Checklist. A scoping review allows for a more flexible and iterative process, accommodating a wide range of materials and perspectives, given that this research addresses an emerging topic —the interplay between traditional practices and PCHS in Bolivia—, and thus involves a mix of a diverse range of sources, from academic articles, government reports, NGO publications, institutional documents, media coverage, and grey literature.

Bolivia's unique sociocultural and political context impacts its HSC landscape. By exploring this systematically, the review will inform subsequent qualitative analysis and

contribute to the broader understanding of global disparities in science communication.

The PRISMA-ScR provides a structured framework for transparency and rigor. The protocol encourages the inclusion of grey literature (e.g., government reports, and technical documents), essential for capturing the nuances of HSC in Bolivia.

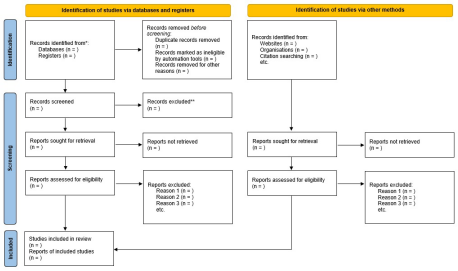

Fig. 3 *Flowchart of the scoping review process. Prisma 2020 Flow Diagram* (2025)

PRISMA-SCR PROTOCOL

Main Research Objectives

Explore the landscape of public communication in health science in Bolivia, including actors, policies, themes, concepts, and practices.

Map and analyze how Bolivia's PCHS integrates traditional practices and scientific expertise during a global health crisis.

Identify key characteristics and gaps in the literature.

Explore synergies and tensions between traditional knowledge systems and modern science communication.

Key Research Questions

What are the key characteristics of Public Health Communication in Bolivia during COVID-19?

How were traditional practices represented and integrated into official Public Health Science Communication (PHSC) in Bolivia during the COVID-19 pandemic?

What challenges and synergies emerged between traditional and scientific paradigms?

How can Bolivia's experience inform global PHSC strategies?

ELIGIBILITY CRITERIA

Inclusion Criteria

Explore Peer-reviewed articles, studies, reports, or documents related to health or science communication in Bolivia.

Materials that were published between March 2020 and December 2023.

Grey literature (government or NGO reports, dissertations, technical documents).

Materials discussing the pandemic's impact on PCHS in Bolivia.

Publications in Spanish and English.

the landscape of public communication in health science in Bolivia,

Exclusion Criteria

Literature that is not specific to Bolivia.

Materials without explicit mention of health communication practices or actors.

Purely technical or clinical studies without dissemination aspects.

Duplicates and non-relevant studies.

SEARCH STRATEGY

Information Sources

Databases: Scopus, Web of Science, PubMed (for health-oriented studies), Sociological Abstracts, SciELO and Dialnet.

Grey Literature: Government or technical reports, documents from Bolivian public health institutions, NGO publications, and institutional communication strategies. Bolivian Ministry of Health website Pan American Health Organization (PAHO) Bolivia reports. NGO websites like Fundación UNIR Bolivia (UNIR). University repositories. International organizations (WHO, UNESCO).

Table 1. Core Concepts of Analysis

Dimension	Concept
Topic	Health science communication; public health communication
Focus	COVID-19 pandemic and its impacts
Geography	Bolivia
Year Range	2020–2023

Search Terms

Health communication, science communication, Bolivia, COVID-19, pandemic, public health, media, dissemination.

Keywords and Synonyms

"Health science communication," "Bolivia," "COVID-19," "public communication," "scientific dissemination,".

Use Boolean operators (AND, OR) to refine searches.

Boolean Search String Example

("health science communication" OR "public health communication" OR "science dissemination" OR "health communication") AND ("COVID-19" OR pandemic OR "health crisis") AND (Bolivia OR "Latin America")

Use * for word variations (communicat* captures communication, communicator, etc.).

Adapt search strings for each database and translate to Spanish where necessary.

Search specific Bolivian government websites, NGOs, or academic repositories directly.

Materials that were published between March 2020 and December 2023.

SCREENING AND EXTRACTION CRITERIA

The Screening and Extraction Workflow for this systematic review integrates tools to ensure a thorough and transparent process. Initial database searches will be conducted across relevant sources, with results

exported as .RIS or .CSV files and imported into Zotero for organization and de-duplication. Using Zotero's tagging and filtering features, duplicate studies are automatically removed, and a refined dataset is prepared for the next stage. To help visualize the selection process and ensure transparency in reporting the number of studies in each database, a PRISMA Flow Diagram will be designed.

The title and abstract screening phase is facilitated by Rayyan, where inclusion and exclusion criteria are systematically applied. Studies are labeled as "Include," "Exclude," or "Undecided," with collaborative features enabling peer validation of decisions. Following the title/abstract screening, full-text articles are reviewed, and decisions are documented directly within Rayyan.

Table 2. *Screening and Extraction Workflow*

Stage	Action	Tools
1	Search	Database interfaces
2	Export	Zotero
3	Screening	Rayyan
4	Review	Zotero, PDFs
5	Extraction	Excel
6	Diagram	PRISMA Generator

Data Charting Process

Extracted data from the included studies is then recorded into a pre-designed Excel template, ensuring all relevant information, such as study details, themes, and methodologies, are systematically captured.

Each row represents a study: Every new study, report, or article gets its row.

Columns represent key information: Each column captures specific details about the study, from bibliographic details to thematic findings. That includes:

Publication Information (title, authors, year, source and type).

Study Context (country, focus, COVID-19 relevance)

Identified actors (scientists, journalists, public health officials; interactions noted)

Themes and content (topics covered; COVID-19 specific issues)

Channels and Media (platforms used and media role)

Outcomes and Impact (key findings related to HSC practices, policies, and actors)

Methodological Notes (theoretical frameworks, methodology, limitations)

EXPECTED RESULTS

The anticipated findings of this scoping review are expected to reveal that PCHS during the COVID-19 pandemic followed, most of the time, global communication trends but with significant adaptations to its sociocultural and political context. The coexistence of traditional and scientific paradigms is shaped by the nation's pluricultural identity and the enduring influence of native knowledge systems. While informed by global health guidelines,

communication strategies often dealt with an extensive skepticism toward science, not only among indigenous populations but across diverse segments of society. Traditional medicine emerged as a critical component of Bolivia's public health landscape, reflecting its broader societal importance and necessitating culturally tailored messaging.

Findings may reveal that significant tensions and paradoxes remain. On the one hand, there is an institutional emphasis on respecting Bolivia's multicultural principles; on the other, scientific recommendations sometimes conflict with traditional beliefs, creating a complex dynamic of divergences and friction.

These challenges could highlight the need to encourage innovative frameworks that balance respect for diverse epistemologies with evidence-based public health interventions. Bolivia's experience provides valuable insights into a deeper understanding of how multicultural contexts can shape inclusive and effective communication networks, fostering trust and collaboration in public health initiatives.

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Evaluating citizen science in biomedicine: A tentative approach

Alejandro Fernández del Río[a], Oscar Llopis[ab] and Carmen Corona-Sobrino[c]

[a]INN4ALL Research Group, Department of Business Management, University of Valencia, alejandro.fernandez-rio@uv.es, [b] Unit for Innovation and Entrepreneurship, Department of Economy and Society, U-GOT KIES Center, School of Business, Economics and Law, University of Gothenburg, oscar.llopis@uv.es, [c]Department of Sociology and Social Anthropology, Universitat de València, carmen.corona@uv.es

Short bio: Alejandro Fernández del Río is a predoctoral researcher in the Department of Sociology and Social Anthropology at the University of Valencia. He holds a degree in Political Science, Government, and Public Administration, as well as a Master's in Social Inclusion-Exclusion from the University of Murcia. Previously, he was a research fellow at the Spanish Center for Sociological Research (CIS) and a collaborator at the Observatory of Social Exclusion (OES). He has led research projects such as "Youth and the Digital Transformation of Public Administration" and is a member of the Civic Studies and Social Innovation Research Group (GECIS). His work focuses on citizen participation, social innovation, and designing strategies to promote inclusion and social engagement. With experience in social activism, association work, and project management, his research emphasizes social exclusion analysis and digital transformation in public sector contexts.

How to cite: Fernández-del-Rio, Alejandro; Llopis, Oscar y Corona-Sobrino, Carmen (2025). Evaluating citizen science in biomedicine: A tentative approach. In *Proceedings of the 6th International PhDays Conference* (pp. 146-154). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19959

Abstract: Citizen science has emerged as transformative approaches to scientific research, fostering inclusivity and transparency in the production of knowledge. The paradigm shift towards open science aims to make research more accessible, transparent, and responsive to societal challenges. Citizen science, defined as the active involvement of non-professionals in the research process alongside professional scientists, has gained significant traction in recent years. This paper explores the intersection between citizen science and transformative innovation policies (TIPs), proposing a framework to evaluate citizen science projects in terms of their transformative potential. By categorizing projects based on the intensity and proximity of participation, the study aims to provide an analytical tool for assessing the systemic impact of citizen science. Through a mixed-method approach,

including interviews with principal investigators and expert consultations, the research seeks to develop a robust evaluation framework that can guide the assessment of citizen science initiatives in healthcare, ultimately advancing their capacity to drive systemic change. The findings aim to contribute to the ongoing dialogue on the role of citizen science in fostering a more inclusive and transparent scientific process.

Keywords: Citizen science; open science; transformative innovation policies (TIPs); healthcare research; evaluation framework.

INTRODUCTION

As science evolves, so too does the way society engages with and perceives knowledge creation. Traditional research paradigms, often limited by closed access and hierarchical structures, have been increasingly challenged by the open science movement. Open science advocates for greater accessibility, transparency, and collaboration, with the goal of aligning research more closely with societal needs (Anglada & Abadal, 2018; European Commission, 2016). Within this broader movement, citizen science has emerged as a significant phenomenon, allowing non-experts to actively participate in scientific inquiry, from data collection to analysis and dissemination. This involvement not only democratizes science but also has the potential to reshape the way knowledge is produced, creating new opportunities for collaboration across disciplinary, institutional, and societal boundaries (Franzoni & Sauermann, 2014).

At the same time, TIPs have been proposed as a means to address systemic challenges through policy interventions that foster deep, structural change. Citizen science, with its emphasis on inclusive and participatory approaches to research, aligns closely with the goals of TIPs, especially in fields like healthcare, where traditional research models have been criticized for their narrow scope and lack of public involvement (Grant et al., 2022). However, evaluating the potential of citizen science projects to effect transformative change remains a complex task, necessitating the development of new assessment tools that can account for the diversity of participation and contexts in which these projects operate.

This paper aims to explore the intersection of citizen science and TIPs, proposing a categorization framework for evaluating citizen science projects based on two key dimensions: the intensity and proximity of participant involvement. The research will contribute to the growing body of literature on citizen science by offering a nuanced approach to evaluation, one that takes into account the diversity of citizen science projects and their potential to drive transformative change. Through a mixed-method approach, the study seeks to develop a comprehensive tool that can be used to assess citizen science initiatives, particularly within the healthcare sector, and to guide future research agendas that seek to harness the transformative power of citizen science.

OPEN SCIENCE

As science and society advance, the ways we understand both changes. Such changes strongly impacted the processes of scientific research and facilitated a shift toward a more holistic approach (Owen & Pansera, 2019). These new approaches put the open science paradigm at the forefront of research practices, and policymakers steadily prioritised new forms of knowledge-production. For example, the European Commission imposed that any EU-funded research output must be open access and widely accessible to the public (Anglada & Abadal, 2018). Open science aims to tear down closed access restrictions imposed by traditional academic journals, and to open up the space for academic debate, and to more transparency in the data and the research process (Anglada & Abadal, 2018). Moreover, open science is expected to make research more oriented towards timely societal challenges while holding the scientific community accountable for their activities (European Comission, 2016).

In this context, citizen science has emerged as a relevant field of contemporary research, involving non-professional citizens in the scientific processes of data collection and analysis, as well as opening unprecedented opportunities for knowledge-creation (Franzoni & Sauermann, 2014). This new paradigm represents a significant change in conventional scientific production, allowing the participation of non-professional citizens in the research process. Although the concept of citizen science is multifaceted and contested, we draw on extant literature to define it as the involvement of non-professionals within scientific research with the collaboration of professional scientists (Beck et al., 2024; Bonney et al., 2009; Franzoni et al., 2022; Shirk et al., 2012).

TRANSFORMATIVE INNOVATION POLICIES

TIPs aim to bring about structural changes within systems. These perspectives are born from the need to solve very specific problems and important challenges for humanity, so it is necessary to take into account this perspective of innovation policy transformation due to the number of actors involved as well as the scale and complexity of the challenge (Mazzucato, 2017; Molas-Gallart et al., 2021; Mowery et al., 2010).

Following Molas-Gallart et al. (2021), three main theoretical frameworks have emerged to conceptualise innovation policies. The first proposes a linear understanding of innovation, where a specific goal leads directly to concrete change. The second framework includes more complexities as innovation and change are intertwined phenomena that incorporate interactions between multiple parties, actors, and stakeholders. Finally, the TIPs framework broadens its focus beyond interaction by recognising systemic and context-dependent challenges as key elements of policy-making processes. These challenges may include changes in behaviours within an organisation or transformations in a regime to modify broader aspects of management and social structures. The latter approach focuses on generating profound, sustained impacts that transcend organisational or sectoral boundaries.

In addition, the White Paper on Citizen Science[1] helps us understand science as both a process and a method in which non-professionals actively participate in scientific endeavours. One of its defining characteristics is the democratisation of science—how people learn about and engage with science. This aspect aligns with TIPs, particularly in addressing social and systemic challenges. Given the complexity of these systems, it is crucial for the actors involved to learn and evolve throughout the process.

A key area where TIPs provide a suitable framework for understanding citizen science is their emphasis on continuous participation throughout the research project. According to the White Paper, a citizen science project should involve participants in all phases of the scientific process, from conception to evaluation. This approach sets incentives to rethink traditional processes by challenging established scientific paradigms.

In this sense, citizen science aims to break away from conventional scientific models by promoting regime change that incorporates new actors and addresses emerging needs. As such, citizen science can be conceived as a form of TIPs.

The first objective of this research project is to categorise citizen science projects to advance knowledge of their attributes. To achieve this goal, our research will focus on projects with the potential to drive systemic transformation. This is particularly relevant, as some citizen science projects may be limited to a linear relationship between researchers and the non-professionals involved in the process.

Rather than evaluating citizen science projects against what they should be, our project will develop an analytical framework that takes into consideration contexts, actors and challenges. This framework will enable research agendas to effectively evaluate citizens' science projects. This framework will allow us to shed light on both the structural aspects of the projects and the diverse ways in which lay participants are engaged, offering a tool to analyse and evaluate citizen science initiatives from a transformative perspective.

To this end, we propose a two-dimensional categorisation including the intensity (Franzoni et al., 2022) and the proximity (Bone et al., 2019; Boschma, 2005) of participation.

To begin with, we will assess the intensity of participation through four core indicators:

- Activities refer to the type and number of tasks in which the different actors of the project participate, such as data collection, data dissemination or project design.
- Knowledge concerns the degree of relevance and depth of specific

[1] To view the document, check the following link: https://ciencia-ciudadana.es/wp-content/uploads/2018/09/WhitePaperOnCitizenScience2014.pdf

information that participants can acquire from or add on to the project. For example, this may include relevant information about a particular disease.
- Resources refer to how actors may contribute to the different phases of the project, including the frequency and timing of their contribution.
- Decisions evaluate at which stages of the project the participants' voices and opinions are considered, as well as the key decision-making processes.

To measure these four attributes, Franzoni et al (2022) propose to consider different stages in scientific processes, including the development of research questions, securing funding, developing materials and methods, collecting and processing data, analysing data or solving problems, interpreting and discussing results, research outputs and their dissemination.

Secondly, we draw on Bone et al. (2019) and Boschma (2005), to identify five key indicators to assess the proximity of participation, including:

- Cognitive proximity assesses the level of knowledge shared between researchers and participants.
- Organizational proximity analyses whether all actors are formally integrated into the project teams or if they participate occasionally.
- Social proximity measures the personal ties and trust that exist between the different actors in the project.
- Institutional proximity: This refers to the similarity in the norms and values shared by the participants.
- Geographical proximity considers how the spatial closeness between researchers and participants influences the dynamics of the project.

I propose that by classifying citizen science projects on these two axes, it will become possible to assess the degree of transformation they can achieve. In this sense, one of our main research hypotheses is that the more a project integrates patients or lay people at each stage of the research process while adopting a highly pluralistic approach, the more such a project will be likely to generate impactful transformations within its system. This transformative capacity relates both to the breadth of participation and to the diversity of perspectives incorporated in the project.

By taking the perspective of TIPs and following Molas-Gallart et al. (2021), our research project proposes a comprehensive assessment tool. More specifically, we focus on transformative and formative assessment based on the six guiding principles proposed by Molas-Gallart et al. (2021):

- Adopt a formative approach to assessment.
- Integrate evaluation with policy design and implementation.
- Make the evaluation process inclusive and participatory.

- Use a combination of methods and techniques.
- Implement a nested approach to assessment.
- Employ a flexible Theory of Change.

CONTEXT AND PROXIMITY APPROACH

The focus on healthcare is particularly fruitful for observing how open science is revolutionising science production and knowledge dissemination. Indeed, established and traditional modes of conducting medical research had narrow-viewed scopes that were concerned with publication in limited-access academic journals. This enclosure, it has been argued, has been critical in hindering the outreach and widespread dissemination of scientific discoveries (Grant et al., 2022; Munos, 2006). More recently, the adoption of open scientific practices has been facilitating key changes. Data, protocols, and research results are shared at early stages and with fewer limitations: this openness not only accelerates the pace of scientific progress but also sets ground for greater collaboration and transparency in medical research (Grant et al., 2022; Munos, 2006).

Abiding by open science paradigms improves the replicability and validity of medical research and strengthens scientific integrity. For example, initiatives such as open access to clinical trial data enable independent researchers to validate and reinterpret results, thereby increasing the reliability of the research (Ross et al., 2012). In addition, open science encourages greater social participation, through citizen science platforms where patients and the general public can contribute to data generation, participate in research, and access relevant medical information (Wicks et al., 2011). The application of this new scientific paradigm not only increases the efficiency and transparency of medical research but also promotes greater equality in access to knowledge and the benefits of medical advances (Cobey et al., 2023; European Comission, 2016).

OBJECTIVES

- To examine how citizen science can be considered a transformative innovation policy, analyzing its characteristics, impact and potential to influence public innovation policies.
- To explore and propose a methodological approach to evaluate citizen science projects.

METHODOLOGY

To achieve its objectives, the research project will adopt a mixed-method approach. The core methods will include:

Semi-structured interviews with principal investigators (PIs) of citizen science projects. Interviews will allow us to identify further attributes, dimensions of analysis and outcomes that have been overlooked by extant literature. Ultimately interviews will provide in-depth understanding of citizen-science projects which in turn will facilitate to devise our typology.

I will adopt the Delphi technique with the participation of researchers and evaluation

experts. This method aims to validate and enhance the proposed comprehensive assessment tool. The process will include at least three rounds of expert consultation to achieve optimal consensus and ensure the tool's reliability and robustness.

Simulated application or quasi-implementation: Once the tool is validated and finalised, a simulated application exercise will be conducted with researchers who have completed or are currently developing projects involving non-professionals in research. This exercise will evaluate how the tool could be applied to their projects, considering their specific dimensions and structures. The goal is to ensure the tool accounts for the unique characteristics of citizen science projects in the biomedical field and to confirm its practical applicability.

EXPECTED RESULTS

With this research project we expect to generate new, fine-grained understandings of the diverse attributes of citizen science projects in the healthcare field. Further, the research will develop a specialised tool tailored to medical research, through a specific design for projects focused on achieving transformative changes within their operational frameworks. This tool will enable the analysis and support of initiatives integrating transformational goals into their practices and approaches, ultimately advancing citizen science within the health sector.

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The projectified city: implications for stakeholder engagement

Ana Escario Chust

INGENIO (CISC-UPV), Universitat Politècnica de València, , aneschu@upv.es

Short bio: Ana Escario Chust is a predoctoral researcher at the INGENIO (CSIC-UPV) institute from the Universitat Politècnica de València (UPV) in Spain, specializing in Urban Sustainability Transitions. Her research focuses on participatory governance and innovative methodologies to enhance urban transformation. With a background in Industrial Design, she is interested in transformative multi stakeholder engagement. Holding a master's degree in International Cooperation and Local Development, she also brings a global perspective and a strong commitment to addressing urban sustainability challenges from fair and inclusive viewpoints.

How to cite: Escario-Chust, Ana. (2025). The projectified city: implications for stakeholder engagement. In *Proceedings of the 6th International PhDays Conference* (pp. 155-161). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19537

Abstract: Through a qualitative analysis of four European Mission Cities—Valencia, Budapest, Amsterdam, and The Hague—this study explores how projectification influences multi stakeholder governance and the agency of these processes. The findings highlight the challenges of sustaining engagement and long-term collaboration in projectified governance models and emphasize the need for adaptive frameworks that balance short-term project-based initiatives with long-term institutional change. This paper contributes to ongoing discussions on sustainability governance by proposing strategies to enhance stakeholder agency and ensure systemic transformation in urban climate action.

Keywords: Stakeholder engagement; transformation; projectification; urban sustainability transitions; Climate Neutral Mission; Agency.

INTRODUCTION

Cities are at the forefront of the climate crisis, facing increasing threats from extreme weather, rising temperatures, and environmental degradation (Bulkeley et al., 2015; IPCC, 2021). Addressing these challenges requires systemic governance

approaches that go beyond conventional, incremental policies (Avelino et al., 2016). Sustainability transition studies emphasize the importance of multi-level, cross-sectoral, and participatory governance to achieve meaningful transformation (Geels, 2011; Loorbach et al., 2017). This shift demands long-term strategies, adaptive policymaking, and stakeholder engagement (Smith et al., 2010).

In response, the European Union has launched the "mission for climate-neutral and smart cities," in which 112 cities have pledged to achieve climate neutrality by 2030 (European Commission, 2022). This initiative marks a significant departure from traditional climate action, requiring cities to rethink governance structures and align policies with sustainability transitions. However, as Dacin (2002) notes, institutionalizing new logics means confronting existing ones, necessitating a critical review of prevailing governance practices.

