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O QUE ESTUDOS DIZEM SOBRE OS INSTITUTOS NACIONAIS DE CIÊNCIA E TECNOLOGIA - INCTS

WHAT STUDIES SAY ABOUT THE NATIONAL INSTITUTES OF SCIENCE AND TECHNOLOGY - INCTS

LO QUE DICEN LOS ESTUDIOS SOBRE LOS INSTITUTOS NACIONALES DE CIENCIA Y TECNOLOGÍA (INCTS)

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Resumo

O presente estudo analisa a trajetória, os principais resultados cientométricos e os impactos estruturais do Programa Institutos Nacionais de Ciência e Tecnologia (INCTs). Com base em uma revisão bibliográfica da literatura especializada, examina-se a expansão do Programa desde a Chamada de 2014 até o ciclo mais recente, marcado por investimento recorde e ampliação do número de institutos. Os resultados indicam aumento significativo da produtividade científica, da internacionalização e da densidade das redes colaborativas, bem como contribuição relevante para a formação de recursos humanos altamente qualificados e consolidação de ecossistemas de pesquisa de longo prazo. Entretanto, identificam-se desafios persistentes, como instabilidade orçamentária, limitações na transferência de conhecimento para políticas públicas e inovação tecnológica, desigualdades regionais na distribuição dos institutos e assimetrias de gênero e raça em posições de liderança. Por fim, o estudo reforça a relevância dos INCTs como instrumentos centrais para o fortalecimento do sistema de ciência, tecnologia e inovação brasileiro, propondo reflexão sobre medidas para maior equidade e sustentabilidade.
Palavras-chave: Desigualdades Na Ciências; CNPq; Coautoria Científica; Políticas Públicas De Ct&I; Impacto Bibliométrico

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Abstract

This study analyzes the trajectory, main scientometric results, and structural impacts of the National Institutes of Science and Technology (INCT) Program. Based on a literature review, it examines the expansion of the Program from the 2014 Call for Proposals to the most recent cycle, marked by record investment and an increase in the number of institutes. The results indicate a significant increase in scientific productivity, internationalization, and the density of collaborative networks, as well as a relevant contribution to the training of highly qualified human resources and the consolidation of long-term research ecosystems. However, persistent challenges are identified, such as budgetary instability, limitations in knowledge transfer to public policies and technological innovation, regional inequalities in the distribution of institutes, and gender and racial asymmetries in leadership positions. Finally, the study reinforces the relevance of INCTs as central instruments for strengthening the Brazilian science, technology, and innovation system, proposing reflection on measures for greater equity and sustainability.
Keywords: Inequalities In Science; CNPq; Scientific Co-Authorship; Public Policies For Science; Technology And Innovation (St&I); Bibliometric Impact

Resumen

Este estudio analiza la trayectoria, los principales resultados cienciométricos y los impactos estructurales del Programa de Institutos Nacionales de Ciencia y Tecnología (INCT). A partir de una revisión bibliográfica, examina la expansión del Programa desde la convocatoria de 2014 hasta el ciclo más reciente, marcado por una inversión récord y un aumento en el número de institutos. Los resultados indican un aumento significativo de la productividad científica, la internacionalización y la densidad de redes de colaboración, así como una contribución relevante a la formación de recursos humanos altamente cualificados y a la consolidación de ecosistemas de investigación a largo plazo. Sin embargo, se identifican desafíos persistentes, como la inestabilidad presupuestaria, las limitaciones en la transferencia de conocimiento a las políticas públicas y la innovación tecnológica, las desigualdades regionales en la distribución de los institutos y las asimetrías de género y raza en los puestos de liderazgo. Finalmente, el estudio refuerza la relevancia de los INCT como instrumentos centrales para el fortalecimiento del sistema brasileño de ciencia, tecnología e innovación, proponiendo una reflexión sobre medidas para una mayor equidad y sostenibilidad.
Palabras clave: Desigualdades en la ciência; CNPq; Coautoría científica; Políticas públicas de ciência; tecnología e innovación; Impacto bibliométrico

1. Introduction

The National Institutes of Science and Technology (INCTs) is a program established in 2008 by the National Council for Scientific and Technological Development (CNPq), in conjunction with the Ministry of Science, Technology and Innovation (MCTI) and state research funding foundations, as part of a strategy to consolidate the national Science, Technology and Innovation (ST&I) system. Inspired by international experiences with networks of excellence, the program replaced and expanded the logic of the former Millennium Institutes, structuring cooperative research networks with medium- and long-term funding, focusing on internationalization, human resources development, and knowledge transfer

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(BRASIL, 2025). Since then, different public calls for proposals have been launched (2008, 2014, 2022, and 2025), reflecting cycles of expansion and budgetary reconfiguration.

Throughout their history, the INCTs (National Institutes of Science and Technology) have established themselves as one of the main federal instruments for scientific promotion, connecting universities, research institutes, and partners from the productive sector around strategic agendas for the scientific and technological development of the country. In this sense, they aim to expand funding options for more comprehensive and relevant scientific research and technological development projects, for the training and development of highly qualified human resources, and for the structuring of research networks that develop, in an articulated manner, projects with clearly measurable objectives and goals, focusing on solving problems in Brazilian society, as well as contributing to the development of public policies and the economic and social development of the country.

