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Biodiversity and the Future of Science: the Case of the Italian National Biodiversity Future Center

Abstract

This article explores the functioning, governance and sustainability of the Italian National *Biodiversity Future Center* (NBFC) – a novel research structure established under the *National Recovery and Resilience Plan* (PNRR) – using an ethnographic case study focused on one of its organizational units. The analysis highlights the strengths and weaknesses of the Center and suggests some possible implications for Italian universities and higher education policy.

Keywords

biodiversity, NBFC, higher education, multilevel governance of science, third mission

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Biodiversität und die Zukunft der Wissenschaft: Das Beispiel des italienischen Nationalen Zentrums für Biodiversität der Zukunft

Zusammenfassung

Dieser Artikel untersucht die Funktionsweise, Governance und Nachhaltigkeit des *Italian National Biodiversity Future Center* (NBFC) – einer neuen Forschungsstruktur, die im Rahmen des *Nationalen Aufbau- und Resilienzplans* (PNRR) gegründet wurde – anhand einer ethnografischen Fallstudie, die sich auf eine seiner organisatorischen Einheiten konzentriert. Die Analyse hebt die Stärken und Schwächen des Zentrums hervor und weist auf einige mögliche Implikationen für italienische Universitäten und die Hochschulpolitik hin.

Schlüsselwörter

Biodiversität, NBFC, Hochschulbildung, Mehrebenen-Governance der Wissenschaft, Dritte Mission

1 Introduction

This article is framed as an institutional research contribution, developing an academically grounded analysis of the *Italian National Biodiversity Future Center* (NBFC). The NBFC is conceived as a national center established within the framework of the *Italian National Recovery and Resilience Plan* (PNRR).

The paper's goal is to provide a research-based developmental perspective on a systemic issue within the Italian research system: functioning, governance, and sustainability of newly established large-scale centers. In this regard, the NBFC is examined as a case study, through which to explore the opportunities and criticalities of this institutional innovation. Specifically, we analyze the NBFC in terms of its multilevel governance, interdisciplinary collaboration, socio-economic impact, and educational role for future generations. By critically assessing its strengths and weaknesses, the paper aims to contribute to the broader debate on how to design, govern, and sustain complex research centers in the national and European landscape.

2 The National Biodiversity Future Center

2.1 Framework

The *National Biodiversity Future Center* (NBFC) finds its regulatory references within the framework of the *National Recovery and Resilience Plan* (PNRR), the instrument through which Italy has adhered to the *NextGeneration EU* (NGEU) program made available by the European Union to member states to address the economic and social consequences of COVID-19. The program focuses on digitization and innovation, ecological transition, and social inclusion.

Within the Component 2 of the PNRR's Mission 4[4] dedicated to education and research, the Ministry of University and Research funded, with an investment of 1.6 billion euros, the creation of five National Centers to enhance research structures and create national champions of research and development in certain Key Enabling Technologies.

2.2 The PNNR general scenario and the specific mission of NFBC

The new National Centers focus on strategic themes set by the Ministry of University and Research, including biodiversity. Biodiversity encompasses multiple natural elements, spatial scales, and human contexts (Conference on Biological Diversity, 1992). Its importance for human life and well-being is widely acknowledged (Robinson, 2024), as are the risks of loss due to climate change and pollution (IPBES, 2019). Italy, holding Europe's richest biodiversity heritage (Ercole et al., 2021), amended its Constitution in 2022 to protect it (Articles 9 and 41).

The NBFC pursues two goals: monitoring and restoring biodiversity in ecosystems, and valorizing it as a resource for sustainable development. It aims to become a center of excellence in research, technology transfer, and training, while raising public awareness and supporting biodiversity policies. This requires the involvement of universities, research centers, associations, and private actors.

Structured according to a "Hub & Spokes" model under the National Research Council, NBFC included six Spokes addressing ecosystems, one focuses on communication and public engagement (Einsiedel, 2005), and one on innovation. Its structure includes the Gateway, a large "virtual and physical infrastructure" designed as a "portal between research and society where the products of research and innovation will become valuable for citizens, innovators, and institutions"[5]. It is a space for

4 https://www.mur.gov.it/it/pnrr/pnrr-misure-e-componenti, retrieved June 1st 2025
5 https://www.nbfc.it/en/presentation, retrieved June 1st 2025

sharing information and discussing biodiversity with various stakeholders, also addressing the emerging need for their active participation in biodiversity issues. An Intellectual Property Board oversees IP. With over 2,000 researchers (53.7 % women, 60 % among PhDs), participation is concentrated in the North (65–70 %).