Projectification has become a defining characteristic of urban governance, shaping how policies are designed and implemented. While projects offer flexibility and innovation, they also present challenges such as governance fragmentation, short-termism, and lack of policy continuity (Jensen et al., 2016). The emphasis on short-term, quantifiable goals and dependence on funding cycles often undermine the long-term coherence required for sustainability transitions (Sjöblom, 2009). Projectification has already been identified as a factor limiting the transformative potential of urban experiments (Torrens, 2021).

A key strategy for fostering systemic interventions is stakeholder engagement, which enhances governance legitimacy, inclusivity, and adaptability (Geels, 2011; Loorbach, 2010; Avelino et al., 2016). However, project-based governance has also shaped stakeholder engagement, making it more fragmented and short-term-oriented (Sjöblom, 2009; Pollitt, 2008). The reliance on fixed funding cycles restricts sustained collaboration, weakens trust, and reduces the transformative capacity of participatory processes (Rhodes, 1997; Sørensen, 2002). Moreover, projectification can shift engagement from co-creation to legitimizing predefined objectives, limiting its potential for systemic change (Torrens, 2021; Frantzeskaki et al., 2018).

One major consequence of projectified stakeholder engagement is its impact on agency. Agency in stakeholder engagement refers to the ability of actors—governments, businesses, civil society, and local communities—to shape governance structures and influence decision-making in sustainability transitions (Avelino et al., 2016; Roebke et al., 2022). It includes both change agency, which drives transformation, and reproductive agency, which maintains existing governance structures (Grillitsch & Sotarauta, 2019; Angeltveit & Isaksen, 2021).

This paper examines how projectification reshapes multi-stakeholder engagement in cities and its implications for agency. The key research questions guiding this study

are: (1) what are the implications of projectification in multi-stakeholder engagement processes? (2) how does projectification affect the agency of multi-stakeholder engagement spaces in urban governance? (3) how can governance frameworks be adapted to mitigate the limitations of project-based engagement?

Given the persistence of project-based governance, exploring strategies to address these challenges is crucial. As Fred (2019) argues, projects have become a fundamental feature of contemporary society, making it necessary to find ways to balance short-term innovation with long-term governance continuity. This paper proposes initial steps to address these issues and outlines promising avenues for future research.

THEORETICAL FRAMEWORK

Projectification and governance

Projectification is the increasing reliance on projects as the main method for organizing work across various sectors, including public administration and private enterprises (Nylén, 2021). These goal-oriented, time-bound initiatives have given rise to "projectified governance," where projects play a central role in policy implementation and development (Hodgson et al., 2019; Sjöblom, 2009). This trend involves not only a rise in the number and scope of projects but also a cultural shift that embeds project management practices into all organizational activities (Fred, 2020; Hodgson, 2019).

In urban sustainability governance, projectification operates under two contrasting logics. On one hand, projects are seen as flexible and innovative tools that promote cooperation among diverse actors—government bodies, NGOs, and private enterprises—enhancing adaptability and resource allocation for complex initiatives (Maylor et al., 2006; Munck af Rosenschöld, 2017). On the other hand, the structured use of projects can lead to re-bureaucratization and depoliticization, reducing political objectives to technical milestones and potentially resulting in fragmented, short-term efforts with limited long-term impact (Nylen, 2021; Hodgson, 2004; Fred, 2020; Torrens, 2021; Bulkeley, 2019). This can diminish accountability and continuity, hindering sustainable systemic change (Beck, 1998; von Wirth et al., 2019).

Multi stakeholder governance

Urban sustainability transitions are complex, involving multiple actors across various sectors collaborating to create sustainable systems (Frantzeskaki et al., 2012; Avelino & Wittmayer, 2016). No single entity can manage these transitions alone, making multi stalkeholder governance essential for achieving ambitious goals (McCormick et al., 2013).

Multi stalkeholder governance enhances the legitimacy, justice, and resilience of sustainability initiatives by integrating diverse perspectives, building trust, and fostering shared ownership (Hölscher et al., 2019). It connects top-down policies with grassroots actions, addresses power dynamics, and mobilizes social and political

resources (Holmén, 2022; Kivimaa & Kern, 2016). Additionally, stakeholder networks help spread best practices across different contexts.

Challenges include conflicting interests, power imbalances, and the potential for tokenism. Overcoming these requires transparent communication, conflict resolution, targeted outreach, ongoing dialogue, and demonstrating the impact of stakeholder input. Effective engagement also demands significant time, resources, and skilled facilitation (Pereira et al., 2018; Hölscher et al., 2019).

Agency

Agency is a central concept in understanding sustainability transitions, capturing the capacity of actors to initiate, shape, and transform socio-technical systems. Rather than being confined to isolated individuals, agency encompasses the actions, interactions, and influences of a diverse range of actors—including organizations, institutions, networks, and communities (Fischer & Newig, 2016; Grin et al., 2011). This broader conceptualization emphasizes that agency is not only about the ability to act, but also about the capacity to interact with, adapt to, and ultimately transform existing structures and norms.

Drawing on Giddens' (1984) Structuration Theory, agency is understood as both enabled and constrained by the institutional contexts within which actors operate. Institutions—comprising rules, norms, and established practices—provide the frameworks that shape behavior. However, these frameworks are not static; they are continuously reproduced or altered through the actions of reflexive and purposeful actors. Thus, agency in sustainability transitions is best viewed as a dynamic interplay where actors engage with pre-existing structures and, through their practices, contribute to their evolution. This reciprocal relationship highlights that while structures condition and limit choices, they are also amenable to change when actors mobilize their capacity for innovation and adaptation (Fischer & Newig, 2016).

A broader understanding of agency also incorporates its relational and temporal dimensions. Agency emerges through the interactions among diverse actors who collectively contribute to sustainability outcomes. These interactions facilitate the sharing of knowledge, the co-creation of solutions, and the establishment of collaborative networks that are essential for addressing complex environmental challenges. In this sense, agency is inherently relational—it is not solely a quality of individual actors but is produced through social processes and collective endeavors (Fischer & Newig, 2016). Moreover, agency is temporally embedded; past experiences, current conditions, and future aspirations shape the actions of actors. This temporal dimension ensures that sustainability transitions are not seen as isolated events but as ongoing processes in which learning and adaptation are continuously integrated into practice (Grin et al., 2011).

Furthermore, agency in the context of sustainability transitions is fundamentally

linked to the capacity for both maintaining and transforming power dynamics within socio-technical systems. The prevailing institutional and technological regimes often embody established power structures that resist change. Nevertheless, when actors exercise agency, they have the potential to challenge and reshape these regimes, fostering shifts toward more sustainable practices. This transformative aspect of agency is critical, as it underpins the ability of actors to navigate complex transition landscapes, overcome inertia, and realign legitimacy in favor of sustainability objectives (Grin et al., 2011).

METHODOLOGY

This study employs a qualitative research approach to explore how projectification influences multi-stakeholder engagement and agency in urban sustainability governance (Flyvbjerg, 2011; Yin, 2014).

The study examines four European Mission Cities—Valencia, Budapest, Amsterdam, and The Hague—selected for their diverse governance contexts within the EU's "Mission for Climate-Neutral and Smart Cities" (European Commission, 2022). Eight interviews were conducted with city representatives involved in the Mission and stakeholder engagement processes. The semi-structured format allowed flexibility in capturing governance challenges and opportunities (Kvale & Brinkmann, 2015).

Additionally, policy documents, municipal reports, and EU publications were analyzed to contextualize stakeholder engagement strategies and governance frameworks.

RESULTS & DISCUSSION

Under construction.

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Innovative Governance for a Sustainable Future: Barriers and Enablers in the Public Management of Coastal Wetlands in the Valencian Community

Luján Climent, Irene; Enguer, Joan; Aldeguer Cerdá Bernabé & Barberà Aresté, Óscar

Universitat de València, , irene.lujan@uv.es

Short bio: Irene Luján Climent is a dedicated researcher with a background in Law, Political Science, and Public Administration from the Universitat de València (UV). She has also completed various academic stays at the Universidad Autónoma de Madrid, the University of Zagreb (Croatia), and the University of Virginia (USA). She holds a Master's degree in City and Urbanism from the UOC and a Master's in Teaching from UEM. She manages and researches in the Horizon EU Project "Blue Green Governance (BGG)" and is pursuing a PhD in political science, specifically in environmental governance and public policies at Universitat de València. Her professional interests include institutional innovation, sustainability, participatory processes, environmental governance, and public policy analysis. Irene has worked as a gender consultant, legal expert, and in public administration, gaining a comprehensive understanding of policy development and stakeholder engagement. Her research focuses on the governance of coastal wetlands in the Valencian Community, aiming to contribute to environmental sustainability and effective public management.

How to cite: Luján Climent, Irene; Enguer, Joan; Aldeguer Cerdá Bernabé & Barberà Aresté, Óscar (2025). Innovative Governance for a Sustainable Future: Barriers and Enablers in the Public Management of Coastal Wetlands in the Valencian Community. In *Proceedings of the 6th International PhDays Conference* (pp. 162-180). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19577

Abstract: Over the last twenty years, the governance and public management of natural resources and spaces in the Valencian Community have undergone significant changes, adapting to modern challenges such as environmental sustainability. This paper aims to evaluate how institutional dynamics and political shifts have influenced the evolution of governance in Valencian coastal wetlands, focusing on the barriers and enablers across five key innovations: the integration of land-sea planning and management; the use of scientific knowledge; citizen participation and engagement; the development of prospective and predictive strategies; and the use of digital tools (Fobé et al., 2024). Moreover, these innovations are categorized into three types: social, technological, and institutional (OCDE, 2018). The study spans

from 1994 to 2024, during a period of expanded Valencian self-government that began in the early 1980s.

The research addresses gaps identified in comparative literature by examining the practical implications of diffuse roles, coordination challenges, resource limitations, and unequal power dynamics in implementing new governance strategies (Aukes et al., 2020; Platjouw et al., 2024). By exploring these issues in the specific context of Valencian coastal wetlands, the study provides deeper insights into overcoming systemic barriers in coastal governance frameworks (Viñals & Ors, 1995).

The study employs qualitative techniques, including documentary, legislative, governmental, and parliamentary content analysis and discourse analysis with key stakeholders (SHs). Data collection methods involve analysing relevant policies and legislative frameworks, as well as interviews with key stakeholders, including government officials, community leaders, civil servants and representatives from environmental organizations, to provide additional insights. A comparative analysis of governance models and their effectiveness in addressing environmental challenges is also conducted.

Keywords: Land-sea Governance; Coastal Wetlands; Public Management; Innovative planning and management.

INTRODUCTION

Wetlands are transitional spaces, where the aquatic and terrestrial environments meet. A high degree of complexity as in any transitional area in nature. Coastal wetlands also embody another transition, between land and sea. It includes all those ecosystems influenced by tides (lagoons, marshes, estuaries, deltas...). They present strong salinity gradients that condition habitats and species and give rise to some of the most complex socio-ecological systems on the planet.

Spain has 392 sites included in wetland inventories or the Natura 2000 Network, a surface area of 303,730ha, and 27 Ramsar sites with a surface area of 223,147ha. Of these, the Valencian Community has 29 sites included in Wetland Inventories or Natura 2000 Network, a surface area of 42,932ha, and 6 Ramsar sites with 33,128ha (Sanchis et al., 2024)

Specifically, the Valencian Community, located on the eastern coast of Spain, is characterised by its diverse and ecologically significant coastal wetlands. These wetlands, spread throughout the region, are critical for biodiversity, and water regulation, and as buffers against climate change impacts. However, they are also highly vulnerable to pressures from urbanization, tourism, and agricultural activities. The governance of these wetlands requires a nuanced understanding of the interplay between local, regional, and national policies, as well as the roles of various stakeholders, including government

agencies, non-governmental organisations, and local communities (Viñals, 2024).

The different types of protection that converge in the protection of Valencian coastal wetlands fulfil different functions that have been added together as a function of legal changes, but also because of factors linked to institutional capacities or interactions between civil society and public administrations. Likewise, the generation of protection figures with different degrees of scope, intensity and management models plays a significant role in raising awareness, disseminating information and enhancing the value of protected areas, which shields them from external aggressions and threats. However, the mere recognition of protected areas has required other actions such as the adequate mobilisation of sufficient resources, the design of effective management instruments, the integrated planning of recovery, restoration and dissemination projects, the follow-up, monitoring and evaluation of the actions implemented, the implementation of stable and consensus-based citizen participation projects by different actors, as well as the development of educational campaigns aimed at young people and children. If not, the mere recognition of protective figures, without the backing of other management tools and a sustainable guarantee of resources, can result in excessive touristification, or greenwashing strategies by certain public administrations and other interested economic sectors (Sanchis et al., 2024).

The floods that occurred on 29 October 2024, which devastated flooded areas adjacent to several ravines that converge in the L'Albufera Wetland, highlighted once again the constant vulnerability of the floodplains of the Valencian Community. This event underlined the crucial regulating function of wetlands and their susceptibility to emergencies and environmental disasters that are increasingly occurring in our territories. This situation is not and will not be the only one, as other wetlands also act as regulators in the interaction between land and sea. The Valencian Community, located in a Mediterranean region with climatic vulnerabilities, faces significant natural risks. In addition, this region has numerous coastal wetlands that are subject to various environmental and human pressures (Aldeguer, 2025).

MAIN RESEARCH OBJECTIVES AND QUESTIONS

This study focuses on the coastal wetlands of the Valencian Community, which are recognized and managed under the highest level of regional protection as Natural Parks and as part of the RAMSAR Convention, 1971. These include Albufera, Hondo, the Mata and Torrevieja's lagoons, Pego-Oliva's marshland, Prat of Cabanes-Torreblanca, Santa Pola's salt marshes. Additionally, two other wetlands, Moros' marshland and the Almenara's ponds, are included due to their ecological significance in the region.

The main objectives of this research are to identify the barriers and facilitators in five key

dimensions of innovation, as defined by (Fobé et al. 2024):

- To assess the **integration of land-sea planning** in the management of Valencian coastal wetlands: To analyse how coordination between different levels of government and stakeholders has developed for the sustainable management of coastal and marine ecosystems.

- To analyse **the use of scientific knowledge in decision-making** and management of wetlands: To examine how collaboration with universities and research centers has led to a better understanding and management of these spaces.

- Examine **citizen and stakeholder participation** in governance processes: Investigate how the creation of governing boards and the introduction of citizen science has facilitated dialogue and collaboration between different actors.

- Investigate the development and use of **foresight and predictive strategies**: Evaluate how digital models and sensing systems have been implemented to assess the cumulative impacts of climate change on wetlands and their long-term adaptive measures that optimise the conservation of these ecosystems in uncertain climate scenarios.

- Assess the **impact of digital tools** on wetland governance: To analyse how digitalisation has improved transparency, environmental monitoring and citizen participation in wetland management.

These five dimensions align with three broader categories of innovation (OCDE, 2018):

Table 1 *Innovations and Dimensions*
Source: Prepared by the authors

Innovation Type	Corresponding Dimensions
Institutional Innovation	Integration of land-sea planning in wetland management (Dimension 1)
Social Innovation	Use of scientific knowledge (Dimension 2) + Citizen and stakeholder participation (Dimension 3)
Technological Innovation	Foresight and predictive strategies (Dimension 4) + Impact of digital tools (Dimension 5)

This classification allows for a structured analysis of how different types of innovations contribute to the effective governance and management of coastal wetlands.

The main **research questions** are: What are the main barriers and enablers of an innovative governance of coastal wetlands in the Valencian Community? How do institutional, social, and technological innovations contribute to sustainable wetland management?

METHODOLOGY

The methodology used in this study is qualitative, based on documentary,

legislative, governmental and parliamentary analysis, as well as on the analysis of the discourse obtained through focus groups with key stakeholders. A total of 31 stakeholders with some kind of relationship or influence (both managers or users) on six protected natural parks in the Valencian Community were considered: Albufera, Hondo, Mata and Torrevieja, Pego-Oliva, the Prat of Cabanes-Torreblanca and the Santa Pola, as well as the wetlands of Almenara and Moros' marshland.

The data was obtained by means of a face-to-face focus group, several in-depth group interviews, as well as different in-depth individual interviews with civil society actors (activists, representatives of economic sectors), Public Administrations (civil servants and managers of protected areas and parks) and academics specializing in the analysis of coastal wetlands in the Valencian Community.

Specifically, the result of the Focus Group (with 11 participants) developed in the Valencian region, with the participation of representatives linked to Public Administrations, economic sectors, foundations, NGOs and the academic sector, was a participatory diagnosis of three dimensions: Impacts of climate change in the Valencian Community: main dangers and climate scenarios, Land-sea governance: obstacles and enabler and The current political framework for land-sea governance in Spain and the Valencian Community.

This first focus group, which took place on 7 June 2024, was carried out through different dynamics for each of the four sessions:

For the sessions on "Land-sea governance: obstacles and facilitators in Europe" and "The current policy framework for land-sea governance in Spain and the Valencian Community" the dynamics consisted of the initial presentation of a series of theoretical concepts from specialised literature and the invitation to a guided and coordinating debate trying to analyse the usefulness and impact of the theoretical concepts on the reality of the Valencian coastline.

During the session on "Impacts of climate change in the Valencian Community: main hazards and climate scenarios", the participants marked with post-its the elements they considered most dangerous. The one they considered most dangerous was marked with a red Post-it, the second with a yellow Post-it and the third with a green Post-it. This classification was quantified by giving a '3' to the red Post-it, a '2' to the yellow Post-it and a '1' to the green Post-it.

Finally, the session on "Knowing the future to transform" the decision involved workshop participants carrying out an exercise where they put winners and losers in different scenarios. Based on this classification, both losers and winners were ranked. Some participants further elaborated their ranking with a development of arguments.

Despite the intention to carry out two face-to-face focus groups during November, the situation of the catastrophe of 29 October in Valencia forced us to carry out, online, several in-depth group interviews, as well as several individual in-depth interviews with civil society actors (activists, representatives

of economic sectors), Public Administrations (civil servants and managers of protected areas and parks) and academics specialising in the analysis of coastal wetlands in the Valencian Community. A total of 20 actors involved in coastal wetlands in the Valencian Community were interviewed.

The in-depth interviews included the following content script:

1. What are the main events that have marked the historical trajectories of wetland governance in the VC since the mid-1990s?

2. Have there been changes (increases, cuts) in financial, human or material resources?

3. How has the institutional design (councils, creation of new parks, etc.) or the number and relationships of political and SH actors evolved?

4. To what extent has the perception of the problems or the solutions or approaches to be applied changed?

5. Have these above changes translated into a new orientation in the design or implementation of public policies governing wetlands?

6. Linked to the factors determining these barriers and enablers related to institutional change in coastal governance, have there been changes in the barriers and enablers guiding the governance of Valencian coastal wetlands?

More specifically, have there been changes in terms of the:

- integrated coastal planning and management

- the use of scientific knowledge

- stakeholder participation and involvement

- the development and use of strategic forecasting

- the use of e-governance tools

The period included in the study covers the period from the approval of Law 11/1994, of 27 December 1994, on Protected Natural Spaces of the Valencian Community, to the present day. This law was chosen as the starting point as it represents an institutional and regulatory milestone in the protection and conservation of Valencian natural areas, establishing the bases for the declaration, management and protection of various categories of protected landscapes. It therefore laid the foundations for the current policy of Valencian protected areas, with natural sites acquiring the status of natural parks (Ruiz et al., 2023).

The identification of the stakeholders included in the analysis sample was carried out through systematic work, initially prospective and subsequently using a prioritisation technique based on the interest and influence of the stakeholders in the issues addressed. In addition, a snowball effect has been allowed, facilitating access to different stakeholder networks through a series of initial contacts that have suggested new participants.

To foster stakeholder confidence in the research project, the return of preliminary results from the focus groups and in-depth interviews was facilitated. Data collection was carried out through a face-to-face focus group and several in-depth group and individual interviews with civil society actors, public administrations and academics specialising in the analysis of coastal wetlands in the Valencian Community.

The qualitative results have been organised using the qualtrix programme, generating

standardised conclusion sheets for each interview or focus group.

DEVELOPMENT OF INNOVATION

Evolutionary Governance Theory (EGT) provides a flexible conceptual framework for understanding changes in institutions. The management of public environmental protection policies is influenced by barriers and enablers that affect five key dimensions: integrated land-sea management, the use of scientific knowledge, stakeholder participation, strategic foresight and the use of e-tools. Governance must be context-specific, reflecting ecological, historical and political contexts, and involving diverse values, knowledge and practices (Borrini-Feyerabend et al., 2013).

Governance has proven to be adaptive and has been linked to civil society participation and the creation of strategic partnerships (Pendleton & Carr, 2023). These collaborations are especially important in contexts of environmental catastrophes (Morelli et al., 2021). This gives us an element that should be studied in the Valencian region, given that, during the implementation of conservationist public policies and their regulatory development, the absence of citizen participation stood out (Ruiz et al., 2023). Furthermore, a polycentric governance system, with multiple centres of decision-making and action, can be more effective and efficient in achieving socio-economic and environmental goals (Srigiri & Dombrowsky, 2022). It is essential to understand the causes and solutions to political and social conflicts, as well as the mechanisms that facilitate or disrupt coordination and cooperation in collective action processes (Bruckmeier, 2014; Greenhill et al., 2021; Schultz et al., 2015; Therville et al., 2019; Vaidianu et al., 2020).

Citizen participation in open and transparent processes is crucial for more efficient and equitable decision-making (Andersson & Ostrom, 2008; Lemos & Agrawal, 2006). In relation to this, EGT suggests that the active participation of citizens is crucial for the creation of inclusive and sustainable policies. Citizens should not only be seen as passive recipients of policy decisions but as active actors who can influence decision-making and policy implementation (Beunen et al., 2015).

Introducing innovations in public management, especially in environmental protection, requires conscious changes based on creativity and learning from past experiences and future expectations. These innovations, although limited by the importation of techniques from the private sector and imitation from other contexts, must be proactive and change-oriented, promoting the democratisation of public administrations with collaborative leadership that fosters citizen participation and transparency (Aldeguer, 2016, 2019; Arenilla, 2014; Babino, 2014; Ballart, 2001; Barnes, 2006; Bason, 2014). To overcome institutional barriers, it is essential to strengthen integrated planning, citizen participation, intergovernmental and intersectoral coordination, and the quality of legislative production, recognising the need for continuous improvement and

understanding current governance as the result of long-term processes.