It is expected that the INCTs will have a degree of collaboration that enhances Brazilian scientific, technological, and innovation research, enabling the results achieved to be quantitatively greater and qualitatively better than those that would be achieved by the sum of the individual contributions of researchers and research institutions.

The creation of networks should provide for the consolidation of research groups, the exchange of knowledge, and the broad scope of the program, fostering research from north to south of the country. Among the partnerships, the capacity to mobilize the main agents promoting scientific and technological development in Brazil stands out, since, in addition to the Ministry of Science, Technology, Innovation and Communications and CNPq, the Coordination for the Improvement of Higher Education Personnel (CAPES) and the State Research Support Foundations participate, as well as international collaborations.

It is worth highlighting that the Program also aims to support other public policies, such as: the Plano Brasil Maior (Greater Brazil Plan), the National Education Plan, the National Health Plan, the National Agenda of Priorities for Health Research, and the National Policy for Agribusiness, all for the development

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of research in strategic areas such as health, ecology and environment, engineering, information technology, energy, nanotechnology, and public policies, totaling 8 (eight) major areas.

However, given the expiration of the National Institutes of Science and Technology (INCTs) approved in 2014, a literature review of studies on INCTs, especially those from the 2014 call for proposals, is considered essential. Therefore, the general objective of this work is to carry out such a review, compile and present some results found on the National Institutes of Science and Technology, focusing on performance evaluation, scientometric impacts, structural inequalities, and contributions to public policies.

1.1 General Objectives

This work has the specific objective of conducting a narrative review, seeking to identify the main weaknesses, obstacles, strengths, and opportunities, and to propose discussions aimed at improvements. Thus, this study is justified by the potential impact it can generate for the National Council for Scientific and Technological Development (CNPq), of the Ministry of Science and Technology, by analyzing, reviewing, and presenting some research results on the Institutes.

2. Methodology

This study is a structured narrative literature review, with a qualitative approach and application of thematic content analysis, based on Bardin (1977) and De Oliveira (2011). It is important to note that this work does not aim to be treated as a strict systematic review; however, it adopts explicit criteria for searching, selecting, and organizing the corpus, in order to ensure transparency and replicability.

The searches were conducted between February and December 2025 in the following databases: CAPES Periodicals Portal; SciELO; Google Scholar. These virtual environments were chosen due to their broad accessibility, reliability, and ease of navigation, characteristics that make them effective tools for locating relevant scientific publications.

Boolean combinations were used with the descriptors: ("National Institutes of

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Science and Technology" OR "INCT") AND ("scientometrics" OR "bibliometrics" OR "evaluation" OR "scientific impact" OR "collaboration networks") AND ("regional inequality" OR "gender" OR "scientific funding" OR "knowledge transfer") AND ("Health Areas" OR "Biological Sciences") AND ("Challenges" OR "Obstacles" OR "Evolution").

The following were included: papers published between 2010 and 2025; empirical or theoretical studies with a direct focus on the INCT Program; and works that addressed scientific performance, collaboration networks, funding, or structural inequalities. On the other hand, the following were excluded: opinion pieces without analytical foundation, works without a central focus on the INCTs; and duplications between databases.

The time frame (2010–2025) corresponds to the period after the consolidation of the first call for proposals for the Program and allows for the examination of the evolution of the academic debate across different funding cycles, without disregarding established studies that structure the scientific debate. This approach allows for a balance of historical consistency and current relevance, ensuring that the analysis is based on frameworks that reflect both conceptual evolution and the normative and contextual changes that occurred during the period, including the critical period of the COVID-19 pandemic.

The analysis followed three main stages: 1st exploratory reading and constitution of the corpus (identified as pre-analysis); 2nd thematic coding (stage of exploration of the material); and 3rd articulation between categories and theoretical framework (stage of treatment and interpretation).

It can be said that, in order to identify recurring patterns, convergences, and interpretative gaps in the literature, five analytical categories were defined: scientometric productivity and performance; structure and dynamics of collaboration networks; financial sustainability and dependence on public funding; regional inequalities; and gender and racial inequalities.

Furthermore, it is worth highlighting that the term 'impact' is used in this study in three distinct dimensions: scientific impact (bibliographic production, citations, co-authorship and authorial insertion), structural impact (consolidation of networks,

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formation of critical thinking and institutional strengthening), and systemic impact (capacity for articulation with public policies and generation of effects in the ST&I ecosystem).

Nevertheless, it should be noted that this review may have limitations regarding its reliance on secondary literature, the absence of a comparative empirical basis, and the use of self-reported data from the Observatory of Science, Technology and Innovation (OCTI). Therefore, the conclusions should be interpreted as a critical synthesis of the existing literature, and not as a direct causal assessment of the INCT Program.