The experience of the NBFC resonates with a broader international debate on how national and transnational centres for biodiversity research are organized, funded, and sustained. Looking at comparable experiences helps to better situate the NBFC within this landscape and to assess both its potential and its systemic vulnerabilities.

In this perspective, the NBFC should not be interpreted merely as a thematic centre on biodiversity, but as a potential national hub within the Italian research system, designed to connect universities, public research bodies, private institutions, and companies in a coordinated framework. Similar international experiences, such as Germany's iDiv, the US NCEAS, France's FRB/CESAB, Australia's NESP hubs, and the UKCEH, demonstrate both the potential and the fragility of such institutional innovations. On the one hand, these centres highlight the capacity of hub-and-spoke models to foster interdisciplinarity, accelerate knowledge synthesis, and strengthen science–policy interfaces (Hooghe & Marks, 2003; Gornitzka & Maassen, 2017; Lepori, Usher & Montauti, 2013). On the other hand, comparative evaluations consistently point to structural vulnerabilities: high coordination and transaction costs, the bureaucratisation of research work, and the difficulty of ensuring long-term financial sustainability (Capano, Regini & Turri, 2016). Situating the NBFC within this wider family of institutional arrangements thus reinforces the importance and timeliness of our research problem: to analyse the governance of complex national centres as a systemic challenge in the Italian context, where the promise of integration and innovation is inseparable from the risks of inefficiency and fragility.

3 Research Design Methodology

This study builds on three main sources of information:

a. the materials documenting the implementation of the *Italian National Recovery and Resilience Plan* (PNRR) as part of the Next Generation EU program and the creation of its National Research Centers, including the NBFC;

b. the active participation in and direct observation of the creation and functioning of the NBFC by the authors;

c. the active participation in and direct observation of the research project on *Biodiversity Management, Restoration Economy, and Societal Impact*, an activity included in Spoke 6 of NBFC *Biodiversity and Human Well-being*.

The documentary materials include project proposals, internal reports, and the institutional websites of the PNRR and NBFC. Direct observation draws on online communications between the HUB and the Spokes, as well as participation in national and local events, such as the two National Forums on Biodiversity (Rome, May 2023; Palermo, May 2025) and the Spoke 6 meeting held in Pavia in November 2023, where four thematic workshops were organized (Completed Projects, Ongoing Projects, External Communication, and Companies and Territory).

Given the sheer size and complexity of the Center, it is premature to attempt a systematic evaluation of the overall operational model. For this reason, we focus on Spoke 6 as a representative organizational section, under the assumption that many of the strengths and weaknesses identified here are distributed throughout the wider structure. This choice is justified by the cross-cutting mission of Spoke 6, which directly addresses the systemic relationship between biodiversity and human well-being, thereby reflecting the interdisciplinary and governance challenges that characterize the NBFC as a whole.

From a methodological perspective, the research design is best understood as an ethnographic case study, in the sense of a systematic and reflexive engagement with organizational practices through direct involvement and interpretive analysis (Van

Maanen, 2011; Ybema et al., 2009). The study employs multi-method triangulation (Flick, 2018), combining: documentary analysis of institutional and project reports; direct observation of national-level meetings and events; and participant observation within a specific organizational activity. Triangulation strengthens the credibility of the findings by cross-validating insights across different sources and levels of observation.

Our positionality as participant-observers is both a resource and a potential source of bias. Insider status provides privileged access to data, processes, and informal interactions that are rarely available to external researchers, enabling a more fine-grained analysis of organizational dynamics. At the same time, it entails well-known risks such as over-identification, selective perception, and reduced critical distance (Brannick & Coghlan, 2007). To mitigate these risks, we adopted a reflexive stance, systematically documenting observations, engaging in team-based discussions to cross-check interpretations, and validating ethnographic insights against documentary evidence. These practices are intended to preserve analytical rigor while capitalizing on the advantages of insider research (Alvesson, 2003).