Theoretical studies and applied analytical experiences on governance emphasise defining polycentric models consisting of multiple decision-making and action centres that have different levels of authority, as well as varying degrees of access to resources and coordination structures, and which can be more or less effective and efficient in achieving socio-economic and/or environmental objectives (Srigiri and Dombrowsky, 2022). Underlying the study of governance is always the need to understand two main elements: 1) the causes and solutions to political and social conflicts; and, 2) the conditions and mechanisms that enable or disrupt coordination and cooperation in collective action processes or actor constellations.

Applied to the case study, we can summarise the following table:

Table 2 *Innovations, barriers and enablers of governance*. Source: Prepared by the authors

Innovation	Barriers	Enablers
Integrated Land-Sea Management and Planning	Organizational fragmentation, lack of vertical and horizontal coordination, and insufficient resources	Effective coordination mechanisms, shared data and knowledge, and knowledge platforms
Use of Scientific Knowledge	**Limited availability of scientific evidence, inadequate use of evidence, and competition between different types of knowledge**	**Integration of interdisciplinary evidence, synergies with other types of evidence, and knowledge transfer platforms**
Participatory Practices and Stakeholder Involvement	Lack of formal participation mechanisms, inequality in stakeholder representation, and insufficient resources	Multi-sector and stakeholder networks, holistic approaches, and creation of shared understandings
Development and use of Strategic Foresight	Temporal and spatial mismatches, and lack of stakeholder involvement	Establishment of foresight practices, facilitation of learning and futures literacy, and interdisciplinary approaches
Use of e-Governance tools	Limited digital literacy, technical issues, and political or administrative resistance	Interoperable tools, inclusive participation, and monitoring and development mechanisms

KEY FINDINGS

Concerning the impacts of climate change in the Valencian Community: main dangers and climate scenarios, the results expressed that

the element that has been considered the most dangerous is "coastal erosion" followed by "increase in average temperatures" and "rise in sea level". These are factors that have an impact on coastal wetlands. On the other hand, about the losers associated with each of the impacts identified as consequences of climate change, the following were listed: biodiversity itself, fishermen and farmers, marine flora and fauna, agriculture located in coastal areas (some of them, such as rice harvesting, in the wetlands themselves), floods, climate refugees, managers of natural areas, the tourism sector or local inhabitants located in the risk areas themselves. Participants also identified potential winners of such scenarios such as construction companies or environmental restoration companies, tourists looking for places without rain), desalination plants, energy sector related to the air conditioning industry or thermal industry.

In addition to the in-depth interviews, by examining these five dimensions in the context of the Valencian Community, this research contributes to a deeper understanding of the **barriers and enablers** of innovative governance strategies for coastal wetlands. The study underscores the importance of continuous dialogue and collaboration among stakeholders to develop sustainable and inclusive governance models that can effectively address the complex interplay of environmental, social, and economic objectives.

In terms of **barriers:**

Integration of Land-Sea Planning and Management: One of the primary barriers in this dimension is the fragmentation of responsibilities across different administrative levels and sectors, leading to coordination challenges. The management of natural areas has been influenced by changes in the policies of the parties in power, which has led to a lack of continuity and variability in the application of policies for the conservation of natural areas and, specifically, coastal wetlands. The different actors interviewed confirm that the lack of a unified framework often results in conflicting policies and actions that undermine effective management. Additionally, the lack of coordination between different levels of multi-level governance exacerbates these issues. When local, regional, and national authorities do not work in harmony, it can result in inefficiencies and gaps in policy implementation, as we have been able to visualise recently in the Valencian catastrophe. The lack of coordination between different services within the administration and between different levels of government is a significant obstacle. This disjointed approach can hinder the development and execution of comprehensive strategies needed for sustainable land-sea integration, ultimately affecting the overall effectiveness of governance in coastal areas. Moreover, the provision of resources to natural protected areas is insufficient due to a lack of staff and funding. This limits the capacity of administrations to make adequate

investments and effectively manage wetlands.

Use of Scientific Knowledge: Collaboration with universities and research centres has been instrumental in advancing the understanding and management of coastal ecosystems. In natural parks, significant progress has been made in the use of scientific knowledge, although this progress is largely dependent on the governments in power. However, several stakeholders agree that, although scientific knowledge is available, there is a lack of time and resources to apply it effectively. The lack of coordination between different services within the administration and between different levels of government is a major obstacle. This lack of coordination can hinder the effective implementation of scientific knowledge in wetland management. In addition, several stakeholders identify that there is a disconnect between technicians working in the field and higher levels of administration, which can hinder the effective implementation of scientific knowledge. This disconnection may be due to differences in the timing and priorities of universities and the administration. Finally, scientific information often reaches political and administrative structures in a limited and summarised form, which may reduce its impact. In addition, the lack of monitoring and assessment of scientific information by administrations is a significant barrier.

Citizen Participation and Engagement: The participation of local actors and civil society has grown over time, yet significant challenges remain. Barriers to citizen engagement include limited awareness, restricted opportunities, and power imbalances that marginalize certain groups. Many local communities feel excluded from decision-making, leading to distrust and reluctance to cooperate. Stakeholder saturation is a key issue, as the same individuals are repeatedly involved, increasing the risk of burnout. Collaboration remains difficult due to persistent tensions between environmental managers, farmers, and local administrations. The underrepresentation of communities closest to the territory and certain economic sectors further weakens participation. Despite advancements in digital tools for engagement, e-governance implementation still has room for improvement. The absence of stable, institutionalized collaboration channels, inconsistent management, and fluctuating policy implementation present additional barriers. Furthermore, poor coordination between administrations and a lack of multidisciplinary, cross-sectoral teams continue to hinder effective governance.

Development of Prospective and Predictive Strategies: The development of forward-looking strategies is significantly hindered by the uncertainties associated with climate change and the complexities of predicting long-term impacts. Policymakers frequently face difficulties in forecasting future conditions and crafting strategies that are adaptable to evolving circumstances. In the context of the strategic foresight analysis, stakeholders identify the lack of

political continuity and short-term vision in planning as the main barriers. These factors hinder the development of long-term sustainable projects, as priorities change with electoral cycles, generating mistrust. In addition, institutional fragmentation and lack of coordination, as well as lack of knowledge, negatively affect decision-making, coherence and effectiveness of wetland governance.

Use of Digital Tools and e-Governance: The adoption of digital tools is often constrained by technological limitations and the digital divide among stakeholders. Smaller municipalities and local organisations may lack the resources or expertise to implement advanced digital tools, limiting their ability to participate fully in governance processes. Stakeholders highlight that There is still considerable progress to be made to ensure that all actions and decisions are conducted openly and are accessible to the public. This transparency is crucial for fostering trust and accountability, and for ensuring that governance processes are inclusive and effective. For example, the meeting minutes of the governing boards of the different natural parks are still not easily accessible in online format, nor to know when they will meet.

In terms of **enablers:**

The integration of land-sea planning and management is a key dimension of effective coastal and littoral governance, coordinating policies and actions among different levels of government and stakeholders. European directives such as the Birds Directive (1979), the Habitats Directive (1992), and the Water Framework Directive (2000) have been fundamental for the protection and management of wetlands. The Natura 2000 network has created a network of protected areas across the European Union, significantly contributing to the conservation of the most valuable and threatened habitats and species. Spain's entry into the European Union and the implementation of these directives have been crucial for the protection of water resources and biodiversity. At the national level, the Natural Heritage and Biodiversity Law (2007) has incorporated modern concepts such as ecosystem connectivity, contributing to greater integration of conservation policies in territorial planning. In the Valencian Community, regional regulations have played a crucial role in the evolution of governance. Decree 89/1986 of the Consell de la Generalitat Valenciana established the legal regime of the Albufera, making it the first natural park in the Valencian Community. Subsequently, the Law of Protected Natural Spaces of the Valencian Community (1994) and the Law of Territorial Planning and Landscape Protection (2004) have been important milestones in the environmental history of this territory. However, the management of natural areas has been influenced by changes in the policies of the ruling parties, leading to a lack of continuity and variability in policy implementation. Despite these challenges, there have been significant advances in the integration of coastal management and planning, such as the implementation of the Territorial Action Plan for the Green Infrastructure of the Coastline (PATIVEL) in

2019. However, the repeal of PATIVEL in 2024 has raised concerns about the future of coastal protection and management. To achieve sustainable and effective management of coastal ecosystems, it is essential to strengthen collaboration among all involved actors and ensure adequate resource allocation. Especially, collaboration among different levels of government and stakeholders has been crucial to advancing the integration of coastal management and planning, promoting biodiversity conservation and environmental sustainability.

Regarding the **use of scientific knowledge** in the Valencian Community, scientific institutions such as universities have played a key role in advancing knowledge on coastal ecosystems and the impacts of climate change. Collaborative research projects, mainly European ones, involving these institutions, government agencies, and non-governmental organizations have contributed to a better understanding of the ecological dynamics of coastal wetlands and the development of innovative management approaches. This collaboration with universities and research centres has been fundamental for advancing the understanding and management of coastal ecosystems. It has enabled studies and monitoring that would not have been possible otherwise. The implementation of advanced technologies, such as sensorization and digital twins, has improved the management of natural parks. These technologies allow for more informed and adaptive decision-making, which is crucial for the sustainable management of wetlands. For example, the Devesa Albufera office has been one of the institutions that has achieved the most LIFE projects in the history of Spain, demonstrating a strong capacity to draft and develop projects and integrate and develop scientific knowledge in collaboration with the administration and universities. These studies have been fundamental for the planning and management of natural resources in the region. Although challenges remain, communication between universities and the administration is improving, facilitating the transfer of scientific knowledge to management practices. This improvement in communication is essential for the effective application of scientific knowledge in wetland management.

Citizen participation and engagement are essential for the legitimacy and effectiveness of governance processes. Enablers in this dimension include the establishment of participatory platforms and advisory councils, which have improved stakeholder involvement and fostered a sense of ownership among local communities. Involving local communities and stakeholders in decision-making helps to ensure that policies and actions are responsive to local needs and contexts. In the Valencian Community, various mechanisms have been established to facilitate citizen participation in coastal governance. These include public consultations, participatory planning processes, and the establishment of advisory councils and committees. For

example, the natural spaces considered as a Natural Park by law, have a participatory management board that includes representatives from local municipalities, environmental organizations, and other stakeholders. This board provides a platform for dialogue and collaboration on issues related to the management and conservation of the park. This has facilitated dialogue and collaboration among different actors. Citizen participation has been shown to improve the process and quality of measures proposed by public administrations. Additionally, some actors comment on how the Citizens' Assembly for Climate in 2021, for example, reached bolder conclusions than any political party, although it is understood that their consensus should be binding. The integration of stakeholders in governance processes is essential and has been facilitated by the creation of these participatory structures. Furthermore, exogenous variables to the Valencian political and administrative system, such as European community aid and regulations, have been important enablers in the protection and integrated management of wetlands.

The **development of prospective and predictive strategies** is important for anticipating and addressing future challenges. Despite these challenges, the implementation of scenario planning and modelling tools has proven invaluable, offering critical insights for adaptive management and aiding in the anticipation and mitigation of future risks. However, political leaders need to prioritize and integrate these strategies to ensure their effectiveness and sustainability. This involves using tools such as scenario planning, modelling, and forecasting to explore potential future conditions and identify strategies for mitigating risks and enhancing resilience. In the context of coastal governance in the Valencian Community, prospective and predictive strategies have been used to assess the potential impacts of climate change on coastal ecosystems and communities. For example, studies have been conducted to model the effects of sea-level rise, increased storm intensity, and changes in precipitation patterns on coastal wetlands. These studies provide valuable insights for developing adaptive management strategies that can help reduce vulnerability and enhance the resilience of coastal ecosystems and their communities.

The **use of digital tools and e-governance** is increasingly important for enhancing the efficiency and effectiveness of governance processes. Digital tools can facilitate data collection, analysis, and sharing, as well as support communication and collaboration among stakeholders. In the Valencian Community, various digital tools have been developed and implemented to support coastal governance. These include GIS for mapping and monitoring coastal ecosystems, online platforms for stakeholder engagement and information sharing, and decision support systems for integrated coastal zone management. For example, the Valencian Institute of Environmental Research has developed a

GIS-based tool for monitoring and managing the Albufera Natural Park. This tool provides real-time data on water quality, vegetation, and wildlife, and supports decision-making on issues such as water management and habitat restoration. Additionally, the Natural Park of Las Lagunas de la Mata y Torrevieja is implementing new digital twins in its area.

DISCUSSION AND CONCLUSIONS

Regarding the obstacles and enablers of land-sea governance, the results indicate, mainly, the following scenario:

- Organizational barriers: lack of coordination between areas and administrations, lack of coordination in the metropolitan area, too many agents involved, lack of resources and lack of political collaboration but high technical agility.
- Barriers to the use of scientific information: the information is there, but it doesn't arrive: the scientific articles don't arrive: existing scientific data are not leveraged, and biased view of data from politics (access to information).
- Barriers to citizen participation of SHs: lack of mechanisms to improve participation, lack of systematization to give value to participation (guide), and, fatigue of the agents involved in participation.
- Enablers: only agents with very specific interests end up participating, participation is expensive generates fatigue and does not generate enough confidence; and, the low participation worsens when you go up the level because the effectiveness decreases.

Finally, about the current political framework for land-sea governance in Spain and the Valencian Community, the actors identified the following characteristics based on the following four dimensions:

- Normative dimension: lack of regulations, little specificity of the regulations and, problems of the new coastal law.
- Institutional design dimension: poor efficiency of regulations, lack of rules in the part of the marine tour (users of the seabed), and political changes affecting regulations.
- Resources dimension: administration is a bottleneck, consensus on the lack of human resources, excessive regulation and lack of coordination and, there is a lack of specialized training for civil servants.
- SHs dimension: Not every actor sees themselves reflected, the problem of citizen participation among actors, double role (actor/technician) and, high complexity in participation.

Consequently, the study identifies several barriers and enablers across different types of innovations in the governance of coastal wetlands in the Valencian Community

The following table tries to provide a clear visualization of the most critical areas and where efforts should be focused to improve coastal wetland governance.

Table 3 *Results*
Source: Prepared by the authors

Innovation	Type of innovation	Barriers	Enablers
Land-Sea Planning Integration	**Institutional**	Fragmented responsibilities, lack of coordination between government levels, changing policies	European directives (e.g., Birds Directive, Habitats Directive), Regional Laws.
Use of Scientific Knowledge	**Social**	Lack of coordination between administrations, insufficient resources and time to apply scientific knowledge	Collaboration with universities, LIFE projects, implementation of advanced technologies (sensors, digital twins)
Citizen Participation and Engagement	**Social**	Exclusion of local communities, unequal power dynamics, stakeholder overload, lack of stable collaboration channels	Advisory councils, participatory platforms, local community involvement in decision-making
Development of Prospective Strategies	**Tecnhnological**	Lack of long-term vision, climate change uncertainty, lack of political continuity	Use of scenario planning tools, simulation models for adaptive management
Use of Digital Tools	**Technological**	**Digital divide, lack of resources and knowledge in smaller administrations, lack of transparency**	**GIS tools, online platforms, digital twins, decision support systems**

Despite the limitations of this study, such as the number of interviewees and the scope of case studies (excluding other coastal wetlands not designated as natural parks in the Valencian Community or other Mediterranean regions of Spain like Catalonia or Murcia), we can conclude explaining that:

The governance and public management of coastal wetlands in the Valencian Community have evolved significantly over the past two decades, adapting to contemporary challenges such as environmental sustainability and climate change. This paper has assessed how institutional dynamics, and political changes have shaped the evolution of governance in Valencian coastal wetlands, acting as barriers or enablers across these different dimensions. The study highlighted the importance of continuous dialogue and collaboration among stakeholders to develop sustainable and inclusive governance models that can effectively address the complex interplay of environmental, social, and economic objectives.

Consequently, this cross-dimensional analysis reveals that institutional factors predominantly operate as barriers, particularly those stemming from fragmented governance structures,

regulatory inertia, and limited inter-institutional coordination. By contrast, the technological dimension primarily functions as an enabler, offering tools and infrastructures that facilitate adaptive risk management and innovation. The social dimension presents a more ambivalent profile, containing both barriers and enabling conditions, yet often acts as a mediating force capable of either reinforcing or counterbalancing institutional and technological dynamics depending on levels of social capital and civic engagement. This nuanced configuration is particularly salient as it underscores the pivotal role of institutional innovations in enabling transformative adaptation. Addressing institutional constraints is therefore essential to harness the full potential of technological innovation and to activate the socially embedded capacities required for long-term adaptive transformation.

Future scenarios will be explored and shared in subsequent research. This ongoing investigation will provide deeper insights and contribute to a more comprehensive understanding of coastal wetlands and land-sea governance and its challenges and opportunities.

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ACKNOWLEDGEMENTS

The research leading to this work was conducted in the framework of the Project BlueGreen Governance (2024-2027). The project is co-funded by the European Union (EU) under the Horizon Europe Programme (Project number 101086091) and by UK Research and Innovation (UKRI) under the UK government's Horizon Europe funding guarantee (Project number 10108603). Views and opinions expressed are however those of the author(s) only and do not

necessarily reflect those of the EU or UKRI. Neither the EU nor UKRI can be held responsible for them.

Co-funded by the European Union

UK Research and Innovation

EU-SPRI ECC
International PhDays 2025 Conference
March 5th, 6th & 7th, at the INGENIO (CSIC-UPV) facilities in València

The Evolution of Corporate Science in Europe: Characterizing Publication Patterns and Scientific Novelty

Alejandro Raga Espinosa[1] and Oscar Llopis[1,2]

[1]INN4ALL Research Group, Department of Business Management, University of Valencia and Unit Associated to CSIC-INGENIO, Spain

[2]Unit for Innovation and Entrepreneurship, Department of Economy and Society, U-GOT KIES Center, School of Business, Economics and Law, University of Gothenburg, Göteborg, Sweden

Short bio: Alejandro Raga is a PhD student at the university of Valencia's department of Business Management, Spain. His research interest focusses on innovation studies, corporate science, economics of science, macrosimulation modeling and macroeconomics

Oscar Llopis is Associate Professor at the University of Valencia, Spain, and Research Fellow at UGOT-KIES, University of Gothenburg. He holds a PhD from the University of Valencia and INGENIO (CSIC-UPV). His research focuses on innovation management, knowledge networks, academic engagement, science-society interactions, and citizen science.

How to cite: Raga Espinosa, Alejandro; Llopis, Oscar (2025). The evolution of Corporate Science in Europe: Characterizing Publication Patterns and Scientific Novelty. In *Proceedings of the 6th International PhDays Conference* (pp. 181-197). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19729

Abstract: Corporate Science (CS)—the study of how firms conduct scientific research—has been a growing field of research. Nonetheless, there still persist a significant bias in terms of geographical area, with most studies centering on the U.S. scientific- Industrial complex (Rotolo et al., 2022). Furthermore, there has been little research on the characteristics of the publications themselves, beyond classical citation-based metrics. With our study we aim to first, reduce the geographical gap by characterizing and establishing a set of stylized facts on the evolution and current state of CS in 27 European Union member states, and second, we obtain empirical evidence on the degree of novelty displayed by these publications. In order to achieve this, we build a comprehensive dataset of publishing European corporations and match it with their corresponding publications, which we latter enrich with patent and bibliometrics data. We aim to contribute to the growing literature of

Corporate Science research by providing evidence of whether the apparent decline is a U.S. only phenomenon or a global trend (Arora et al., 2018; Simeth and Raffo, 2013), and discern how European industrial researchers contribute to the scientific community in terms of novelty.

Keywords: Corporate Science; Innovation; Novelty; European Union; Publication patterns

INTRODUCTION

Corporate Science can be defined as the phenomenon of private, for-profit firms engaging in scientific publication. Existing studies in the field have approached the phenomena from three distinct perspectives. First, descriptive studies focused on characterizing and establishing stylized facts about corporate science and publishing activity (Arora et al., 2018), for instance, the discovery of the decline of corp orate research at US based firms. A second stream examines corporate and organizational aspects behind scientific publishing (Rotolo et al., 2022) for example the finding s on how firms publish to alter previous art to gain advantages in patent races. Finally, a third stream centers on the consequences of corporate publishing (Arora et al., 2018; Sheer, 2022), for example, we now that publishing increases the firm value on financial markets. Research in this field is mostly quantitative, and often focused on US-based firms within few specific (Rotolo et al., 2022).

Overall, existing research has provided valuable empirical evidence on the economic and organizational benefits and challenges of corporate science. However, two critical aspects remain understudied. First, there is limited research on the nature of the scientific output produced by firms and its potential technological impact. While some prior work has examined the scientific impact of corporate articles (Sheer, 2022; Simeth and Cincera, 2016), they rely primarily on citation or journal-based metrics, such as total citations or journal impact factor. Other dimensions of corporate science, such as its degree of novelty or disruption (Uzzi et al., 2013; Wang et al., 2017), remain largely unexplored. Second, there is a notable lack of studies focused on non-US contexts, which neglects important regional specificities. In particular, the scarcity of empirical research on CS in Europe is unfortunate, as it could provide important insights into the dynamics behind the "European Paradox" - the observed gap between Europe's strong scientific output and its comparatively weaker industrial innovation performance.

Based on the above, this study addresses the following research questions:

- What are the key stylized facts about corporate science in Europe?
- What is the degree of scientific novelty and disruptiveness of corporate science produced in Europe?

To answer these questions, we will combine different datasets. First, we will compile a pool of articles published by European companies using OpenAlex, a free-access

scientific repository. Second, we will augment the corporate-level information with Orbis, which provides harmonized financial and ownership information, at the firm level. This will allow us to conduct an extensive parametric analysis, thus contributing to answering the first research question previously defined. Third, we will follow existing studies compute several novelty (Uzzi et al., 2013; Wang et al., 2017) and scientific disruption (Park et al., 2023; Wu et al., 2019) indicators, thus allowing us to observe the degree of novelty and disruption of corporate publications as compared to articles published by traditional academic institutions.

This study aims to advance our understanding of corporate science in three ways. First, by developing and analyzing an extensive dataset of European corporate publications, thus addressing a geographical gap in the field of CS (Rotolo et al., 2022). Second, we move beyond traditional citation-based metrics to assess the novelty and disruption of corporate scientific output. Finally, we aim to provide systematic evidence on how industrial scientists contribute to the broader scientific community in terms of scientific output.

The remainder of this paper is structured as follows. Section 2 provides the theoretical background, examining the phenomenon of CS, its antecedents and consequences, and exploring its impact beyond corporate boundaries through the lens of scientific novelty and disruption. Section 3 describes our data collection methodology and the integration of multiple specialized databases to create a comprehensive dataset of European corporate publications. Section 4 presents our (very) preliminary findings on the landscape of CS in Europe, with particular focus on publication patterns of top performing firms. Finally, Section 5 discusses our preliminary conclusions and outlines next steps for expanding the analysis beyond top performers to characterize the broader population of publishing firms in Europe.

THEORETICAL BACKGROUND

THE PHENOMENON OF CORPORATE SCIENCE

What is CS?

Scientific research serves two fundamental purposes: it advances our understanding of the world while enabling technological progress that drives economic growth (Rosenberg, 1974; Nelson, 2000). However, science's defining characteristic as a public good —being both non-rival in consumption and difficult to exclude others from using —, creates a theoretical puzzle (Nelson, 1959; Arrow, 1962; Stephan, 1996; Stiglitz, 1999): why would profit- seeking firms invest in producing knowledge that they cannot fully appropriate? Yet, a substantial portion of scientific output originates not from public research institutions such as universities or public research labs, but from private corporations Hicks (1995); Tijssen (2004).

Corporate science (hereafter CS) encompasses scientific research conducted and publicly disclosed by private firms through peer-reviewed publications, in

contrast to other R&D outcomes such as patents or trade secrets (Bush, 1945), that often use scientific research as an input. This apparent paradox between the public nature of scientific knowledge and its private production has attracted scholarly attention across multiple research domains.

The theoretical foundations of CS research can be traced to Schumpeter's seminal distinction between innovation and invention. This distinction highlighted how firms' R&D activities encompass multiple functions requiring different skills and capabilities, thus implying that some firms can gain competitive advantage through their innovative activ- ities. This idea boosted significant interest in the early 90s, examining the characteristics of firms' in-house scientific research (Gambardella, 1992; Hicks et al., 1994; Rappa and Debackere, 1992), with Hicks (1995) setting the groundwork to establish corporate science as a distinctive field of research.

CS research expanded significantly in the early 2000 (Rotolo et al., 2022), evolving into three distinct perspectives, distributed across a large array of disciplines. The first stream adopts a descriptive approach, characterizing the landscape of CS through three main lenses: i) documenting historical patterns and trends in CS output (Hicks et al., 1994; Tijssen, 2004; Arora et al., 2018), ii) analyzing university - industry intereactions (Hicks et al., 1996), and iii) examining how CS influences subsequent research and other R&D activities (Spencer, 2001; Tijssen and Van Leeuwen, 2006). A second stream of literature examines how scientific publishing affects firm performance. These studies doc- ument positive links between scientific publication and multiple performance dimensions such as firms' absorptive capacity (Cockburn and Henderson, 1998), innovation performance (Sheer, 2022), or stock market value (Simeth and Raffo, 2013). These findings help to explain firms' incentives to publish despite the appropriability challenges. The third stream examines the organizational dynamics of corporate scientific disclosure. This research mainly analyzes the organizational factors that influence firms' propensity to publish research, such as the development of certain capabilities (Simeth and Lhuillery, 2015), as well as the tensions arising between open science norms and commercial imperatives (Stephan, 1996; Partha and David, 1994). Overall, this stream helps to understand how firms can "learn" to publish and develop certain capabilities and skills to cope with the inherent apropriability challenges of CS.

Antecedents and consequences of corporate science

As previously introduced, firms' engagement in corporate publishing exhibit substantial heterogeneity, driven by differences in both capabilities and strategic choices. Publishing scientific research requires specific organizational capabilities (Simeth and Lhuillery, 2015) that not all firms can or choose to develop. Even if firms have the capabilities to perform basic research, they face strategic trade-offs between investing in scientific publication and allocating resources to other business-related priorities. To examine this variation in CS engagement, this section briefly

reviews three key aspects: first, the motivations driving firms to publish; second, how industry and firm-level characteristics shape disclosure decisions; and third, the benefits firms derive from scientific publication. Table 1 offers a summary of the below discussed findings.

Incentives for CS

There is a wide range of incentives for firms to engage in scientific research production. From an economic perspective Hicks (1995) argues that firms mainly engage in long term research in order to guide their applied research trajectories. This position, aligned with a knowledge-based view of the firm (Grant, 2006), recognizes the development of scientific research as an important avenue for firms to develop internal capabilities that can be also used to enhance other downstream activities (e.g. new product development). According to this view, corporate publishing can be viewed as an important input that shapes firms' technological trajectory and innovation capabilities, rather than an end in itself.

A second incentive to publish is more strategic in its nature. Godin (1996) suggests that firms leverage scientific publications to signal product quality and technological sophistication to stakeholders. Relatedly, Arora et al. (2021) show how firms strategically use peer-reviewed publications to establish legitimacy for the claims they make about their products or services.

Human capital acquisition and retention represents a third critical motivation for CS. As pointed out by Stephan (1996), researchers posses key capabilities that might be otherwise extremely difficult to find on the open market. Allowing corporate scientists to openly publish their findings serves as a tool to attract and retain them. This theoretical argument finds empirical support in Stern (2004) claim that scientists accept lower wages ("publication premium") when firms allow them to publish. This effect is particularly prominent for young researchers, where publication opportunities are important to develop scientific reputation, social capital, and to keep an option to return to academia (Simeth and Lhuillery, 2015).

Finally, another motivation involves using scientific publication to attract investor attention and signal firm value (Baruffaldi et al., 2024). Often, firms need to gather investors attention. In that case, scientific publications can be a useful a tool for disclosure, specially if the firm is subject to financial constrains, lower investor demand and has low proprietary costs.

More so, not all firms are equally positioned to engage in scientific research. First, not all industries are equally intensive in the use of science. At the industry level, sectors differ in their use of scientific knowledge. The intensity of knowledge spillovers (Arora et al., 2021) or the ease of legal appropriation (Simeth and Raffo, 2013) can be effective indicators of sector differences regarding the strategic importance of CS. Some areas are heavily subjected to regulatory oversight over its products, such as pharma or chemical industries, where performing scientific research it is not just a way of acquiring insights, but a necessary step

towards full commercial approval (Rafols et al., 2014).

At the firm level, specific investments might be needed to develop disclosure capabilities which, once acquired, can be employed to participate in the research community around it (Simeth and Lhuillery, 2015). These investments are implemented through specific disclosure strategies involving allocation of resources within the R&D department of the company, which can generate extra costs and conflicts by spurring rivalrous contest for resources between the different phases of research (Cockburn et al., 1999). Other factors such as firm size, foothold on the market, age and other within-firm specifications also influence the willingness to incur in these costs (Hicks, 1995)

Outcomes of CS

So, if engaging in CS can be so troublesome, and firms still do it, it might be due to the fact that they are obtaining benefits out of the practice that outweigh the potential costs, resulting in a positive return on investment (Arora et al., 2018). First off, internal science can be useful for improving inventions down the line. As stated by Deng et al. (1999) there is a positive correlation between the level of scientific intensity a company uses on its patents and market valuation. Furthermore, the integration between basic and applied research/invention within the firm considerably improves the quality of its patents, as measured by forward citations and, as stated by Sheer (2022) under the right combination of integration and specialization firms can draw upon their own internal re- search to improve their own inventions. Arora et al. (2021) also establishes that companies

get benefits from the use of science on their own downstream developments, but with the caveat that this benefit might be outweighed by increased spillovers to rival companies.

In order to leverage scientific findings on their downstream inventions, firms firstly need to understand its value. Conducting in-house scientific research not only helps through its own output alone, but also enhances firms' absorptive capacity (Hicks, 1995; Cockburn et al., 1999). This allows firms, through learning-by-doing, to understand scientific language, rules and customs, improving its ability to select relevant research and apply it more effectively (Cockburn and Henderson, 1998).

Companies can also benefit from engaging in CS through their ability to access external knowledge sources. By building ties with other research actors relevant to the firm through the scientific community, firms gains access to otherwise obscure or hidden information (Cockburn and Henderson, 1998), opportunities for collaboration with other researchers, and more novel knowledge Stern (2004).

Furthermore, corporations can use their own ability to disclose information to affect the behavior of other firms. Through strategic disclosure, the firm can modify the outcome of patent races through the modification of prior art (Rotolo et al., 2022),

although this strategy seems rather uncommon, at least on its own, and more usually used in conjunction with other IP strategies (Malva and Hussinger, 2012).

Another advantage firms might get from of their publication portfolio is higher valuation on financial markets. Simeth and Cincera (2015) performs an empirical analysis of US R&D performing firms by matching Compustat with patent and publication data, and they find a positive correlation between the publication stock of a company and market value even after controlling for characteristics of the patent stock (such as quantity or quality). Arora et al. (2018) gets similar results, although in their analysis the marginal market premium of each article declined over time severely, specially for high quality publications (as measured by weighted citations indexes).

Finally, firms are able to gain status and reputation through the prestige of publication. By going through the rigorous process of peer review, corporate scientific output is subjected to a high level of scrutiny, that once accepted, can be displayed as a symbol of past accomplishments, excellence, and leveraged to gain trust. This reputation gains can later be used through branding and advertising to support commercialization strategies, as mentioned before.

Is there a decline in CS?

In short, these three research streams have significantly advanced our understanding of CS. We now have detailed insights into how firms organize their research activities to maximize their ROIs (Sheer, 2022), and how they develop specialized capabilities for scientific disclosure (Simeth and Lhuillery, 2015). However, a central debate has recently emerged regarding current trends in CS activity. While early research documented increasing corporate publication rates (Halperin and Chakrabarti, 1987; Godin, 1996), more recent studies present different evidence about the trajectory of corporate scientific activity (Rotolo et al., 2022). Notably, Arora et al. (2018) empirically documents a sys- tematic decrease in scientific publication by US publicly traded companies between 1980 and 2016. While earlier studies had already suggested a similar declining trend (Tijssen, 2004), Arora et al. (2018) provides very comprehensive evidence about this. Their study reveal that this decline is based on two factors: a decreasing market premium for inter- nal scientific capabilities (reflected in both stock market valuations and M&A pricing), and firms' growing preference for accessing scientific knowledge through external chan- nels rather than internal production (Rafols et al., 2014). This shift suggest a profound transformation in how firms value and perform scientific research. In this respect, Arora et al. (2021) analyzes the tension between private benefits and knowledge spillovers in corporate science. Their research evidences an important trade-off: while firms obtain significant value from applying scientific knowledge to their downstream inventions, they also face increased costs when their research spills over to competitors. This spillover risk has intensified over time, thus partially explaining the observed decline in CS.

However, the claim of a decline in CS has been contested. Some studies examining different geographical and sectoral contexts present contrasting evidence that overlaps with Arora et al. (2018) period of analysis. For instance, Archambault and Larivière (2011) document increased scientific publication among Canadian industrial firms between 1980 and 2005. Similarly, Pellens and Della Malva (2018) find CS publication growth in the semiconductor industry, and Simeth and Raffo (2013) find growing CS activity among French firms across multiple sectors, with declines limited to specific industries such as pharmaceuticals and office machinery.

These conflicting findings may be due to important methodological limitations in CS research. Mainly, Rotolo et al. (2022) reveal a significant geographical bias in existing studies: 72% focus on single countries, predominantly the US, UK, and Japan. In fact, some of the most influential findings, like those made by Hicks (1995) in its seminal study, or Arora et al. (2018) hallmark research on the apparent decline of CS are exclusively observed with US data. Similarly, sectoral coverage is often narrow, with 68% of studies examining specific industries. As Camerani et al. (2023), making cross-study comparisons are very difficult due to varying approaches and coverage. Moreover, most research tend to over-represent science-intensive industries. Therefore, there is a need to develop broader and wider studies that can better capture the geographical and sector specificities related to a potential decline of CS.

Given the above, studying another region comparable in size, population and level of economic development but with its own idiosyncrasies has the potential of not only shedding light upon the field of CS research itself, but also to explain major differences in their respective innovation systems. In this respect, understanding CS in Europe is particularly crucial given the so-called "European Paradox", a persistent gap between Europe's scientific capabilities and its technological output (Dosi et al., 2006). This paradox manifests in the significant disparity between European and U.S. patent filings, despite comparable levels of scientific research output in both regions. Evidence suggests that corporate science plays a critical role in bridging scientific research and technological innovation: Sheer (2022) shows that sustained investment in CS enhances both the quality and quantity of firms' patent portfolios. Thus, differences in how European firms approach and invest in scientific research may also help to explain this paradox.

IMPACT OF CS BEYOND CORPORATE BOUNDARIES

While research on CS has extensively focused on its firm-level antecedents and benefits (see section *Antecedents and consequences of corporate science*), our understanding of how CS shapes the broader scientific and tech- nological landscape remains limited. This gap is important, given the emerging evidence that CS outputs are different from "traditional" science outputs (namely, science pro- duced from traditional institutions such as

universities). For instance, Arora et al. (2018) suggest that the decline in corporate science has been led by a reduction in high-impact publications, as measured by citation weights. However, relying solely on citation-based metrics to assess scientific impact has well-documented limitations (Wang et al., 2017). Citations capture only one dimension of scientific impact and may miss other crucial aspects such as novelty, or and paradigm-shifting potential. Given this, we suggest to explicitly explore whether there is a distinctive impact of corporate publications, not only in terms of "traditional" indicators (e.g. citations), but also in their potential to generate novel scientific contributions and scientific disruptions.

Beyond scientific impact: Novelty and Disruption

Scientific novelty and scientific disruption are two interrelated yet distinct concepts that play crucial roles in the advancement of scientific knowledge. Novelty refers to the intro- duction of new ideas, methods, or findings that significantly differ from existing paradigms or norms (Leahey et al., 2023; Uzzi et al., 2013). For instance Uzzi et al. (2013) concep- tualize novelty based on infrequent combinations of journal reference pairs, showing how unconventional knowledge combinations often lead to high-impact research. Research characterized by high novelty is more likely to achieve direct technological impact and influence subsequent scientific inquiries (Veugelers and Wang, 2019).

In contrast, disruption entails a deeper transformation that changes the foundational structures of scientific disciplines or practices (Leahey et al., 2023; Park et al., 2023; Wu et al., 2019). While novel research adds new elements to existing knowledge structures, dis- ruptive research fundamentally challenges or replaces existing scientific paradigms. This distinction is important: a paper can be novel without being disruptive (by introducing new combinations of existing knowledge) or disruptive without being novel (by challenging established theories with conventional methods).

Given this distinction, we suggest examining whether scientific knowledge produced by private firms (CS), might be related to the production of novel and/or disruptive science outputs.

Corporate Science, novelty and disruption

Research has shown that the dynamics of scientific teams play a crucial role in fostering both novelty and disruption, but the relationship is not clear. On the one hand, some studies report positive relationship between larger and / or more diverse teams and scien- tific novelty. For instance, (Lee et al., 2015) found that team size has inverted-U relation with novelty, as larger teams can bring in greater knowledge variety. Carayol et al. (2019) also found positive an effect of team size on scientific novelty.

However, other evidence suggest that certain forms of collaboration inhibit novel scientific contributions. Wagner et al. (2019)

found that international collaboration tends to produce conventional rather than novel or atypical research. While diverse teams can bring more perspectives to the production of science, authors argue that these potential benefits are suppressed by transaction costs and collaboration barriers among co-authors from diverse geographical and institutional origins. Supporting this view, Shin et al. (2022) confirm a negative effect of collaboration on novelty. The authors argue that while smaller groups often explore unconventional research paths, larger teams tend to build incrementally on established successes using more conventional research designs.

Given the above, our objective is to shed light on the relationship between corporate science, novelty and disruptiveness. Corporate research teams operate in distinct organizational contexts with hierarchies, more standardized processes, and commercial imperatives. They also work under a completely different institutional setting, as compared to academic scientists. It is therefore an open question whether the distinctive institutional and organizational aspects of CS will enhance or constraint the production of highly novel or disruptive science. On the positive side, CS settings may be closer to practical applications, which may enable corporate scientists to address unique knowledge combinations between basic science and technological problems. It may also be that corporate labs have greater resources and infrastructure to enable more disruptive research. On the negative side, the pressure to generate commercially relevant results might lead firms to pursue incremental advances over more uncertain and riskier paths. Given that novel science is more uncertain in its impact and acceptance (Trapido, 2015; Wang et al., 2017), it might be that firms' corporate structures discourage the pursue of riskier research paths.

DATA

Our study builds upon the database framework introduced by Arora et al. (2018), extending it with enhanced granularity by incorporating all European publishing firms, regardless of their size or stock market status. As illustrated in Figure 1, our data collection and integration process combines multiple specialized databases to create a comprehensive dataset of firm-level scientific activities.

DATA SOURCES AND COLLECTION PROCESS

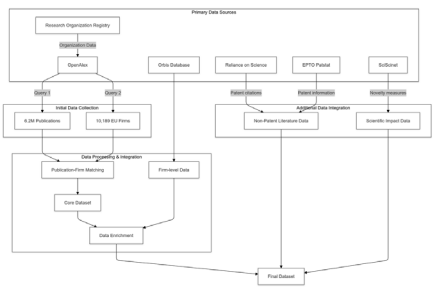
The foundation of our database, as shown in the top section of Figure 1, rests on three pri- mary data sources. The core component is OpenAlex (Priem et al., 2022), which sources its institutional data from the Research Organization Registry (ROR). ROR serves as a community-led registry providing persistent identifiers to research organizations, offering several advantages over traditional identification systems. Since its inception in 2019, ROR has facilitated bibliometric data organization across governments, research institu- tions, and platforms like CrossRef through a rigorous curation process. The registry's open-

access nature ensures regular monthly updates and thorough review of organizational changes.

Our data collection process began with two parallel queries in OpenAlex. The first query extracts 6.2 million publications with firm-affiliated authors. The second query identifies our population of interest: 10,189 EU-based firms based in EU member states. These firms are identified through ROR's geographical and institutional metadata. This approach allows us to distinguish between native EU companies and subsidiaries of foreign firms through ROR's parent-child organizational relationships. Overall, this population represents all research organizations based in EU member states that are classified as companies and have produced at least one scientific publication during their existence. This broad population is crucial for developing a comprehensive understanding of Euro- pean corporate science, addressing the geographical gap in existing literature that has primarily focused on US firms.

DATA INTEGRATION AND ENRICHMENT

Figure 1: Data collection process and dataset integration



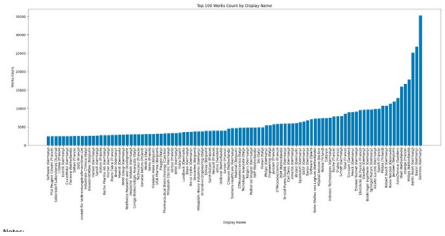
The data processing and integration phase (as displayed in the lower left section of Figure 1), involves matching publications with their corresponding firms using ROR identifiers. This matching process creates our core dataset, which we then enrich with firm-level data from Orbis, including crucial variables such as R&D expenditure, number of employees and so forth. This matching process with Orbis is particularly important, as it allows us to characterize our population of 10,189 firms along multiple dimensions, including size, age or industry classification. The integration of Orbis data is essential for our first research objective of establishing key stylized facts about European corporate science, as it enables us to analyze how firm characteristics influence scientific output and to identify patterns across different industry-level and firm-level characteristics.

Our integration strategy incorporates additional data through three main sources. We merge non-patent literature (NPL) data from the Reliance on Science database (ROS) (Marx and Fuegi, 2020) with patent information from the EPTO Patstat dataset. This combination provides a comprehensive view of how scientific publications influence techno- logical development, which will help us to examine the technological impact of EU-based CS, thus contributing to shed light to our analysis of the "European Paradox". To address the question of novelty and disruption of EU-based CS, we incorporate novelty measures at the article level from SciScinet (Lin et al., 2023). This integration aims to assess the novelty and disruption of EU-based CS beyond traditional citation-based metrics.

PRELIMINARY FINDINGS

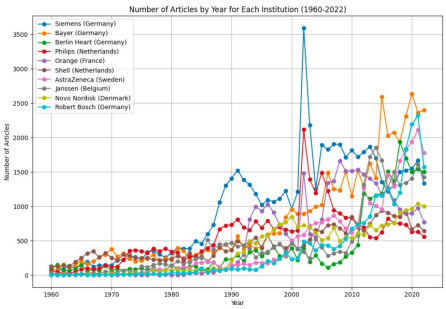
From previous literature, we have reasons to expect that the evolution and prevalence of CS at EU member states will have substantial differences with respect to the US scientific- industrial complex. Camerani et al. (2023) recently found a positive growth of CS on a worldwide dataset comprised of 2500 firms drawn from the 2014 EU Industrial R&D Scoreboard, which suggest that the decline of CS suggested by (Arora et al., 2018) might be regional rather than global. Furthermore, some suggested hypotheses to explain the difference in number of filed patents between the US and Europe argue that European firms rely less on scientific discovery as compared to their US counterparts, thus hindering their ability to develop innovations (Dosi et al., 2006). If this is the case, we could also expect lower intensity of scientific research in European corporations in comparison to US firms, given that they undervalue science on their R&D functions. Dosi et al. (2006) also points out that the capability of European firms to absorb and use scientific knowledge is lower than their US counterparts, which might also be reflected in the amount of scientific output they produce.

Figure 2: Top 100 companies performing CS in Europe



The number of firms identified through our query for EU member states differs significantly from a similar search performed only for the US, with a difference of around a 10% increase in publishing firms at the EU (around a thousand more publishing firms with respect to the US). In Figure 2 we present results for the top 100 most active European companies, based on the overall publication output. Overall, the top performer in terms of publication is Siemens, followed by Bayer, Berlin Heart and Philips, with a sharp decline in publication count after them. Some of them, like ExxonMobil (Germany) and General Motors (Poland) and more notably Janssen (Which was acquired by Johnson & Johnson in 1961) are subsidiaries of foreign firms, but results are consistent with the findings of Csomós and Tóth (2016) of high concentration of intellectual property on corporate headquarters.

Figure 3: Evolution of Top 10 CS performers in Europe



In Figure 3, we present the evolution of the top 10 performers in terms of publication counts in Europe from 1960 to 2022. Figure 3 shows a sharp increase in number of publications from 1985 onwards on most top performers, in contrast with the findings of Arts and Fleming (2018). This upwards trend is not uniform across the decades, with some firms like Siemens and Philips

peaking at the mid 2000s and then declining, and other firms such as Bayer, Bosch and Berlin Heart showing a more steady increase in their publication counts. This last company is of special note given is impressively long history of scientific output dating back to the 1700s, due to its heritage as a medical research center before becoming a turning in to a for-profit firm in the early 2000s. By sector, most of these top performers belong to industrial engineering and biotechnology, while Orange belongs to the IT sector and Shell to energy and petrochemicals.