The last activity constitutes the privileged observatory of the authors, involving five researchers (three professors from the University of Pavia and two early-career researchers in sociology and economics funded through NBFC). Importantly, our group was the only one representing the social sciences in a context otherwise dominated by natural and life sciences. Furthermore, the team was formally assigned the task of supervising the external communication of Spoke 6. This dual role positioned us internally within the organizational structure while simultaneously being perceived by many colleagues as somewhat external and service-oriented. Such a hybrid positionality – at once insider and outsider (Dwyer & Buckle, 2009) – proved to be particularly productive for ethnographic inquiry, as it enabled us to access relational dynamics and collect valuable observational material precisely because of this altered, and sometimes ambiguous, perception of our role.

Spoke 6, on which our analysis focuses, involves around 300 researchers from universities, research institutes, and companies, coordinated by the National Research

Council, and is structured into four distinct but complementary working groups on: (1) how Nature-Based Solutions modulate the urban exposome; (2) how biodiversity can be enhanced to obtain new sources of food, drugs, nutraceuticals, and (bio)materials; (3) how biodiversity can be leveraged by redesigning industrial production processes in line with the principles of the circular economy; and (4) how biodiversity conservation and restoration can generate significant economic and social impacts.

4 NBFC as Innovative Research Coordination Structure: some general findings

To analyze the NBFC, we adopted a SWOT approach. While similar problems may occur across all Spokes, focusing on Spoke 6 enables closer examination of specific inefficiencies. Two main themes guide our analysis: first, the governance features of the hub-and-spoke model; second, the third mission activities, especially the Center's role in mediating between academia and enterprises and in fostering cultural change on biodiversity at social, economic, and political levels.

4.1 Multilevel governance of science: complexity both as an opportunity and a problem

The NBFC represents an unprecedented initiative in the Italian context due to its distinctive organizational model. It can be considered a relevant case study for examining the multi-level governance (MLG) of science (Maassen & Olsen, 2007; Fumasoli, 2015). In line with the broader understanding of MLG as the interplay of decision-making across vertically and horizontally differentiated arenas (Hooghe & Marks, 2003; Scharpf, 1997), NBFC's governance is articulated through several layers: the European and national policy levels, the implementation level coordinated by the Ministry and the central Hub, and the local level where Spokes develop their activities.

Importantly, NBFC governance unfolds not only vertically but also horizontally, involving collaboration among a diverse set of actors, including universities, research centers, associations, private companies, and non-profit organizations. While such arrangements may foster integration and interdisciplinarity, the literature highlights their structural limitations, particularly in contexts characterized by fragmented institutional capacities (Bleiklie, Enders & Lepori, 2017). One critical issue is bureaucratization. The administrative requirements associated with PNRR-funded projects add to the existing procedures of the institutions involved—most notably universities—thus multiplying reporting obligations and creating inefficiencies. As also noted in European and comparative studies, researchers often find themselves personally responding to administrative requests at the expense of their core scientific activities.

This problem is particularly acute in Italy, where the PNRR has introduced a substantial but highly regulated funding stream. Recent analyses emphasize both the opportunities and the risks associated with these investments, pointing to the weak administrative capacity of universities and research organizations to absorb additional bureaucratic tasks (Regini & Ghio, 2022). The absence of dedicated administrative staff within many institutional structures exacerbates this situation, further transferring the burden of project management to researchers themselves (Capano, Regini & Turri, 2016).

The coordination of NBFC is challenged by the multiplicity of governance levels, which often makes the clear identification of roles and responsibilities difficult. Within the Spokes, however, coordination appears more effective: the case of Spoke 6 demonstrates that smaller size, clearer leadership, and a more direct chain of responsibility contribute to more efficient decision-making and operations. Yet professionals engaged in Spoke activities cannot dedicate themselves fully to NBFC, since most hold academic or managerial responsibilities in their own universities or research institutions.

This inevitably produces inefficiencies and gaps in coordination. Dedicated NBFC recruits, specifically hired to sustain organizational and research tasks, mitigate some

of these shortcomings, but this redistribution of effort also means diverting time from research—the very activity that constitutes the Center's primary mission.