PRELIMINARY CONCLUSIONS

Our early findings suggest that the landscape of corporate science in Europe is distinct from the US, with a higher number of publishing firms and different composition of top performers as those shown in Arora et al. (2018) and followup studies. Although our data is still in a very early stage, we find further reasons supporting a deeper analysis of the history and evolution of CS in Europe as a distinctive phenomena as compared to the US, given these differences and the potential wider implications for the European innovation system outlined in section 2.1.2. Our next steps will involve a more detailed analysis of the data, including the characterization of the firms in terms of size, age, industry and other relevant indicators, as well as expanding the analysis from only top performers to the whole dataset.

With respect to scientific impact, there has been no attempt to characterize the level of novelty and disruption of corporate publications, as compared to traditional science production. Prior studies suggest that firms are no strangers to publishing in high im- pact journals (Arora et al., 2021, 2018; Sheer, 2022), particularly those working at big centralized industrial labs. In some instances or sectors corporations have higher cita- tion impacts than universities and other public sector research entities, like biotechnology (Hicks et al., 1994; Hicks, 1995). However, the degree of novelty and disruption of such corporate produced publications remains an open question.

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March 5th, 6th & 7th, at the INGENIO (CSIC-UPV) facilities in València

Open Innovation Approaches in Corporate Innovation hubs: exploratory analysis

Nicole Ciocia

University of Modena and Reggio Emilia, , nicole.ciocia@unimore.it

Short bio: Nicole Ciocia is a PhD candidate at the University of Modena and Reggio Emilia, specializing in the field of Management and an Innovation Manager at Krones Innovation Hub. Her research focuses on Open Innovation and Innovation Hubs, with a particular emphasis on the corporate innovation hubs (CIHs). In her research, Nicole explores the role of inter-organizational collaborations, knowledge sharing, and different approaches of open innovation adopted by different hubs. By studying the dynamics of innovation networks, she aims to provide insights into how firms can leverage external and internal resources to adapt to fast-changing market environments. Her academic interests also include the strategic management of innovation and the impact of collaborative networks on corporate growth and competitiveness.

How to cite: Ciocia, Nicole (2025). Open Innovation Approaches in Corporate Innovation hubs: exploratory analysis. In *Proceedings of the 6th International PhDays* Conference (pp. 198-213). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19581

Abstract

The study investigates the emergence and characteristics of Corporate Innovation Hubs (CIHs) in Italy. Despite their growing prevalence and importance in driving innovation, significant gaps remain in the literature regarding their distinctive features, operational dynamics, and impacts. Anchored in the Open Innovation (OI) framework—which emphasizes collaboration and knowledge exchange—this pilot studies these gaps by analyzing selected Italian CIHs through a mixed-methods approach.

The research included a desk analysis to map Italian CIHs and three semi-structured interviews to explore their structures, activities, and challenges. The findings reveal that there is no single, universal approach to adopting OI. Instead, companies leverage CIHs in diverse ways, with varying strategies and objectives, positioning these hubs as flexible catalysts for innovation tailored to their specific needs.

Keywords: Corporate Innovation Hub; Open Innovation; Knowledge Transfer; Innovation Approach; Network.

INTRODUCTION

The continuous evolution of the global market, the increasing complexity of technological, economic, and social challenges, the globalization of markets, the shortening of product life cycles, and the convergence of technologies have created the need to shift managerial and innovation paradigms (Di Minin & Ferrigno, 2020). In this context, the concept of Open Innovation (OI) was introduced by Chesbrough in the early 2000s, challenging traditional innovation approaches based on Schumpeterian models. OI promotes innovation through collaboration with external actors, moving beyond the notion that companies must maintain tight internal control over innovation processes to preserve their competitive advantage (Elmquist, Fredberg, & Ollila, 2009). At the core of OI lies the creation of ecosystems or networks through which organizations can share knowledge, facilitating knowledge flows to accelerate innovation and advance technological capabilities (Chesbrough, 2003). One of the most significant structures that has gained prominence in the Italian industrial landscape in recent years is the innovation hub, a concept with varied definitions in the literature. For some, innovation hubs are primarily physical spaces where diverse actors collaborate, often compared to co-working offices (Littlewood & Kiyumbu, 2018). For others, the emphasis shifts away from the physical space to highlight the importance of networks, know-how flows, and skills in the context of OI (Siebert et al., 2019). Others, in literature, describe the innovation hub as a mechanism employed by corporations to promote the creation of new ideas and innovative products (Youtie & Shapira, 2008; Magnusson, 2009; Chesbrough, 2011). This is achieved by leveraging the contributions of various stakeholders, including employees, suppliers, partners, and customers, who are actively involved in the innovation process (Longo & Giaccone, 2017).

These different perspectives underscore the lack of extensive literature supporting a comprehensive study of this phenomenon. In particular, there is a dearth of detailed studies profiling Corporate Innovation Hubs (CIHs)—innovation hubs promoted and managed by private companies and used to support innovation. Addressing these gaps, scholars like Mohan and Chinchwadkar (2022) in their paper, *"Technology Business Incubation: A Literature Review and Gaps,"* have noted that the limited understanding of CIHs stems from a predominant focus on Digital Innovation Hubs and other technological incubation models.

This research aims to conduct a preliminary exploratory analysis of real-world CIH cases, following an initial mapping of the innovation hubs currently present in Italy.

With this objective as the focus, the study aimed to investigate the goals and intervention areas of CIHs within the framework of an Open Innovation (OI) approach, adhering to its principles and paradigms. In particular, the research sought to examine the objectives, intervention domains, and implementation strategies of Open Innovation within the corporate context of CIHs.

The remainder of this paper is structured as follows: Section 2 introduces the theoretical background on OI and CIHs. Section 3 describes the methodology used for the analysis, followed by the presentation and discussion of results in Section 4. Section 5 concludes the paper, outlining implications and potential directions for future research.

THEORETICAL BACKGROUND

OPEN INNOVATION

Over the years, the management of innovation by large corporations has undergone significant evolution, marked by the adoption of various strategic approaches. These changes reflect companies' adaptation to the new challenges of the global market and the growing complexity of technological, economic, and social challenges. Twenty years ago, it became evident that the challenge to overcome was no longer simply innovation itself but finding a way to innovate the process of innovation: the concept of *"Innovating Innovation"* (Chesbrough, 2003). In fact, it was within this context that a paradigm shift occurred in the early 2000s. The innovative approach used up to that point was defined by Chesbrough (2003) as Closed Innovation—a model based on the belief that companies should maintain internal control over innovation processes to preserve their competitive advantage (Elmquist, Fredberg, & Ollila, 2009). However, this model showed significant limitations, particularly as companies began to understand, through the influence of *"erosion factors"*—such as the increasing number of highly skilled individuals, the accelerated pace of innovation demanded by the market, and the emergence of new financial structures like venture capital that commercialized research and helped smaller, innovative firms to grow—that maintaining competitiveness and quickly responding to market changes required abandoning isolation and embracing new forms of collaboration (Chesbrough, 2003). It is precisely in this context that the concept of Open Innovation (OI) emerged—an innovative paradigm based on companies leveraging both internal and external ideas to accelerate innovation and advance their technological capabilities. According to this new model, innovative projects can be developed either inside or outside the company, and innovative ideas can flow into the company's pipeline at any stage of the process, as illustrated in Figure 1 (Chesbrough, 2003).

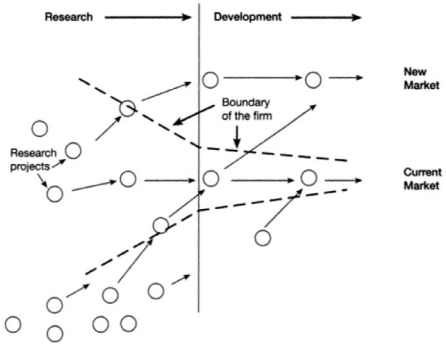

Fig. 1 *The Innovation Process Underlying Open Innovation*. Source: Chesbrough (2003)

With the advent of this new paradigm, a significant transformation occurs in corporate organization and its boundaries,

which, while impenetrable in Closed Innovation, are now semi-permeable, allowing innovation to flow more freely between the external environment and internal research and development departments (Elmquist, Fredberg, & Ollila, 2009). Specifically, the core of Open Innovation lies in the generation of new knowledge and, most importantly, in the ability to create systems and architectures that integrate existing knowledge fragments to address practical problems (Bogers et al., 2019). This competence in "system integration" or architecture design plays a crucial role in the context of Open Innovation (Chesbrough, 2006), as it is through the creation of an open innovation ecosystem that value is generated. In Open Innovation, the real value lies in the presence of a network that allows companies to access a vast pool of external resources, including knowledge, assets, and skills (Bogers, Sims, & West, 2019). In contrast, the Closed Innovation model emphasizes the necessity of keeping processes entirely internal and controlled by the company to ensure a competitive advantage (Elmquist, Fredberg, & Ollila, 2009). However, in practice, there is no sharp division between Open and Closed Innovation. Instead, there are various matrices comprising different forms of innovation with varying degrees of openness (Huizingh, 2011; Bogers et al., 2019). This divergence from the theoretical model is partly due to the varied use of terminology associated with Open Innovation (Chesbrough, & Bogers, 2014). In the literature, a taxonomy is applied to Open Innovation, mainly categorizing its modes into: *"Technology-oriented OI"*, focusing on knowledge and technological innovation as the ultimate goals; *"Market-oriented OI"*, primarily centered on knowledge and meeting the actual needs of the market; *"Organizational-oriented OI"*, which involves radical organizational changes, such as the creation of spin-offs (Ahn, Minshall, & Mortara, 2015). Moreover, in discussing Open Innovation, the term "open" is often used in the literature as a synonym for "user-centered." Thus, Open Innovation is defined as a paradigm of innovation, referred to as "open source innovation," in which end-users also participate in the innovation network (Von Hippel, 2006). Similarly, the term "open source model" describes an innovative approach where multiple actors collaborate on a single project, investing private resources for the creation of a public good (Raasch et al., 2009).

INNOVATION HUBS

Innovation today is no longer confined to the research and development (R&D) departments of companies; it has become a phenomenon involving a wide network of actors, including universities, public institutions, startups, and citizens. This concept is well represented in the triple and quadruple helix models, which expand the traditional understanding of innovation by including, respectively: universities and other knowledge-producing institutions, industry—including high-tech startups and multinational corporations, government at various levels (Etzkowitz, 2002), and, in the quadruple helix, civil society (Carayannis & Campbell, 2009). The helix in these models symbolizes the mechanism that drives the

process, namely, knowledge transfer (Scaramuzzi, 2012). In this context, Innovation Hubs emerge as key nodes that promote collaboration and knowledge sharing among various stakeholders, functioning as entities that integrate the principles of the triple and quadruple helix. But, at the same time, the innovation hubs are one of the modes used by the firm to adopt the open innovation approaches (Longo & Giaccone, 2017). In the literature, some describe the innovation hub as a mechanism employed by corporations to promote the creation of new ideas and innovative products (Youtie & Shapira, 2008; Magnusson, 2009; Chesbrough, 2011). This is achieved by leveraging the contributions of various stakeholders, including employees, suppliers, partners, and customers, who are actively involved in the innovation process. So, this definition of innovation hub is so correlated with the Open Innovation approach, because the core concept of open innovation is that innovation stakeholders, as innovation hubs, should actively engage with external parties to drive innovation and create new revenue opportunities (Remneland Wikhamn & Styhre, 2023).

To fully understand the role and impact of Innovation Hubs in Open Innovation processes, it is essential to define them. However, the literature offers few and fragmented definitions of Innovation Hubs. The most comprehensive one is provided by Pratt (2021). According to the author, Innovation Hubs can be characterized along three dimensions: first, they are physical spaces, understood as dedicated buildings where various activities are co-located; second, they are flexibly managed spaces, with “easy entry and exit processes”; and third, they are places for knowledge and information exchange. In innovation management literature, the terms "space" and "place" are often used to describe environments that support and facilitate innovation. Both are associated with opportunities for interaction, collaboration, research, and knowledge creation (Haukipuro et al., 2024). Massey (2005), in her book For Space, defines space as an open, living, and continuously evolving entity shaped by social interactions—a concept that aligns perfectly with the idea of an Innovation Hub. Indeed, Innovation Hubs can be viewed as “built-up physical spaces that engender innovations” (Jiménez & Zheng, 2021, p. 164) and, consequently, as forms of co-working office spaces offering various services such as community building, pre-incubation, incubation, and acceleration (Jiménez & Zheng, 2017). In contrast, Siebert et al. (2019) define Innovation Hubs as a combination of physical and digital workspaces and tools where various ecosystem members interact with the goal of learning and producing innovation. While there are differing perspectives on the exact nature of these spaces, with some viewing them as hubs of physical interaction and others as nodes in a virtual network, both approaches agree on the crucial importance of creating environments that foster innovation. While the term "innovation" in "innovation hub" is clearly the focal point around which these concepts revolve, there is less consensus on what is meant by "hub" in its spatial dimension—whether it refers to a physical

space or a relational space. Indeed, some argue that innovation hubs are, in fact, innovation labs. This is because the term "lab," more commonly associated with physical and natural sciences, evokes a sense of a safe haven for experimentation and targeted problem-solving (Bloom & Faulkner, 2016). This distinction highlights two complementary approaches to innovation: while hubs operate as centers of connection and sharing, promoting innovation through collaboration among diverse actors, labs focus on experimentation and the development of new ideas in a controlled environment. Both play a critical role in the innovation process but with different objectives and methods. For the purpose of this research, however, the term innovation hub will be adopted, as it better emphasizes key aspects that fully express their importance in the innovation ecosystem. Specifically, the significance of networks and ecosystems of intermediaries is central in this context, as they catalyze the open innovation approach discussed earlier. This innovation model is based on the idea that companies no longer innovate in isolation but collaborate with a network of external partners to develop new ideas and solutions. Consequently, the term "hub" is more appropriate for capturing this dynamic.

According to Toivonen and Friederici (2015), the four fundamental characteristics that define Innovation Hubs are as follows:

Creation of Collaborative Communities

Innovation Hubs consist of groups of individuals and entities that share ideas and resources with the common goal of experimenting and achieving objectives. At the center of these networks are autonomous individuals whose power and influence derive from their status as founders, charisma, recognized expertise, and/or strong network position rather than formal leadership roles. Hubs view individuality, leadership, collaboration, and participation as complementary traits.

Diversity of Members

Hubs attract members with diverse knowledge, fostering "creative collisions" between individuals from different networks and domains. This cognitive diversity encourages the emergence of novel combinations of ideas and practices, leading to unique and actionable innovations.

Facilitation of Creativity in Physical and Digital Spaces

Hubs are typically located in metropolitan areas and feature work environments designed to promote interaction. These spaces often include wooden furniture, large desks, whiteboards, foosball tables, artwork, shared kitchens, coffee bars, meeting rooms, and bean bags. Digital spaces, on the other hand, amplify an Innovation Hub's presence, enabling it to reach a broader audience and strengthen its identity.

Localization of Global Entrepreneurial Culture

Hubs see themselves as part of a global entrepreneurial culture, adapting their core values to the norms and values of their local environment. For instance, in Japan, hubs

must balance innovation and inclusivity with cultural norms that may resist promoting entrepreneurship among younger generations.

Classification of Innovation Hubs: CIHs

Innovation Hubs can be classified based on various criteria, such as organizational structure, type of space, sectoral focus, and services offered. Based on classification by the nature of the space (physical or digital), the type of promoter (private or public), and predominant activity (research and development, startup support, or technology transfer), Corporate Innovation Hubs (CIH) can be defined as physical hubs that act as knowledge mediators and catalysts for ideas, concepts, and technologies (Berger & Brem, 2016; Monteiro & Birkinshaw, 2017). They function as intermediaries between established companies and startups (Crisan et al., 2019).

Specifically, CIHs in the last reports published were described like "corporate units or independent legal entities owned by a corporation (private hubs) that operate autonomously but aim to support innovation within the company by facilitating the development and acquisition of new ideas, technologies, and innovative approaches" (Italian Open Innovation Lookout 2024). So, these are autonomous departments that fully share the corporate's goals and mission. Among the main services offered by Corporate Innovation Hubs are coaching, mentoring, tutoring, co-creation, networking, prototyping, technology and trend scouting, strategic consulting, and applied research. For others, however, CIHs establish and manage ecosystems within large, consolidated groups and conglomerates. Furthermore, they possess the ability to coordinate business resources, allocate them effectively and synchronized, and exploit synergies between various business units within the corporate network (Barcellos, 2023). According to this definition, therefore, CIHs play an extremely important role, but primarily within the corporate group, which reduces their autonomy and strong outward orientation. It can be inferred that there is a lack of clarity in the definitions, which appear to be rather fragmented.

RESEARCH OBJECTIVE AND METHODOLOGY

The analysis of the literature regarding CIHs has highlighted significant issues, including excessive fragmentation of definitions and several gaps regarding distinctive characteristics, modes of interaction with corporate companies, and the impacts generated. The aim of this initial research is to explore the emblematic characteristics of Italian CIHs in the industrial sector and analyze how CIHs apply the OI approach within their context.

Setting this as the ultimate goal of the investigation, this research aimed—within the framework of an OI approach, embracing its assumptions and paradigms—to explore the objectives and areas of intervention of CIHs. Specifically, the research sought to identify the goals, areas of intervention, and implementation choices of Open Innovation

within the context of CIHs in their corporate environment.

Given the exploratory nature of this study, a qualitative methodology was adopted, using various research tools to triangulate the results and achieve the most comprehensive understanding of the topic possible. First, a review of the academic literature on Open Innovation and Innovation Hubs in the industrial context, with a focus on CIHs, was conducted. This review allowed for the identification of the most recurring themes related to Open Innovation and Innovation Hubs, as well as the identification of less explored topics. Scopus was used as the primary database, and by limiting the occurrences to scientific articles and conference papers, a keyword-based search was carried out, utilizing the most correlated keywords to the topics explained in this research. Below is the number of occurrences for each keyword searched.

Table 1. *Number of scientific articles per keyword*

Keyword	Number of articles	Time frame
Ecosystems	371.127	1924-2024
Network management	223.867	1956-2024
Innovation strategy	10.097	1981-2024
Open Innovation	7.213	1985-2024
Innovation ecosystem	3.758	1985-2024
Open business models	1.100	1989-2024
Closed innovation	402	1988-2024
Open innovation ecosystem	375	1997-2024
Managing knowledge	310	1987-2024
innovation hubs	297	2004-20024
Closed open innovation	114	1995-2024
digital innovation hubs	70	2015-2024
corporate innovation hubs	4	2015-2022
Open innovation in Italy	3	2014-2019

Secondly, a desk analysis was conducted, through keywords and by checking the characteristics described - where available- on company websites, to identify how many industrial innovation hubs exist in Italy and, among them, select the sample to interview. In particular, an initial mapping was conducted using the main keywords: innovation hub, innovative hub, and corporate innovation hub. Subsequently, an online search was carried out using secondary sources to identify the companies in Italy that currently invest the most in research and the largest companies by revenue. For each of these companies, their corporate websites were analyzed to verify the presence or absence of an innovation hub. From the resulting mapping, the sample to interview was selected according to the following selection criteria: industrial innovation hubs, connected to a corporate company offering products or services, located in Italy, and applying the Open Innovation approach. The innovation hubs that met the selection criteria and were eligible for the exploratory purpose of the research were actually 10. Four were

contacted, and three responded positively to the request for interview availability. The interviews had an average duration of 40 minutes, were conducted via video call, two in Italian and one with an English-speaking contact, recorded and fully transcribed, and immediately anonymized. For this reason, in the following paragraphs, they will be referred to as Hub 1, Hub 2, and Hub 3, ensuring complete confidentiality. Below are the details of the three interviews.

Table 2. *Conducted Interviews*

	Number of hub employees	Number of corporate employees	Number of R&D employees
H1	3	19k	400
H2	40-50	31k	1000
H3	9	9k	300

In all three cases, semi-structured interviews were conducted, united by the same framework aimed at questioning individuals in managerial roles within the innovation hubs about the research objectives. It is important to specify that all three hubs belong to large corporate companies and also have an internal Research and Development (R&D) department. The interviews were audio-recorded with the consent of the interviewees to allow transcription and analysis of the text. Following the transcription and anonymization of the interviews, a thematic analysis was performed on the entire textual corpus, following the approach of Thematic Analysis (TA) (Clarke, V., & Braun, V., 2013). The results from the analysis are presented in the following paragraph.

KEY FINDINGS

MAPPING OF CIHS

From the desk research conducted, it was possible to identify the main innovation hubs located in Italy or operated by corporations with a presence in the country. Specifically, 28 corporate innovation hubs were identified, including those primarily acting as startup accelerators and incubators, which were not considered in the sample selection for the interviews.

Among these 28 hubs, based on ISTAT's division of Italian regions into northern, central, and southern Italy, 18 hubs (64% of the total) are located in northern Italy. Meanwhile, 25% of the identified hubs are in central Italy, and only one hub is located in southern Italy. Furthermore, the sole hub in southern Italy is part of a network of four innovation hubs from the same corporation, spread across four different cities, thus being part of an already established and organized network by the parent company.

Another finding from the mapping is that CIHs are predominantly adopted by large, well-established companies. Of the 28 hubs, 9% belong to medium-sized enterprises, while the remaining 86% are associated with large corporations. Additionally, 50% of these large companies are publicly traded.

In terms of sectors, the energy industry emerges as the most active in this phenomenon, with the highest number of innovation hubs. All the associated corporations are large and publicly traded companies. The energy sector also leads in the number of Digital Innovation Hubs (DIHs)

in Italy, as confirmed by the European Digital Innovation Hubs Catalogue available on the European Commission's website.

INTERVIEWS ANALYSIS

The analysis of the interviews conducted with the three Innovation hubs revealed significant similarities and differences regarding the topics under investigation. All three hubs were founded in different periods and to address different needs of the parent company. H1 was established only two years ago, in 2022, in response to the parent company's realization that it did not have all the necessary resources to overcome the present and future challenges of the market. H2, founded in 2019, was created with the goal of addressing challenges related to digitalization and digital transformation. H3, founded in 2015, has a different purpose, as it was created by the company to promote consumer-driven innovation, where consumers can actively participate in the innovation process, aiming to address their real needs and avoiding solely following market trends or already acquired technical skills, as the company reports having done in the past. The following table summarizes the key aspects regarding the founding period and the reasons behind the establishment of each of the three interviewed innovation hubs.

Table 3. *Founding period and reasons of the hubs interviewed*

	Founding Period	Reasons
H1	2022	To address the parent company's lack of resources for current and future market challenges
H2	2019	To tackle digitalization and digital transformation challenges
H3	2015	To foster consumer-driven innovation, focusing on real needs rather than market trends or existing skills.

Thus, while H3 has chosen to focus more on consumers to guide innovation based on their needs, the other two innovation hubs have opted to apply an OI approach to address technological and market challenges. It emerges that all three hubs have objectives aligned with the core concepts of OI; however, in the case of H3, this is more specifically directed towards involving a particular stakeholder, the end consumer, while the other two are not as specifically aimed at one type of stakeholder. In fact, in the case of H3, the ultimate goal of the hub aligns with the concept of OI, often found in the literature, as synonymous with "user-centered" innovation. According to this conception, open innovation becomes an innovation paradigm defined as "open source innovation," where the innovation network includes – and primarily involves – the end consumers (Von Hippel, 2006). On the other hand, the other two hubs follow the OI concept developed by Chesbrough, which emphasizes the creation of systems and

architectures that integrate existing fragments of knowledge to tackle real-world problems as the true value of OI (Bogers et al., 2019), without pre-identifying a specific stakeholder from which to predominantly source this knowledge.

In fact, during the interviews, when asked to describe the hub's network, it emerged that H1, which uses the OI approach to participate in knowledge exchange with external entities in order to innovate and overcome internal and market challenges, sees universities, research centers, and external organizations as the main actors in its network. These entities provide specific knowledge and guidelines to follow for the sector. H2, on the other hand, identifies universities and research centers, like H1, but also includes incubation centers, scouting players, institutions, and startups as key actors in its ecosystem. Therefore, both H1 and H2's participation in a knowledge ecosystem with key stakeholders such as universities, research centers, and incubators is primarily aimed at maintaining continuous access to a flow of knowledge and opportunities, identifying new trends and technologies that could provide added value to the parent company's R&D department. In contrast, according to the representative from H3, such openness is not fully present. Rather, the networks of H3 can be seen as following a more focused network logic, aiming at pursuing specific goals. Indeed, H3's network includes as main actors end consumers, universities, startups, accelerators, and consultants.

Table 4. *Ecosystems of the hubs interviewed*

	Ecosystems
H1	Considers universities, research centers, and external organizations as key ecosystem actors
H2	Includes universities, research centers, incubation centers, scouting players, institutions, and startups in its ecosystem
H3	H3's network includes end consumers, universities, startups, accelerators, and consultants

The term "ecosystem" is specifically differentiated when referring to H1 and H2, as opposed to "network" in the case of H3, because for the latter, the focus is mainly on finding industrial or technological solutions that are extremely specific to the sector in which it operates. This highlights the absence of an exploratory goal in the relationships within H3, which is characteristic of an ecosystem, in contrast to the operational and problem-solving goals aimed at precise and detailed challenges, typical of a network. Indeed, an ecosystem differs from a network due to the broader scope of the network and its objectives. While building a network is based on voluntary collaboration by all members, with similar roles and importance within the network, this specificity does not occur in an ecosystem (Leminen et al., 2012). The ecosystem, therefore, is a network made up of different stakeholders, often with differing views that lead to divergences on the topics of discussion (Hoffecker, 2019). In general, a network, unlike an ecosystem, is a relationship network more focused on

specific goals. Thus, it is a more targeted, narrower concept that could be considered a subset of an ecosystem (Aarikka-Stenroos & Ritala, 2017).

In general, however, all three hubs, although with different objectives and ecosystems made up of various stakeholders, leverage external know-how inputs to improve their innovation processes and achieve the set goals.

The activities primarily carried out by hub H1 involve the research and development of technological solutions and new materials. In fact, for H1, part of the work includes the experimentation of new solutions and materials that can be used to improve operational efficiency. In this case, therefore, we could speak of a "technology-oriented" open innovation approach, as defined in paragraph 2.1. In contrast, hub H2 emphasizes the crucial role that internal research activities play, aimed at creating new companies (spin-offs) to enhance internal intellectual property. In this case, the literature defines the open innovation approach as "organizational oriented." Even more distinct is the approach of hub H3, which leverages internal expertise to develop innovative products and services in collaboration with consumers, employees, and business partners, in order to meet the real market needs. For this reason, when discussing H3's approach to open innovation, it can be referred to as "OI market oriented."

Table 5. *Activities carried out by the hubs interviewed and OI approaches*

	Activities
H1	Focuses on researching and developing technological solutions and new materials to improve operational efficiency
H2	Focuses on internal research to create spin-offs and enhance intellectual property
H3	Uses internal expertise to develop innovative products and services with consumers, employees, and partners to address real market needs

The three hubs, in their operational methods and execution of activities, adopt business models that leverage open innovation in different ways. H1 stands out with an approach focused on internal research and development (R&D), with a strong emphasis on experimenting with new technologies and materials. This business model focuses on operational efficiency and optimizing industrial processes. Collaborations with universities and external research centers enhance H1's ability to access advanced knowledge and specialized skills that are not available internally. On the other hand, H2's business model is heavily oriented towards creating value through internal intellectual property. Unlike H1, H2 does not limit itself to internal experimentation but actively leverages external knowledge flows to create new entities (spin-offs) and develop new technologies. This represents a hybrid model, as the use of the venture client model to integrate external startups demonstrates

how H2 balances internal exploration and experimentation with the implementation of mature technologies developed by external partners. This model highlights the ability to create synergies between internal and external resources, accelerating the time-to-market of innovations and maximizing the value of intellectual property. H3, however, adopts a different approach with a business model based on participatory innovation, involving not only external technological partners, such as startups, but also consumers and employees. Its co-design approach creates innovation that is closer to market needs and enables quick responses to micro-challenges through small-scale solutions, bringing flexibility and speed of adaptation.

Table 6. *OI approaches adopted by the hubs interviewed*

	OI approaches
H1	Technology oriented
H2	Organizational oriented
H3	Market oriented

CONCLUSION

During the research, an initial exploratory analysis of the phenomenon of Innovation Hubs in the context of Open Innovation applied to the Italian industrial landscape was conducted. The main objective was to highlight the key characteristics of Corporate Innovation Hubs (CIHs), explore their operational modes, and understand the implementation of the Open Innovation paradigm in the applied context. Through a mixed methodological approach, integrating desk research and literature analysis with semi-structured interviews, it was possible to deepen the topic and gather insights and information that can be used for further studies to fill the existing knowledge gap on the subject. The goal of mapping and exploring industrial innovation hubs in Italy was achieved, providing a clear view of the distinctive characteristics of these structures and allowing for an understanding of their operational modes and the different goals companies aim to achieve by leveraging Open Innovation ecosystems. However, despite the results obtained, this is only a first exploratory analysis, serving as a foundation for further examination of all aspects related to CIHs.

ACKNOWLEDGEMENTS

This publication was produced during the PhD programme in Labour, Development and Innovation at the University of Modena and Reggio Emilia, Cycle XL, with the support of the Krones Group, which funded the Higher Apprenticeship PhD scholarship.

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EU-SPRI ECC
International PhDays 2025 Conference
March 5th, 6th & 7th, at the INGENIO (CSIC-UPV) facilities in València

Inclusive innovation through Collective IPRs: An Empirical Study on the EU Wine industry

Rahmi Can Yamanoglu

Gran Sasso Science Institute, , rahmican.yamanoglu@gssi.it

Short bio: Rahmi Can Yamanoglu is a PhD student in Regional Science and Economic Geography at the Gran Sasso Science Institute in Italy. He earned a Master's degree in Human Geography from Lund University, Sweden. As a research intern at Utrecht University, he contributed to a Horizon Europe project examining cultural and creative industries in non-urban areas. His current research interests center on the dynamics of innovation and intellectual property rights, and their implications for firms and other economic agents.

How to cite: Yamanoglu, Rahmi Can (2025). Inclusive innovation through Collective IPRs: An Empirical Study on the EU Wine industry. In *Proceedings of the 6th International PhDays Conference* (pp. 214-229). València, Spain, March 5–7. https://doi.org/10.4995/PhDays2025.2025.19919

Abstract: In response to the unequal distribution of innovative activity, the concept of inclusive innovation has emerged as a paradigm to address socio-economic disparities by actively integrating marginalised groups into the innovation process. This study sheds light on an underexplored aspect of inclusive innovation and investigates how collective intellectual property rights, specifically geographical indications, and collective trademarks, can serve as indicators of regional inclusive innovation. Focusing on the EU wine industry, a sector deeply rooted in regional identity and innovation, this research examines the role of collective intellectual property rights in fostering regional inclusive innovation.

Keywords: Inclusive innovation; IPRs; Collective trademark; Geographical Indications; Wine industry.

INTRODUCTION

To mitigate persistent challenges associated with uneven regional development and deepening spatial and economic inequalities, recent policy initiatives have set ambitious objectives to reconfigure both the "pace and pattern of growth" (Lee, 2019). While these initiatives such as OECD's 2030 Sustainable Development Goals primarily focus on reducing global imbalances, they also herald reorientations in economic practices and foreground a more engaged discourse on inclusive growth strategies. At the heart of these strategies is innovation, frequently hailed as a driving force behind

economic growth and development. However, the disruptive outcomes of innovation, such as widening economic and territorial inequalities, necessitate a recalibration of innovation systems to ensure inclusivity (Breznitz, 2021; Heeks et al., 2014; Lee, 2019). Over the past decade, interest in inclusive innovation as a strategy for promoting more inclusive and sustainable development has mushroomed and attracted the attention of multilateral organizations, national governments, development bodies, and researchers (George et al., 2012; Heeks et al., 2014; Pansera & Owen, 2018).

Despite definitional ambiguities, academic engagement with the inclusive innovation paradigm has expanded significantly (Lee, 2023). Inclusive innovation presents distinct pathways in execution and stakeholder engagement but is united by a common ethos: integrating marginalized actors into the innovation process to ensure they share in its outcomes. Lee (2023) argues that inclusivity in innovation is no longer confined to theoretical discussions but has begun influencing policy debates and regional development strategies, reinforcing the idea that inclusive innovation is both practical and transformative.

That said, the geographical dimensions of inclusive innovation remain relatively underexplored. Specifically, the interaction between regional characteristics, institutional frameworks, and other spatial characteristics, which potentially play a determining role in shaping the adoption of inclusive innovation strategies, has received limited academic attention. I will ground the theoretical foundations of my paper in this understudied academic space. Specifically, I will study regional innovation through collective intellectual property rights (CIPRs), which are commonly employed as regional branding and economic protection assets. However, this study will expand the theoretical discussions on CIPRs and argue that CIPRs are, beyond their traditional roles, indicators of regional inclusive innovation. Thus, I will engage in a dialogue between the CIPR and inclusive innovation literature and theoretically promote this new indicator for mapping regional inclusive innovation. Following this, I will investigate how CIPR adoption impacts regional innovation performance. For the empirical analysis, the EU wine industry will be focused on a sector deeply and historically rooted in regional identity and driven by innovation, where collective intellectual property rights such as geographical indications and collective trademarks play a key role in local development. These research steps will be motivated by the following research question:

Do collective intellectual property rights as indicators of inclusive innovation, contribute to regional innovation?

INCLUSIVE INNOVATION

Despite its present ambiguities and historical shifts in meaning and common perception, the word *"innovation"* has become a buzzword of the century and modernity, symbolizing societies' political, social, and material progress (Godin, 2015). The contemporary perception of innovation

is tied to economic development. It is oftentimes regarded as a great endowment and modern-times virtue (Lyons, 2005 as cited in Godin, 2015, p. 2). Aligning with this thinking many scholars and practitioners have developed assumptions innovation automatically delivers public value through new services and technologies or improving the existing ones. Consequently, policy recommendations are shaped around fostering a greater quantity of innovations rather than their quality (Uyarra et al., 2019, p. 2361). This perspective, however, does not recognize the ultimate role of innovation, which is merely a means to the ultimate ends of higher economic prosperity and improved quality of life (Feldman et al., 2016).

Innovation is a double-edged sword, both an asset and a hope of addressing pressing societal and environmental challenges while simultaneously exacerbating inequalities. On one hand, extensive literature highlights innovation as a powerful tool for tackling global issues (World Health Organization, 2023). On the other hand, an equally robust body of research underscores the "dark side" of innovation, emphasizing its potential to deepen existing inequalities. For instance, technological advancements frequently favor already prosperous regions and industries, leaving less developed areas further behind (Kurer & Gallego, 2019; Lee, 2023).

Recent scholarship increasingly advocates for recalibrating innovation systems to foster inclusivity. Breznitz (2021) underscores the importance of localizing innovation and restructuring it to meet the specific needs of diverse communities, which could lead to more equitable economic development. This approach aligns with global policy frameworks, such as the 2030 Sustainable Development Goals, which emphasize inclusive growth as a means to reduce inequalities. Scholars have thus begun to reconceptualize innovation not solely as a catalyst for economic advancement but as a powerful tool for addressing socioeconomic disparities (Heeks et al., 2014). Defined as “the development and implementation of new ideas that create opportunities to enhance the social and economic well-being of disenfranchised members of society” (George et al., 2012, p. 663), inclusive innovation challenges traditional models that exhibit significant bias in resource allocation, favoring the interests of certain groups while marginalizing others, particularly in socio-economically disadvantaged regions (Srinivas & Sutz, 2008). According to George et al. (2012), the inclusive innovation framework focuses on ideas related to innovation beyond sectoral boundaries. Additionally, this approach considers opportunities for social and economic well-being by addressing structural barriers that limit access to innovation. It also distinguishes the process of inclusive innovation from its outcomes, viewing the goal of inclusivity as final, even when the desired outcome is not fully realized.

Furthermore, despite the increasing focus on inclusive innovation, significant conceptual ambiguities remain. One of the key challenges lies in defining the essential characteristics of inclusive innovation. Heeks et al. (2014) conceptualize inclusive

innovation as occurring in different stages, with varying degrees of inclusion across consumers, producers, and the broader innovation discourse. Moreover, Chataway et al. (2014) highlight the historical evolution of inclusive innovation actors, emphasizing that inclusive innovation strategies, initially driven by concerns over different growth trajectories, now involve multiple stakeholders, including NGOs, market-driven transnational corporations, small- and medium-scale producers, and governments. Notably, the authors point out the changing role of transnational companies, which are now actively engaging in inclusive innovation intending to scale up production and globalize the sales of their inclusive products. In this regard, disadvantaged communities are seen as potential markets for innovation. The authors also emphasize the significant market challenges that other small and medium-sized firms face. Medium-sized firms often struggle to penetrate unfamiliar, low-income markets due to knowledge gaps. In contrast, small firms, even though they are suitable for addressing local innovation needs, encounter difficulties in commercializing their incremental innovations, which leads to missed opportunities for local welfare improvements.

Moreover, the understanding of essential characteristics of inclusive innovation has fostered the development of diverse theoretical camps. Levidow and Papaioannou (2018) identify two primary and conflicting schools of thought, which signify the fundamental divergence in interpreting the question of "inclusion into what". The liberal-individualist perspective imagines a more equitable distribution of societal benefits through greater investment in high-tech sectors, targeted skills training, reduced product costs, and improved external conditions can expand access to the fruits of innovation for marginalized populations. Central to this theoretical position is the idea that innovation can be inclusive if marginalized individuals are integrated as active participants, particularly as consumers, within the conventional structures and paths of market-led technological change. For instance, skill development is seen as a means of enhancing employability and adapting to the rising qualification standards required by technology-driven jobs. The reduction of the cost of products and the broad extension of technological innovations are considered solutions for accessing marginalized individuals, suffering from the unequal outcomes of diverse forms of innovation.

In contrast, the social-collectivist camp critiques this approach for its insufficient attention to the political context and its failure to address entrenched structural inequalities. This perspective holds that innovation rooted in collective action is not only a pathway to more profound social inclusion but also a means of challenging the dominant socio-economic frameworks that are behind inequality (Levidow & Papaioannou, 2018). Fundamentally, while the liberal-individualist approach focuses on addressing the deficits exposed by technological outcomes, the social-collectivist approach seeks to answer *"under what conditions"* equitable

outcomes might be realized (Oldekop et al., 2016). This latter view entails a vision for transforming the direction and structure of technological change. In other words, whereas the liberal-individualist camp interprets inclusive innovation primarily through the lens of technological outcomes and consumption, the social-collectivist camp emphasizes collective agency in co-creating innovation. It advocates for restructuring societal benefits through the commons and public goods and underscores the need for systemic transformation that supports a more inclusive and equitable distribution of resources.

Moreover, within the broader discourse on inclusive innovation, geographical aspects have also attracted academic attention. According to Planes-Satorra and Paunov (2017) a country's production system plays a central role in determining the distribution of capacities for participation in innovation activities across firms, sectors, and regions. The authors propose territorial inclusiveness, which emphasizes the importance of democratic spatial distribution of innovation activity and the integration of excluded regions and groups within the broader innovation discussion. Territorial inclusiveness is defined as "the extent to which the capacities to participate in innovation activities are evenly distributed across regions within a country." (Planes-Satorra & Paunov, 2017, p. 12). These efforts stress the need for innovation strategies that promote inclusiveness across regions and recognize the potential for innovation to transform lagging areas. Within this framework, intellectual property rights play a critical role in promoting industrial and territorial inclusiveness by unlocking the value of regionally rooted production factors as well as pooling regional sources.

COLLECTIVE INTELLECTUAL PROPERTY RIGHTS, REGIONAL INNOVATION SYSTEMS, AND INCLUSIVE INNOVATION

Regional innovation systems literature asserts the key idea of innovation is not a random process but is closely tied to the social and physical conditions in which it takes place (Tödtling & Grillitsch, 2015, p. 1745), including regional institutions (Cooke, 2008; Rodríguez-Pose, 2020). Within certain administrative or territorial boundaries, regional institutions support firms by fostering knowledge creation and protection, developing human capital, and regulating economic activities (Cooke, 2008). The successful coordination of these elements is critical for establishing and maintaining "innovative regions".

On the other hand, one can note recent deviations, or perhaps departures, from conventional innovation systems literature, which are viewed as somewhat exclusive. Dissatisfaction with the failures and limitations of these systems has led many scholars to theorize about sustainable and inclusive systems (Altenburg et al., 2012; Morales et al., 2023). Inclusive innovation systems (IIS) are considered systems purposely structured to guide both the generation and use of knowledge toward socially inclusive objectives (Arocena & Sutz, 2021, p. 95). The key difference between

conventional RIS and IIS is that certain actors and forms of knowledge, previously excluded from the former, become integral to the latter. For example, incorporating low-income populations into the innovation system, redefining the roles of intermediaries, developing new capabilities among agents, and redirecting system goals are cited as some of the novelties offered by IIS (Morales et al., 2023).

How can we conceptualize intellectual property rights within regional innovation systems to foster more inclusive innovation systems in general? Intellectual property rights, or legal institutions in general, are key organizational tools within regional innovation systems. IPRs play a pivotal role in shaping both the distribution and nature of innovation, as well as determining the range of actors involved. Historically, policymakers have relied heavily on IPRs to stimulate knowledge production and diffusion, covering a wide spectrum of ideas, inventions, and creative works (Castaldi et al., 2024). However, IPRs come with dilemmas: while they protect private interests and promote industrial competitiveness, they can also restrict societal benefits by limiting knowledge diffusion and access to critical innovations (Bessen & Meurer, 2008). This tension raises important questions about how well IPR systems align with broader social objectives.

Moreover, scholars suggest that IPRs could be leveraged to promote regional assets and support inclusive innovation, especially within traditional sectors (Planes-Satorra & Paunov, 2017). Given the close connection between IPRs and economic activity, changes in one often necessitate adjustments in the other. This alignment with inclusive innovation encourages us to consider intellectual property forms that address not only individual legal rights but also collective interests. For this matter, the introduction of collective intellectual property rights, specifically geographical indications and collective trademarks, is essential.

Geographical indications are a key form of place-based assets, and they are commonly employed in rural development strategies. GIs are designations assigned to agricultural and food products originating from distinct locations, where the products' characteristics and reputation are closely tied to their geographical environment (Crescenzi et al., 2022, p. 381). The reputation of GI products is the accumulation of centuries of concerted efforts by local stakeholders (Arfini et al., 2019; Biénabe et al., 2013). Moreover, these products embody the deliberate collaboration and shared vision of various actors and emphasize the product’s identity and the distinctiveness of its production methods. These factors, intertwined, contribute to their collective value and character (Belletti et al., 2015). Similarly, collective trademarks are owned and regulated by a collective entity, such as a union, cooperative, or similar organization, and designed to represent generally regionally tied stakeholders' interests (Castaldi & Mendonça, 2022; Ghafele & Gibert, 2012, p. 752). Member entities are permitted to use a collective trademark provided they adhere to the specific

conditions and regulations set forth by the owning organization. Non-compliance with these standards may lead to the revocation of permission to utilize the collective mark. Moreover, akin to individual trademarks, collective trademarks mitigate information asymmetry among consumers and provide the ability to differentiate goods or services (Bruch et al., 2014).

Furthermore, debates over the appropriate legal frameworks for protecting collective assets, such as traditional cultural expressions, have long engaged legal scholarship. However, the full conceptual scope of these collective legal instruments, particularly their relationship with innovation, remains underexplored. Collective intellectual property regimes offer valuable opportunities to foster inclusive innovation at both regional and national levels. To determine if CIPRs serve as models of inclusive innovation, we should first ask whether they are inherently inclusive and, if so, in what ways.