Another central characteristic of the NBFC is multidisciplinarity, which is essential but also demanding in practice. Investigating biodiversity's ecological, social, and economic dimensions requires broad disciplinary integration (Farinha-Marques, 2011). While the NBFC project envisioned multidisciplinarity as a distinctive strength, turning it into effective collaboration has proven complex. As emphasized in the literature (Schijf et al., 2022; Rhoten & Parker, 2004), interdisciplinary work requires epistemological and linguistic negotiation, long before empirical cooperation can be consolidated. The predominance of natural and life sciences within NBFC reduces some difficulties, as many researchers share a common epistemological basis. Nonetheless, developing shared projects with distant disciplines demands time and resources that are often scarce. For this reason, cross-disciplinary working groups have been established, allowing researchers to converge around specific themes. An illustrative case is the collaboration between the authors, all sociologists, and two colleagues in business studies within Activity 4 of Spoke 6. This cooperation enriched the analysis of biodiversity and social innovation, offering complementary perspectives on business models and societal impacts. Yet challenges persist: disciplinary definitions, theoretical frameworks, and methodological traditions are not always easily reconciled, and publishing interdisciplinary results remains problematic, as academic advancement still depends on disciplinary journals.

The difficulties intensify when broader synthesis is required. Cross-disciplinary groups present their results in common meetings, but the very limited time allocated to individual contributions constrains exchange. While these interactions foster a desire to understand and sometimes inspire new collaborations, they are not sufficient to consolidate systematic integration. At the level of Spokes or the NBFC as a whole, where hard sciences are dominant, the challenge of establishing dialogue with the social sciences becomes even more pressing. Nevertheless, evidence from Spoke 6 meetings and national Forums suggests that disciplinary distance also stimulates curiosity, opening opportunities for unexpected collaborations. In this context, the social sciences demonstrate a transversal potential, particularly in mediating with local

communities and policymakers, providing a crucial link between biodiversity research and its societal uptake.

4.2 A research coordination structure

According to the Triple Helix Systems model (Ranga & Etzkowitz, 2013), the NBFC integrates state, academia, and industry in a collaborative framework. In line with PNRR objectives, it involves businesses, universities, and research centers in producing knowledge and technologies for the conservation and enhancement of biodiversity, with the aim of generating innovation, new enterprises, and professional opportunities.

Companies participate as partners alongside universities and research entities. At the local level, "Cascade Calls" have funded activities, though their complexity discouraged some participants. The owner of a startup supported by Spoke 6 emphasized the benefits of collaboration, praising the Center's shared goals and its "authority":

> " […] pushing in the same direction together, results are achieved more quickly, teamwork is built, and Italy's unique resources are enhanced […]. Being able to work with such an important center is also very gratifying for us because it is authoritative, stimulating, and also exciting. And passion is essential because the challenges are not few" (Planta Rei, Founder, May 13, 2024)

These statements contrast with findings from a workshop during the National Biodiversity Forum in Palermo (2024), where companies outside NBFC expressed mistrust towards universities. The issue of trust (Vaira, Rostan, Ceravolo & Balduzzi, 2024) was linked to research timelines, perceived as too slow and bureaucratic compared with market needs, as well as constraints on data use. The persistent mismatch between academic and business rhythms is a classic theme in third mission studies.

Such opportunities coexist with structural limits. Since NBFC relies on the administrative frameworks of universities, bureaucratic delays are not reduced but often multiplied, as confirmed by experiences in Spoke 6. The result is further divergence

between scientific production timelines and those required by companies. Nevertheless, the Center has been active in developing skills and professions needed for biodiversity management, a task more easily aligned with existing university activities.

Finally, dissemination and communication, crucial for public engagement, show similar tensions. Despite the involvement of Spoke 7, agencies, and local representatives, coordination remains weak, leaving researchers uncertain about external communication and at risk of workload increases. Without a coherent plan, citizen science initiatives and educational projects risk fragmentation. In response, Spoke 6 created its own communication structure. Interviews with companies further revealed low public understanding of biodiversity, limiting the impact of protection and restoration. Building a stronger biodiversity culture thus represents a major opportunity for the NBFC to influence public debate and policymaking.