We move from these questions to our first departure point: CIPRs are inclusive because ownership of those IPRs relies on collective action and management to define boundaries and standards of use (Quinones-Ruiz et al., 2016). These rights, governed under sui generis frameworks, further emphasize the protection of geographical territories and collective entities rather than individual legal persons. As such, geographically binding IPRs are considered public goods with a collective nature, since the use of toponyms is typically restricted to collective ownership and cannot be appropriated by individual parties. Marks referencing places oftentimes signal the reputation of a place, signal the quality of trade goods and services and aim to help consumers make more informed purchase decisions (Josling, 2006; Mazé, 2023). On the other hand, the reputation of the place relies on the historical efforts of local stakeholders tied to certain geographical territories. That is to say, rather than being defined by individual ownership, the collective participation and inclusion of diverse stakeholders, both present and past, are the locomotives of this reputation. Why does this collective participation and inclusion matter? Shortly, it matters since, amid the endless presence of ubiquitous goods, authenticity still, remains a valuable commodity. The use of geographical names has become increasingly important in an era of globalization, with ease in international trade and the widespread presence of ubiquitous products. As regions seek to enhance their competitiveness, they capitalize on unique cultural, geographic, and economic attributes (Crescenzi et al., 2022, p. 382). Such participation is vital as it fosters a sense of shared identity and cultural heritage among stakeholders, enhancing the authenticity and perceived value of the products associated with these geographical names. Overall, unlike individual IPRs such as patents and trademarks, CIPRs must be inclusive to some extent due to their intrinsic nature and connection to specific territories and cultural contexts.

Despite their advantages, CIPRs are not without exclusionary flaws. Empirical studies reveal that the process of setting

standards may unintentionally marginalise certain local producers who are unable to meet these requirements. Ibarra Rojas (2015) highlights the challenges faced by local collective trademark projects, including the exclusion of certain artisan groups and inadequate training on the use of collective trademarks. Belletti et al. (2015) also emphasise that strict technological requirements for GI ownership can exclude smaller, poorly equipped farmers, thereby limiting their participation and production capacity. Moreover, collective rules may further marginalise stakeholders and fail to account for specific local resources, such as traditional production techniques that cannot meet the imposed requirements (Belletti et al., 2015). Consequently, while we previously argued that CIPRs are inclusive, we must revisit this perspective and refer to them as "inclusive with flaws".

The second step involves examining the degree of innovation associated with CIPRs. The body of literature on innovation through the use and adoption of collective intellectual property rights is unevenly expanding, while geographical indications have received substantial attention, collective trademarks remain largely overlooked. Several theoretical avenues can be explored to investigate the relationship between CIPRs and innovation. Unlike in the US system, where geographically bounded trademarks operate on a first-come, first-served basis, under the EU's sui generis system, GIs function as protectionist mechanisms by limiting competition within its economic landscape. As Josling (2006) aptly argues, GIs elevate firms and producers from "the flat plains of perfect competition to the foothills of monopolistic competition"' where competitors are barred from using the protected product name and regional stakeholders and landowners enjoy numerous economic benefits. While monopolistic competition could theoretically suppress innovation by reducing competitive pressures (Frankel, 2011); an alternative perspective within the literature posits that GIs may actually stimulate innovation.

In essence, ownership of GIs imposes certain production rules and regulations on producers, which are oftentimes tied to local traditions, which can limit opportunities for innovation. This creates a trade-off for producers between maintaining monopolistic competition and facing regulatory and therefore, most possibly, technological, lock-ins; however, according to Silva et al. (2024), some producers incorporate innovative techniques and applications to enhance the sustainability of their traditional production methods and improve product quality. In certain cases, GI regulations have even adapted to mitigate environmental impacts, leading producers to explore innovative production techniques and adopt new business models (Habli et al., 2023).

Moreover, GI ownership may motivate producers to seek more efficient agricultural production methods, where innovation is key. The rise of quality standards associated with GI ownership also incentivizes producers to innovate within their processes to meet compliance standards and achieve higher product quality (Meloni & Swinnen,

2018). Furthermore, a notable study by Stranieri et al. (2023) found that GIs can foster innovation, particularly in less-developed regions of the EU, although they may exert a slightly negative effect in technologically advanced areas.

GIs can also promote incremental innovation, particularly in marketing strategies and consumer engagement. Several studies have noted that GIs serve as a creative marketing tool, increase product value, facilitate entry into new markets, and attract a broader customer base (Durand & Fournier, 2017; Meyer & Naicker, 2023). Additionally, having a GI encourages producers to extend their marketing channels and engagement efforts. Through GI ownership, local producers can distinguish their products more effectively in the market (Vieira Juk & Fuck, 2015), reach a wider audience (Sánchez-Hernández et al., 2010), or appeal to specific customer segments interested in authentic products (Vieira Juk & Fuck, 2015). Finally, by adhering to GIs, producers are motivated to innovate in their sales methods, expand their presence across various outlets, and foster closer relationships with their customer base (Bermejo et al., 2021; Hinojosa-Rodriguez et al., 2014). Considering these aspects of CIPRs, we propose our first hypothesis:

> H1: THE INTENSITY OF COLLECTIVE INTELLECTUAL PROPERTY RIGHTS POSITIVELY INFLUENCES REGIONAL INNOVATIVE PERFORMANCE.

Furthermore, CIPRs have great potential to contribute to regional innovation, particularly in peripheral or less-developed regions. These regions are often characterized by structural challenges, including weaker institutional frameworks, limited access to markets; and fragmented knowledge networks (Grillitsch & Nilsson, 2015). By fostering collective management of geographically rooted resources such as toponyms and traditional knowledge, CIPRs create institutional arrangements that can offset these disadvantages as they enable resource pooling, and collective effort on tackling market and institutional barriers (Belletti et al., 2015; Quinones-Ruiz et al., 2016). For instance, traditional knowledge, as a non-excludable and non-rivalrous resource, is often neglected in conventional innovation systems that prioritize proprietary ownership (Morales et al., 2023). However, CIPRs provide a mechanism to integrate such knowledge into RIS, effectively transforming it into a collective asset that drives innovation. In fact, indigenous communities in Peru have leveraged collective trademarks under CIPRs to protect their cultural heritage while simultaneously engaging in market-oriented innovation (Jimenez et al., 2022). This ability to align the preservation of traditional knowledge with its commercialization creates new pathways for innovation that are difficult to imitate. Peripheral regions often face significant disadvantages in global and national markets due to their distance from key economic hubs and limited institutional capacity. CIPRs mitigate these disadvantages by fostering “coopetition” (Brandenburger & Nalebuff, 1996), where actors who might otherwise compete collaborate to develop and commercialize

shared assets. They help producers overcome market barriers by facilitating access to national and international markets (Jatib et al., 2015; Starobin, 2021) and expanding sales beyond local areas (Linh, 2019). In addition, CIPRs communicate the distinct qualities of products and protect the cultural heritage of regions (Biénabe et al., 2013; Silva et al., 2024), both of which are essential for the economic development of peripheral regions. This discussion leads us to propose our second hypothesis:

> H2: THE POSITIVE ASSOCIATION BETWEEN CIPR INTENSITY AND REGIONAL INNOVATION IS STRONGER IN PERIPHERAL OR LESS-DEVELOPED REGIONS.

Finally, it is essential to situate CIPRs within the broader theoretical camps of inclusive innovation to clarify their place. In contrast to liberal-individualist perspectives that largely imagine marginalized groups as consumers to be integrated within the broader innovation discourse, CIPRs align more closely with the social-collectivist approach, which emphasizes collective agency in co-creating innovation. Rather than treating regional stakeholders as mere end-users, CIPRs enable diverse actors to collaboratively shape both the direction and structure of local innovation—through shared standard-setting, cooperative branding, and ongoing dialogues about product quality and identity. These collective attributes underlie CIPRs' potential as a promising mechanism for fostering the scope of inclusive innovation.

WINE INDUSTRY

The wine industry serves as a good example of a sector where CIPRs, especially GIs, are historically deeply embedded and widely adopted. The concept of GIs originated in the wine industry, primarily to protect and promote the unique "terroirs" that distinguish the quality of wines (Meloni & Swinnen, 2018). As of 2023, the global wine market is valued at an estimated $353.4 billion, with France, Italy, and the United States being dominant players. The European Union alone accounts for 60% of global wine production (OIV, 2024). However, despite its economic significance, the industry faces notable challenges. Global wine consumption and production levels in 2024 are at their lowest since 1996 and 1961, respectively, with projections indicating a potential 3% decline in the coming years. These trends are shaped by a combination of geopolitical, economic, and environmental factors. The conflict in Ukraine has disrupted global supply chains, leading to significant logistical challenges. Coupled with this, persistent energy crises have driven up production and distribution costs, which in turn have impacted wine pricing. Additionally, unstable climate conditions have further complicated production by altering traditional growing environments and reducing yields. Changing consumer preferences and a decline in demand in key markets, such as China, also contribute to the downturn in the global wine sector (OIV, 2024). Together, these interconnected factors underscore the multifaceted challenges currently facing the industry.

The wine industry has long been a focal point in innovation studies literature. This focus mostly explores producers' knowledge exchange and the influence of these networks on regional innovation dynamics. For instance, Giuliani and Bell's (2005) seminal study highlights the uneven distribution of benefits within wine clusters, emphasizing that not all stakeholders gain equally from knowledge spillovers. While some firms are central actors in these networks, others remain on the periphery with limited access to their advantages. On the other hand, Morrison and Rabellotti's (2009) study demonstrates that firms situated in peripheral positions within local clusters benefit significantly from external linkages, outperforming core network firms in growth, exports, and innovation metrics. Conversely, core firms tend to rely on localized knowledge networks and the support of technological gatekeepers as mechanisms for catching up in the innovation race. This knowledge exchange extends beyond formal networks, as informal cooperation with competitors also plays a vital role in sharing insights about wine-growing and production techniques (Dana et al., 2013). Similarly, though approached from a different perspective, the authors (Frigon et al., 2020) arrive at a comparable conclusion: networks are essential for both eco-innovation and conventional innovation. However, the authors distinguish between internal and external linkages, pointing out their differing roles depending on the type of innovation. Additionally, other components of the regional innovation system, such as universities and public bodies, emerge as critical sources of knowledge for innovation in the wine industry. The authors (Giuliani & Arza, 2009; Morrison & Rabellotti, 2007) emphasize the web of networks consisting of both formal and informal relationships among universities research institutes, and firms in the wine industry for the diffusion of new knowledge. These networks play a key role in providing access to specialized expertise in certain scientific fields and in nurturing regional innovation systems (Giuliani & Arza, 2009). That said, the impact of tools like CIPRs, which play a significant role in facilitating producer interactions, on innovation remains unclear.

METHODOLOGY

This study employs a quantitative research design to investigate how GIs and collective trademarks influence regional innovation within the wine sector. First, a comprehensive dataset was compiled from the EUIPO database, comprising 1,699 GIs (PDO and PGI classifications) and 281 collective trademarks (both active and expired) relevant to wine products under Class 33 of the Nice Classification. Each record was geo-referenced to NUTS 3 regions based on the owner's address to ensure accurate spatial matching. As a proxy for innovation, we use the number of newly registered individual trademarks in Class 33, drawing on the rationale that trademarks capture product innovation, such as brand extensions or new product launches (Flikkema et al., 2021; Gao & Hitt, 2012). In addition, trademarks provide an accessible and cost-effective alternative for SMEs to protect their innovations. Unlike patents, which are costly and complex, trademarks

enable small wine producers to protect their intellectual property in a price-sensitive market (Morales et al., 2024). Aligned with the focus of our research, trademarks are considered a suitable tool for capturing innovation in the wine industry, particularly to enhance our coverage of local producers in the market. Additionally, to analyse the role of peripherality in CIPR intensity, we are in the process of identifying and applying an appropriate classification framework, such as Objective 1 regions.

To enhance data precision, we are cross-validating approximately 90,000 Class 33 entries against the Vivino database, given that Class 33 also includes other alcoholic beverages, extracts, and essences. Our empirical strategy entails a panel data regression model with region and year-fixed effects, controlling relevant covariates to mitigate potential omitted-variable bias and to account for unobserved heterogeneity across regions. The baseline model is shown below:

$$innovation_{it} = \beta_0 + \beta_1 GI_{i(t-1)} + \beta_2 CT_{i(t-1)} + Controls_{it} + \gamma_i + \sigma_t + \epsilon_{it}$$

$innovation_{it}$: The number of individual trademark registrations per region and year

$GI_{i(t-1)}$: A one-year lagged variable of Geographical indication registrations per region per year

$CT_{i(t-1)}$: A one-year lagged variable of collective trademark registrations per region per year

$Controls_{it}$: Economic and innovation-related control variables

γ_i: Region-fixed effects

σ_t: Year fixed effects

ϵ_{it}: Error term

EXPECTED RESULTS AND CONCLUSION

Overall, in line with our hypotheses, we anticipate that the intensity of CIPRs, measured by the density of GIs and collective trademarks, will have a positive and statistically significant effect on regional innovation (proxied by newly registered individual trademarks) in the EU wine industry. Furthermore, we expect this relationship to be stronger in peripheral regions, where resource pooling and cooperation can help mitigate weak institutional infrastructures and limited access to innovation sources.

This study contributes to ongoing debates on inclusive innovation by introducing CIPRs as a novel indicator and examining their role in shaping regional innovation. By testing our hypotheses in the EU wine industry, we aim to enhance our understanding of the territorial dimensions of inclusive innovation. We anticipate that these findings support further advancements in innovation studies and contribute to the development of more inclusive innovation strategies in practice.

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Mapping Supply Chain Shifts under widespread supply chain risks—Take the Global Battery Industry as An Example

Linyi Guo

The University of Manchester, , linyi.guo@postgrad.manchester.ac.uk

Short bio: Linyi Guo is a second-year PhD candidate at the Alliance Manchester Business School at the University of Manchester, under the supervision of Professor Andrew James and Professor Kieron Flanagan. Her primary research interests are innovation management and innovation policy, with a focus on high-tech industries. Her current research project involves mapping supply chain shifts in the global battery sector, aiming to understand how supply chain risks, involving technological advancements, geopolitical factors, and policy changes, are influencing global supply chain networks. She is eager to collaborate with fellow researchers and industry professionals interested in innovation management and supply chain management.

How to cite: Guo, Linyi. (2025). Mapping Supply Chain Shifts under widespread supply chain risks — Take the Global Battery Industry as An Example. In *Proceedings of the 6th International PhDays Conference* (pp. 230-248). València, Spain, March 5–7.
https://doi.org/10.4995/PhDays2025.2025.19649

Abstract: The global-level exchanges of raw materials, manufactured goods, and information are highly intertwined. Multiple factors result in supply chain disruptions. As an essential part of supply chain management, the main objective of this research is to integrate the efficient supply chain information among the upstream and downstream suppliers to generate supply chain maps based on different time points. Despite the high unavailability of the multi-tier supplier data, this study aims to improve the accuracy of the buyer-supplier network by the material/good flow to enhance supply chain transparency and visibility and to propose a method to construct a dynamic global supply chain network in a particular industry. This study will mainly concentrate on two aims. First, the construction of the global supply chain, specifically in the battery industry. Second, discover changes at the supply chain level. Changes will be carried on from geographical changes, network changes, ownership changes, structural changes, and technological/ knowledge changes. These dimensions could help better explore the underlying mechanisms in the global supply chain.

Keywords: Supply chain mapping; Supply chain risks.

INTRODUCTION

The global-level exchanges of raw materials, manufactured goods, and information are highly intertwined (Fan et al., 2024). Multiple factors, including the rapid development of emerging technologies and digital technologies, geopolitical uncertainties (e.g. trade protectionism and nationalism), natural disasters (e.g. earthquakes and tsunamis), and large-scale outbreaks such as the COVID-19 pandemic, resulting in supply chain disruptions (Cajal-Grossi et al., 2023). Supply chain disruptions, such as semiconductors and some critical raw materials, happen from time to time, combined with demand adjustments in different periods. Such disruptions raise both scholars' and enterprises' attention on the effective management of inventory and suppliers (MacCarthy et al., 2022).

Therefore, knowing what happened and what is changing in the global supply chain is a prerequisite for multinational corporations and governments to discover the potential supply chain risks and improve industrial practice. The main objective of this research is to integrate the efficient supply chain information among the upstream and downstream suppliers to generate supply chain maps based on different time points by the supply chain mapping method (Culot et al., 2022). However, research related to drawing a supply chain map mainly focused on particular companies or products on a small scale, such as in a short time period or only obtaining first-tier suppliers. The large-scale buyer-supplier relationship network is limited in access and presence because of the difficulty of obtaining multi-tier supplier relationship data (Culot et al., 2022; Dong et al., 2024; Liu & Zhang, 2014). Another characteristic that troubles researchers in mapping the global supply chain is that today's global supply chain is more transient and intricate, which increases the difficulty of constructing a supply chain map and updating such a map regularly.

While past research related to the supply chain level could only present a static supply chain map by a certain time, this research addresses this gap by presenting the dynamic supply chain network using the buyer-supplier relationship data, with the starting date and ending date of the relationship, over eight continual years, from 2017 to 2024. Despite the high unavailability of the multi-tier supplier data, this study aims to improve the accuracy of the buyer-supplier network by the material/good flow to enhance supply chain transparency and visibility and to propose a method to construct a dynamic global supply chain network in a particular industry. Industries previously selected by supply chain mapping are primarily concentrated in the clothing, vehicle, and energy industries because they are relatively less volatile in the supply chain contribution. However, the battery industry is more volatile since the technology is not tech-intensive, which could be adjusted timely according to the national industrial development. For example, the U.S. announced a $1 billion US battery plant plan to reduce reliance on China in October 2024.

Therefore, this study will mainly concentrate on two aims. First, the construction of the global supply chain, specifically in the lithium-ion battery industry. Second, discover changes at the supply chain level. Changes will be carried on from geographical changes, network changes, ownership changes, structural changes, and technological/knowledge changes. These dimensions could help better explore the underlying mechanisms in the global supply chain. Research Questions are as follows:

(1) How is the configuration of the global battery supply chain in different years?

(2) What are the changes in the battery supply chain after 2020?

Supply chains are increasingly seen as networks, which is a complex adaptive system (Ivanov & Dolgui, 2020). Normally, the complete upstream and downstream information are difficult to collect and compile. This research will mainly choose the supply chain mapping method. This method could improve the visibility and transparency of the supply chain and learn about the reasons for supply chain disruptions.

This research will provide three meaningful contributions. Firstly, it improves the method of large-scale, multi-tier supply chain relationships by using the secondary data obtained by the FactSet Reserve Database. Secondly, instead of analyzing the supply chain configuration at a particular time, this research applies the dynamic supply chain management perspective, which could identify transient changes happening in the supply chain. Thirdly, this study chooses the lithium-ion battery industry to test the changes, offering insights for multinational enterprises and policymakers to mitigate risks associated with unexpected situations and plan ahead.

In the second section, I explain what is supply chain mapping. Then, I develop a theoretical framework for supply chain changes. In the third section, I detail the method, dataset and company this research chooses. In the fourth section, I present the expected empirical results.

LITERATURE REVIEW

SUPPLY CHAIN MAPPING

The Definition of Supply Chain Mapping

Supply chain mapping is defined as the linking of activities and actors in the supply chain. Supply chain mapping looks at the whole chain as a whole, including the flow of products and other information such as transaction volume, the starting and ending date of the buyer-supplier relationship, the company's geographical location, etc. (Ivanov & Dolgui, 2020; Kusi-Sarpong et al., 2022). It is a simplified yet accurate map, in which supply network relationships, flows, and dynamics are captured (Theodore Farris, 2010). In short, supply chain mapping provides visibility of the network that links suppliers and customers together and helps organizations make operation decisions.

The supply chain map contains three parts inside the supply chain: upstream, midstream, and downstream supply chain. Upstream SC represents the network of a firm's suppliers and sub-suppliers.

Midstream SC refers to all activities and processes that are performed within the company to convert the raw material to a value-added product. Whereas downstream SC refers to the coordination of the flow of information and goods with clients and customers (Mubarik et al., 2023).

Scholars and firms map the supply chain according to their research questions. For example, Roy (2011) focused on the key stages of production, lead times, transportation modes, and inventory points of three focal firms (a wine producer, an olive grower, and a job shop manufacturer) in New Zealand, while De Marchi and Di Maria, (2019) mapped the leather industries' global value chain that investigates the role of buyers in supporting environmental upgrading of suppliers' products and processes. The advantage of the supply chain mapping method is that it can provide a valuable vision of the whole supply chain and offer some insights on key elements or key processes of the supply chain, encouraging firms and countries to prepare ahead before the happening of supply chain risk and buffer supply chain disruptions.

Why do supply chain mapping

Previous literature concluded four aspects to do the supply chain mapping, including the intensified supply chain risks, technological improvement and digitalization, environmental protection requirements, and country-level policy and geopolitical factors.

(1) Widespread risks in the global supply chain

Today's global supply chain is highly intertwined and has multiple production stages. A single move affects the entire system. While most literature from the 2000s and 2010s analyzed the global supply chain under a low-tariff and relatively stable environment, the global supply chain after 2015 has faced huge challenges, such as unexpected natural disasters and epidemic situations, which increase the uncertainty of the global supply chain (MacCarthy et al., 2022; Simchi-Levi et al., 2015; Van Den Brink et al., 2020). Supply chain risks are prevalent, becoming a more pressing problem in supply chain management.

(2) Technological improvement and digitalization

Digitalization and emerging technologies, such as Digital Twins, the Internet of Things, and Blockchain, have dramatically changed the configuration, management and control of the supply chain. The advent of digital technologies has opened up opportunities for companies to gather large volumes of data alongside the upstream and downstream suppliers and goods to make better decisions (Bansal et al., 2020).

(3) Environmental protection requirements and sustainability goals

Sustainable development strategies, such as the low-carbon 2050 strategy, are a dominant concern for contemporary operation management. On the one side, companies and suppliers are mostly profit-oriented and do not pay too much attention to sustainable production and their suppliers' suppliers. Based on a survey by MIT and CSCMP (2020), 35% of 1128 supply chain professionals don't know about their

Environmental, Social and Governance (ESG) goals. They have a weak understanding of supply chain transparency and sustainability (Gualandris et al., 2021). On the other side, customers and investors are eager to obtain more information about the upstream and downstream of the supply chain before they purchase and invest in the products of the company (MacCarthy et al., 2022). Therefore, it puts forward higher requirements for the transparency of the total supply chain.

(4) Country-level policies and geopolitical tensions

Geopolitical tensions and corresponding industrial policies improve the vulnerability of the global supply chain. Due to the intensified global geopolitical conflicts, some countries, led by the U.S., started to implement trade protectionism and technological blockade in order to ensure their own autonomy in key products, decrease the export dependency on other countries, and increase the competitiveness of their enterprises in the domestic and international markets. For example, based on the aggregate level of trade data, China's share of US goods imports peaked at 21.6% in 2017. But China's share of US goods imports experienced a sudden drop to 16.5% because of the US government trade limitation starting from 2018 (Alfaro & Chor, 2023). After the COVID-19 pandemic and the trade war between China and the US, supply shortages in the global supply chains happened from time to time (Alfaro & Chor, 2023; Goldberg & Reed, 2023). One classical example is that during the trade war between China and the US, the supply chain for semiconductors was severely impacted, resulting in a global shortage of chip manufacturers and related products. Another example is that the Russia-Ukraine conflict resulted in the energy supply crisis in the West countries. They need to search for alternative energy. Before countries formulate appropriate policies, they need to have a clear view of the configuration of the global supply chain.

Relative Methods to Do Supply Chain Mapping and Their Advantages and Disadvantages

In order to get an objective and comprehensive understanding of the global supply chain, scholars adopted different ways to collect supply chain data to analyze. The data to collect depends on the purpose of supply chain mapping.

Wichmann et al. (2020) tried to use Deep Learning and Natural Language Processes (NLP) to extract individual buyer-supplier relations automatedly from the Web (unstructured text). Although machine learning could decrease the workload by manpower, it still has many disadvantages that should be improved later. First, researchers have to construct a large-scale corpus that covers all the suppliers' and supply-relationship-related keywords before using the machine learning method to identify supplier-buyer relationships. Second, incorrect information may be mixed in the large volume of data on the website, which may decrease the accuracy and reliability of the research result. Third, this method may have severe information missing. Although researchers like Wichmann could extract buyer-supplier

relationships from the unstructured texts, other essential information, such as the good to supply, the volume to supply, and the starting date and the ending date of the supply, may be lacking. This may influence the quality of the analysis.

Different from Wichmann et al. (2020) who collected unstructured text data, Van Den Brink et al. (2020) combined country-level mining data with individual-level mining data to get the supplier data because in the raw material industry, mines are the key suppliers. The country-level mining data came from the British Geological Survey and the United States Geological Survey. Scholars applied an online global overview of cobalt deposits, company reports, a list of cobalt-producing mines, research reports, media articles, and related websites to collect the individual cobalt mines. Therefore, scholars could find potential supply chain risks in the supplier dataset.

Besides, in some complex supply chains, scholars distinguished key segments (up, mid, and downstream) by-product codes (Caravella et al., 2024).

Finally, MacCarthy et al. (2022) concluded that there are two kinds of data to collect: primary data and secondary data. Primary data usually collects interview data, direct observation, company reports, and firms' information systems (ERP systems). Secondary data has usually been applied at a macro level, such as the global value chain level, industry level, and country level. Industrial and country-level data can be accessed from a number of national and international organizations. Among them, UN ComTrade offers monthly international trade data and some specific trade data with products. But the limitation of this dataset is that it cannot link the suppliers and buyers together. To solve this problem, Culot et al. (2022) provide a detailed analysis of the secondary database to use to collect the firm-level supply chain relationships. Bloomberg SPLC, FactSet Supply Chain Relationships, and Mergent Supply Chain offer superior coverage and data quality compared to CompuStat and Mergent (Dong et al., 2024). All three databases allow users to search by firm name or ticker (i.e., the unique identifier assigned to each publicly traded stock). Information on direct suppliers, customers, and competitors is provided. However, supply chain mapping by using firm-level data is still in the beginning stage. In this research, I will mainly investigate the multi-level buyer-supplier relationship, including upstream suppliers and downstream suppliers.

POTENTIAL SUPPLY CHAIN CHANGES FROM SUPPLY CHAIN MAPPING

Past literature proved that supply chain structure tends to minor change in the short term (Osadchiy et al., 2016). However, when and how the supply chain changes are still in the early stage of supply chain management literature. Therefore, this research tends to explore global supply chain changes from a dynamic perspective. Based on the above research question, a theoretical framework for changes in the global supply chain is presented below.

Based on the previous studies, this research identified global supply chain changes in

five different aspects, including geographical changes (Alfaro & Chor, 2023; Braun et al., 2023; Goldberg & Reed, 2023; Gong, Hassink, Foster, et al., 2022), network changes (Durach et al., 2024; Fan et al., 2024), ownership changes (Antràs, 2020), technological and knowledge changes (Barrientos et al., 2011; Gereffi et al., 2019), and structural changes (Antràs & Chor, 2018).

Table 1. *The theoretical framework of global supply chain changes*

External changes			
No.	Types of Change	Possible manifestations	Measurements
1.	Geographical Changes	Reshoring, nearshoring, friendshoring, FDI flows at a country level	The whole chain suppliers' country distribution in different years; the change in FDI flows from National Bureau of Statistics
2.	Network Changes	Companies in the supply chain may have different suppliers and customers	The number and density of the network; the duration of buyer-supplier relationship
Internal changes			
3.	Ownership Changes	The change in company's ownership from one country to another	The ownership changes from one country to another
Internal changes			
4.	Structural Changes	Vertical integration	The length of supply chain related to the company
5.	Technological / knowledge Changes	Upgrading and downgrading	The comparison position in the global supply chains
		FDI flows at a firm level	FDI flows got from financial statements
		Research output	R&D output got from financial statements
		Patent (number, forward citation)	The application date and forward citations from the Worldwide Patent Statistical Database (Patstat)

This research tries to identify the difference between external and internal changes. External changes refer to the supply chain changes outside the organization. Therefore, the measurement of the external changes will focus on the upstream and downstream suppliers of the focal company to get an overview of the transformation of the supply chain in one specific industry. Internal changes refer to the supply chain changes within the organization. It will focus on the ownership changes, upgrading, and vertical integration.

(1) Geographical Changes

In recent years, the geographical location of manufacturers has changed frequently. Past scholars have classified these phenomena into three dimensions: reshoring, nearshoring, and friendshoring. Reshoring refers to the supply chain returning to the consumer countries instead of outsourcing to other countries. Based on the research of Gong et al. (2022), the US reshored their core industries, such as the aerospace and medical industry, from China to the US to decrease the trade dependency of China and guard its supply chain safety. Nearshoring refers to companies moving their suppliers to countries near the mainland (Braun et al., 2023). Based on the survey of IBM Global Locations Trends 2020, they found that 40% of respondents thought that the trend of nearshoring would increase. Accordingly, Alfaro & Chor (2024) discovered that the US moved its supply chain from China to Mexico based on the export trade data. Friendshoring refers to the change of manufacturers to places near the consumer country. For example, the US moved its supply chain from China to Mexico after 2021 (Alfaro & Chor, 2023).

Geographical changes are mainly influenced by market demand, political environment, local institutions and trade policy (Alfaro & Chor, 2023; Gereffi et al., 2019). However, most of the past research was based on the research on the tendency of executives of multinational enterprises by researchers' surveys. There is no actual evidence to show such migration in the supply chain and why they change. Besides, researchers know little about the period for enterprises to adjust their suppliers and the adjustment of geopolitical range. Are they adjusting within a country level or choosing other countries' suppliers (Gualandris et al., 2021)?

This study will be based on three focal companies to collect lists of upstream and downstream companies in the battery industry, along with their suppliers, to determine the geographical changes of suppliers across the entire industry from a macro perspective. Besides, country-level inward and outward foreign domestic investment (FDI) flows could help learn the degree of geographical changes as building factories locally is highly related to FDI (Alfaro & Chor, 2023; Antràs, 2020). FDI can be observed in the outward and inward FDI data of every country (Antràs, 2020; Goldberg & Reed, 2023).

(2) Network Changes

Buyers and suppliers are interdependent to acquire critical resources to ensure business continuity and long-term survival. The supply chain uncertainty happens when an external party exerts huge control over the resources and there are limited alternatives available. Therefore, knowing the upstream and downstream suppliers' network could help identify relevant suppliers. The supplier-buyer network changes refer to the adjustment of industrial upstream and downstream supplier relationships. Network changes could reflect the cooperation level between companies and the duration of the network. Scholars used the network analysis method to know what are the critical nodes, that is suppliers, in the global supply chain and

whether such critical suppliers change in different years or keep stable. Another application of network changes is using the number of suppliers to estimate its supply chain heterogeneity.

Previous scholars have proved that the supplier's network change has a positive relationship with technological level, cost, local policy and institute, policy environment, and market demand (BRINZA et al., 2024; Gong, Hassink, Foster, et al., 2022; Gong, Hassink, & Wang, 2022).

This study will use three focal companies' supplier networks as the main network, measuring the number of links to the focal company, the core of the network, and the density of the network in different years to investigate the cooperation level and degree among companies and countries. Also, I will measure the duration of the supply chain relationship to measure the resilience of the supply chain.

(3) Ownership Changes

The change in a company's ownership from one country to another may be led by the trade policy, policy environment, and the strategy of the company (Carbonara et al., 2002). For example, after the trade war between China and the US, the trade barrier was increased between China and the US. In 2019, Ningbo Jifeng Auto Parts Co., a Chinese automotive parts manufacturer, acquired a controlling stake in Grammer AG, a German company specializing in automotive interior components. This acquisition allowed Ningbo Jifeng to expand its market in North America and learn the latest European technologies simultaneously. Therefore, understanding the change in ownership could help investigate the company's development direction, including where it decides to develop. In this study, I will collect the ownership change from the official website of the company.

(4) Structural Changes

The structural change inside the company that could influence the supply chain is vertical integration. Vertical integration is defined as a list of decisions on whether the company should manufacture inside or buy outside the company (Guan & Rehme, 2012). For some automotive companies, they decided to integrate upstream and downstream chains together and produce in-house (Sturgeon et al., 2008). In the real world, enterprises may choose to have larger production units within the company and decrease the number of suppliers (Abrahamsson & Brege, 1997). In some other cases, the situation is totally different. The reasons for structural changes are multiple, including costs, the consideration of strategy, price advantage, and uncertainty in cost/product/price. Under the influence of the current political instability, the main consideration of enterprises is how to solve the problem of uncertainty. In this study, I will measure whether the company does vertical integration in different years.

(5) Technological/Knowledge Changes

The change in technology and knowledge is highly related to geographical change, ownership change, and network change because knowledge and technology are intangible, accompanied by people and particular products. Therefore, when other

changes happen, technological and knowledge changes occur as well.

Technological/ knowledge changes have several forms in the supply chain. The first one is upgrading and downgrading. Upgrading refers to the process of economic actors moving from low-value to relatively high-value activities. Downgrading refers to the process of economic actors lowering their rank, value, or quality in economic activities (Gereffi et al., 2005). Incremental upgrading may be realized through learning by doing or the allocation of new tasks by the chain's lead firm, which reflects knowledge/technology changes (Humphrey & Schmitz, 2002). Humphrey and Schmitz (2002) identified four types of upgrading: (1) product upgrading, which refers to increased unit values; (2) process upgrading, which refers to making the input-output process more efficient by introducing better technology or adjusting the production process; (3) functional upgrading, which refers to applying new functions or abandoning old functions to increase the overall skill content of activities; (4) inter-sectoral upgrading, which refers to firms move from one product line to another product line by acquired competence. Although there are four types of upgrading, it is hard to identify the boundary between different types of upgrading in the real world. Also, supplying a whole range of goods in one place does not fit the concept of upgrading (Gereffi, 2019). For example, Antràs & Chor (2018) and Frederick (2019) also used the World Input-Output Database (WIOD) to trace the countries' GVC positioning (upstream, midstream, and downstream) and the changes in different years. In this study, I will use the suppliers' comparison positions (upstream or downstream), and the change in the length covered in the chain to measure upgrading and downgrading.

The second one is the FDI flows at a firm level. This indicator could reflect the change in companies' collaboration level with other companies. Typically, a high FDI amount reflects the high level of knowledge/technology transfer (Isaksson et al., 2016). This data could be collected from the firm's financial statements.

The third one is the R&D output. Dohse et al. (2024) found that research output could reflect firms' supply chain constraints. Therefore, research output could be seen as an indicator to measure technological/ knowledge changes. This data could be also collected from the firm's financial statements.

The fourth one is patent. Patent reflects the change in technology/knowledge level in the company. Although previous research proved that it is not accurate to use patents to measure technology transfer, it does indicate communication between two sides (Jaffe et al., 2000). Isaksson et al. (2016) suggested that the buyer-supplier relationship produces knowledge spillover, which can be measured by patents. Therefore, in this paper, I choose to collect the date of patent application and patents' forward citation from suppliers. The patent application date could reflect the time that knowledge/technology was created, and the forward citation could reflect the quality of the patent, which indirectly proves the change in the supply chain.

In the third section, this research will combine the below indicators with the supply chain mapping method.

METHODOLOGY

SUPPLY CHAIN MAPPING METHOD

To deeply understand the changes behind the global supply chain, the first step is to know who supplies, what to supply, and who purchases. A supply chain map could visually display by presenting appropriate and accurate information in a manner that can be easily understood and, at the same time, be sufficiently informative to aid supply chain visibility, analysis, and integration (MacCarthy et al., 2022; Mubarik et al., 2023).

There are two roles of supply chain mapping when faced with such changes in the supply chain. From a macro level, we could have a comprehensive understanding of the real effects of the policies and decoupling sentiment, including where the location of the production transfer, how large the scope of the transfer, will affect the power relations of existing suppliers, and how will there be a large number of supplier relationship reconstructions.

From a micro level, we can understand the strategy change of multinational enterprises when they face global political uncertainty. Although previous scholars interviewed executives of multinational corporations about their future plans for reshoring or nearshoring, there has not yet been a clear conclusion on what their options for choosing the place to manufacture. Therefore, this study could provide an empirical perspective on the choices of multinational corporations by combining their activities and plans. For example, the ownership change and financing change could reflect executive choices.

In this research, I choose the FactSet Supply Chain Relationship Database to collect three focal companies' multi-tier buyer-supplier relationships. The FactSet Supply Chain Relationship Database is a commercial supply chain database that covers business relationship interconnections among companies globally. FactSet analysts systematically collect companies' relationship information exclusively from primary public sources such as SEC 10-K annual filings, investor presentations, and press releases, and classify them through normalized relationship types. Company information is fully reviewed annually, and changes based on corporate actions are monitored daily. The result is a comprehensive, detailed and up-to-date dataset of material intercompany relationships.

FactSet Supply Chain Relationships currently covers more than 25,000 publicly traded companies around the world, comprising over 270,000 business relationships, normalized into 4 main categories and 13 types, with historical data going back as far as 2003. Percentage revenues between suppliers and customers are disclosed, as available. In addition, supply keywords are captured where available to provide meaningful context to the nature of the relationship between companies. As for the data Maintenance, FactSet Supply Chain Relationships is

maintained and updated on an ongoing basis as companies release their annual financial filings throughout the calendar year. Relationships information for IPOs is derived from the prospectus.

DATASET

This study will choose three lithium-ion battery companies that deeply participate in global supply chain as the main study object. Reasons to choose the lithium-ion battery industry are multiple. First, the production of lithium-ion batteries is highly dependent on critical materials, such as cobalt, lithium, and nickel. Supply chain mapping could reveal the geographical information of the main suppliers and potential supply risks of these raw materials and help manufacturers predict and mitigate supply disruptions due to political instability, trade policies or natural disasters. Second, Mapping the supply chain helps increase transparency in the industry, allowing companies to more accurately understand every link in their supply chain. This is particularly important for ensuring compliance with ESG standards, as the extraction and manufacturing of lithium-ion batteries can involve environmental damage and labour rights issues. Third, lithium-ion batteries have a long production chain all over the world, which is a proper industry for observing changes in the global supply chain.

The three companies in this research are Contemporary Amperex Technology Co., Limited (CATL), Automotive Cells Company (ACC), and Tesla.

Contemporary Amperex Technology Co. Limited (CATL): A global leader in lithium battery manufacturing, specializing in EV and energy storage batteries, with advanced technology and large-scale production for major global automakers.

Automotive Cells Company (ACC): A European battery manufacturer co-founded by Stellantis, TotalEnergies, and Mercedes-Benz, focusing on localized high-performance battery production to support Europe's EV supply chain.

Tesla: An American EV and energy company, producing high-energy-density lithium batteries at Gigafactory for electric vehicles, energy storage systems, and renewable energy applications.

DATA ANALYSIS PROCESS

The data collected from the dataset includes: Supplier_ID, Supplier_Name, Company_ID, Company_Name, Supplier_Country, Supplier_Region, Revenue_Percentage, Relationship_Start_Date, Relationship_End_Date, Supplier_Keyword, Customer_Keyword, relationship_keyword. This research will be based on the relationship's keyword to judge whether this supply chain relationship belongs to the battery industry.

As multi-tier supply chains may cover around 100,000 supply chain relationships, natural language process and big data model is the most efficient method to do the data process, which select the relevant battery suppliers in the different tiers.

In particular, this research choose RAG to construct the thesaurus, a word bank for

upstream and downstream battery keywords, to select suppliers.

Table 2. *The thesaurus for upstream and downstream battery keywords*

Upstream Keywords	Midstream Keywords	Downstream Keywords
aluminum foil	Lithium Battery Anode	Power Battery Manufacturer
Cobalt salt	Lithium battery cathode material	Power battery packaging
Copper Foil	Lithium-Ion Battery Electrolytes	battery formation and testing equipment
Electronic Copper FoilProducts	Lithium-ion Battery Separator Film	new energy vehicle cooling power battery
Graphite	battery materials	new energy vehicle power lithium batteries
Lithium	Cathode active materials	power battery
Copper	cathode material	power battery boxes
	cathode materials	power battery companies
	graphite anode	power battery module
	lithium battery electrolyte manufacturers	vehicle battery tray production equipment
	lithium battery materials	

POTENTIAL RESULTS

This research is expected to offer several meaningful conclusions that will contribute to both academic literature in supply chain management and practical applications, particularly within the lithium-ion battery industry. Firstly, by constructing dynamic global supply chain maps over multiple years (2017 to 2024), the study will reveal the evolving configurations of the battery supply chain. This analysis based on time series will highlight trends such as shifts in supplier-buyer relationships, the emergence or disappearance of key players, and changes in the geographic distribution of supply chain activities. In particular, this research will try to find out the average time customers spend replacing suppliers. Such insights can be a pre-step for researchers to investigate the reasons behind such changes.

Secondly, the research will likely uncover specific changes that have occurred in the battery supply chain after 2020—a period marked by significant global disruptions due to the COVID-19 pandemic and increasing geopolitical uncertainties. The study may reveal how companies have adapted their supply chain strategies in response to these unexpected challenges, such as diversifying their supplier base, reshoring manufacturing processes, or investing in alternative raw materials and technologies. Understanding these adaptive strategies can provide valuable lessons for enhancing supply chain resilience and flexibility.

Thirdly, the analysis of geographical changes will shed light on the shifting clusters of production and consumption

within the battery industry. The study might find, for example, a movement of manufacturing hubs from one region to another due to factors like geopolitical tensions, access to raw materials, or supportive government policies. This could have implications for regional economic development and international trade relations.

Moreover, examining network changes and structural shifts within the supply chain will provide insights into the complexity and interconnectivity of the industry. By applying network analysis techniques to the buyer-supplier relationship data, the research may identify key nodes and clusters within the supply chain, as well as bottlenecks and vulnerabilities. This can help in assessing the overall robustness of the supply chain and in designing strategies to mitigate risks associated with over-reliance on specific suppliers or regions.

The study may also reveal ownership changes and technological or knowledge transfers that are reshaping the industry. For instance, increased mergers and acquisitions could indicate a trend toward vertical integration, while partnerships and joint ventures might reflect collaborative efforts to innovate or enter new markets. Analysis of patent data from the Worldwide Patent Statistical Database (Patstat) could uncover shifts in technological leadership and the diffusion of innovation across the industry.

Finally, the methodology developed in this research—utilizing the FactSet Database for multi-tier supply chain mapping—could serve as a valuable framework for future studies in other industries. By demonstrating the feasibility of constructing dynamic and detailed supply chain networks despite data limitations, the research may encourage more comprehensive analyses of global supply chains in sectors beyond the battery industry.

Overall, the potential results aim to enhance the understanding of how global supply chains evolve over time in response to various risks and challenges. The findings could inform multinational corporations on how to optimize their supply chain strategies and assist policymakers in developing regulations that promote supply chain resilience and sustainability. By providing a clearer picture of the global lithium-ion battery supply chain, this research contributes to the broader goal of mitigating risks associated with supply chain disruptions and supporting the development of sustainable energy solutions.

CONCLUSION

LIMITATIONS

Although the FactSet Database could provide a significant tool for researchers to deal with large-range supply chain relationships, we still need to watch out for the accuracy and comprehension of the data. This data set is not designed for research. Therefore, it is hard to identify product flows between firms. The number of supplier relationships may be influenced by the company's popularity. Large companies disclose more supply relationship

information, and people are more likely to pay attention to them, which increases the chance for FactSet to collect their data into the database. Compared to Bloomberg, the number of supply relationships is less (Culot et al., 2022). Maybe buyer-supplier relationships from another dataset will be included in this research. Second, although the FactSet database provided 10 keywords of the supply chain, in some cases, the keyword is not equal to the product in the supply chain relationship, which requires further verification.

RESEARCH CONTRIBUTIONS

First, this study will make a methodological contribution to improving the feasibility of supply chain mapping. While previous studies collected supplier relationships through news online as the data source and used the Machine Learning method to map the supply chain, this study will use the FactSet Database to collect supplier relationships in the battery industry to guarantee a more accurate relationship. Despite the difficulty of obtaining the material flow in the supply chain, this research covers multiple-tier supplier information, which could be collected and assessed by the keywords of supply transaction.

Second, this research offers a dynamic supply chain management perspective using the starting date and ending date of the buyer-supplier relationships, which could investigate the cooperation between companies and identify the potential risks and vulnerabilities behind such buyer-supplier relationships.

Third, this study is also relevant for practice as it uses the lithium-ion battery industry to further explore the changes in the supply chain and develop strategies for multinational companies and policymakers to mitigate risks associated with uncertain events, such as raw material shortages, geopolitical uncertainties and natural disasters.

CONCLUSION

Under the complex geopolitical environment, the global supply chain faces great challenges in keeping resilient. The supply chain mapping method could serve as a feasible tool to improve the visibility of the supply chain, thereby allowing scholars to know the specific problems occurring in the global supply chain, such as supplier dependency, supply chain bottlenecks, etc., to do the supply chain risk management. As it is a map that covers up, mid, and downstream global supply chains, it could help understand the establishment and termination of relationships between suppliers in different years. Therefore, companies in the supply chain could make efficient strategies to adjust supplier relationships.

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