4.3 To summarize collected evidences

To summarize all the evidence emerging from the ethnographic observation we attempted to structure a SWOT model. The main themes of reflection that require attention appear to be three.

	HELPFUL **to achieving the objective**	**HARMFUL** **to achieving the objective**
INTERNAL ORIGIN **Attributes of the organization**	**STRENGTH POINTS** High knowledge professionals devote a large part of their scientific times to the center Recruiting of a high number of researcher fully (or almost fully) dedicated to the scope of work of the NFBC Possibilities to pool together new infrastructure and scientific tools for a more advanced research	**WEAK POINTS** Inner complexity of the structure of the center (multilevel structure) causing lack of coordination at different level because (typically) head persons of different research units and Spokes are not fully dedicated to NFBC scope Difficulties to integrate a real interdisciplinary approach with different scientific cultures and languages Lack of administrative personnel fully dedicated to the center (use of Departments administrative personnel) Lack of specific skills of scientific personnel in scientific dissemination and communication
EXTERNAL ORIGIN **Attributes of environment**	**OPPORTUNITIES** Governmental support to the NFBC with specific funding Centrality of the issues for the future of the planet Possible future opportunities in term of cooperation with different private and public stakeholders	**THREATS** Lack of recognition of the role of the center in suggesting policy frameworks for the future because of the inadequacy of dissemination process The bureaucratic requirements outlined in the guidelines for the scientific, and especially financial, reporting

Fig. 1: NBFC’s SWOT analysis

Firstly, the multidisciplinary composition of NBFC researchers is both a strength and a weakness. Coordinating this heterogeneity poses organizational and epistemological challenges not yet fully addressed. Building stable structures to manage such complexity would require institutional learning beyond the scope of PNRR procedures. While PNRR funding has expanded research staff and equipment, it has not led to parallel recruitment of administrative personnel or the creation of suitable organizational models. Operations remain delegated to already overloaded Departments and Centers, while the regulatory framework requires constant adjustment.

A further issue concerns the center's capacity to realize third-mission activities. Promising progress is evident in educational programs fostering green economy skills with institutional and private partners. However, collaboration with businesses for new technologies and effective dissemination for cultural change appears weaker. Administrative difficulties and mismatched timelines between research and business persist, suggesting that the center has not yet triggered the necessary cultural shift. Governance complexity further slows decision-making.

Finally, effective dissemination requires a cultural change by academics, still ongoing in Italy. Evidence highlights the importance of involving professional science communicators to strengthen biodiversity outreach and public understanding.

5 The Future of NBFC: discussion and implications

The NBFC started in September 2022 and is set to conclude by 2025, though it will likely continue under a new institutional arrangement. Its foremost challenge will be financial sustainability. Funded through Next Generation EU, the Center benefitted from an unprecedented investment in Italian research. As this extraordinary support ends, the NBFC must self-finance future activities, competing for resources or pooling existing ones.

The termination of PNRR may also alter National Centers' relations with universities. Much research has been implemented by individual institutions, and without financial incentives it is unlikely they will remain engaged in structures that burden operations and drain resources. The Recovery Plan also required major administrative efforts: reorganizing units, creating new ones, and developing staff skills. If the five Centers—including NBFC—do not persist, universities risk wasting these investments.

PNRR funds enabled the recruitment of 257 researchers only at NBFC. Their future is uncertain, with three foreseeable consequences:

a. NBFC and the other Centers risk losing valuable human resources;

b. the competences of a new generation may dissipate;

c. universities will be pressured to stabilize these researchers without the financial means to do so.

The NBFC has generated intense research and third mission activity. By mid-2025, 1,270 scientific works had been published[6]; 13 patents filed, 85 products and services

6 https://www.nbfc.it/pubblicazioni-scientifiche

developed, and 10 citizen science initiatives launched. Public outreach was supported via the Biodiversity Gateway.[7] Evidence nonetheless shows:

a. while vertical coordination enabled NBFC's creation, horizontal coordination in the Hub-Spokes-Activities structure needs longer to overcome its weaknesses;

b. despite fostering collaboration, genuine interdisciplinarity is hampered by insufficient incentives and conditions;

c. while third mission activities expanded, partnerships continue to face obstacles between public and private actors, and university and non-university bodies.

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7 https://www.biodiversitygateway.it/en/

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