3. Results and Literature Review

3.1 Historical Evolution

In the 2014 Call for Proposals, the central focus of this research, 102 (one hundred and two) INCTs were approved, occupying a strategic position in Science, Technology & Innovation (ST&I), both due to their characteristic of having a thematic focus in a specific area of knowledge for long-term development, and due to the complexity of their organization and the size of their funding. Thus, the Program also aims to support other public policies, such as: the Plano Brasil Maior (Greater Brazil Plan), the National Education Plan, the National Health Plan, the National Agenda of Priorities for Health Research, and the National Policy for Agribusiness. All of this is for the development of research in strategic areas such as health, ecology and environment, engineering, information technology, energy, nanotechnology, and public policies, totaling 8 (eight) major areas (BRASIL, 2023).

This call for proposals received several deadline extensions due to its success and the results achieved throughout its duration. In 2022, there was another call for the inclusion of new INCTs, in which 58 (fifty-eight) new Institutes were approved, totaling 160 “active” INCTs in 2024. However, the projects approved in the 2014 call were terminated due to the contract validity. Nevertheless, also in 2024, a new call was made for the selection of new INCTs to begin in 2025, thus giving important continuity to this public policy of investment in cutting-edge research. This new call approved 143 (one hundred and forty-three) new INCTs, consolidating the largest

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investment ever made in the Program, approximately R$1.63 billion (202.3 million USD) (BRAZIL, 2025).

This growth follows international trends of strengthening large scientific consortia as a strategy to address complex problems (BOZEMAN; BOARDMAN, 2014). This is because programs based on collaborative networks tend to increase scientific productivity, internationalization, and the impact of research (WAGNER & LEYDESDORFF, 2005; GHENO et al., 2021). In the Brazilian case, we see that the INCTs (National Institutes of Science and Technology) have contributed to raising the international visibility of national science, expanding the country's participation in global collaboration networks (SIDONE; HADDAD; MENA-CHALCO, 2016; MCMANUS et al., 2020).

3.2 Networks, co-authorship and scientometrics

Furthermore, studies such as those by McManus et al. (2020) and McManus and Baeta Neves (2021) have demonstrated that programs structured in national research networks, such as the INCTs, show higher rates of scientific growth than those observed in isolated groups; that is, the INCTs have contributed to increasing national scientific productivity in strategic areas. This shows that researchers linked to the INCTs have a greater number of publications in high-impact journals, a higher rate of international collaboration, and a greater likelihood of producing highly cited papers when compared to the national average.

Analyses of co-authorship networks, such as those by Do Couto et al. (2024) and Vasconcelos et al. (2025), show that the density and centrality of researchers linked to INCTs have increased significantly over the last decade, indicating greater connectivity, knowledge circulation, and scientific coordination capacity (SIDONE; HADDAD; MENA-CHALCO, 2016; MENA-CHALCO; CESAR-JR., 2014). This pattern is consistent with international evidence that broad scientific networks tend to accelerate the diffusion of ideas, increase the rate of innovation, and broaden the impact of publications (WAGNER; LEYDESDORFF, 2005; WAGNER, 2018).

The concrete results of this collaboration deserve highlighting; for example, according to OCTI data, the evaluation of the INCTs in the Biological Sciences area

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alone, from the 2014 INCT call (2014-2024), carried out using a database of the members of the 24 INCTs, shows that these Institutes reported 372,081 research products, considering full papers, papers in conference proceedings, book chapters, and full abstracts (OCTI, 2024).

Another relevant aspect refers to the structural impact, as mentioned, in this case, regarding the impact on the consolidation of networks, the formation of critical thinking, and the institutional strengthening of INCTs in the consolidation of long-term research ecosystems. It is noteworthy that stable scientific consortia—such as INCTs, European Centres of Excellence, and US National Science and Technology Centers—tend to generate cumulative effects, such as the formation of critical thinking, the attraction of talent, institutional strengthening, and greater capacity for attracting resources (BOZEMAN; BOARDMAN, 2014; OECD, 2020). In the Brazilian case, INCTs have played a central role in the articulation between universities, research institutes, hospitals, multi-user laboratories, and technological centers, contributing to the creation of more integrated and resilient scientific environments, in addition to the training and qualification of human resources (CNPq, 2025).

The concrete results of this collaboration deserve highlighting. For example, according to OCTI data, the evaluation of the National Institutes of Science and Technology (INCTs) in the Biological Sciences area, from the 2014 INCT survey (2014-2024), based on a database of members from the 24 INCTs, shows that the networks formed by these institutes have 3,440 members during this period, distributed across different levels of education: 2,713 PhDs, 346 Masters, 170 graduates, 75 with secondary education, 51 with specializations, 19 with professional master's degrees, 18 with medical residencies, and 10 with technical courses. This pool of human resources indicates multidisciplinary teams with a high level of qualification (OCTI, 2024).

3.3 Funding

On the other hand, even with the recent successes and expansion of the Program, some challenges persist and may compromise the transformative

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potential of the Institutes. According to Ramalho, De Souza and Provete (2025), a recurring problem is the instability in science funding in Brazil, even though the recent call for proposals represented a record increase in resources allocated to INCTs, there is a history of budget cuts and delays in the release of scholarships and operating funds, which weakens the continuity of projects and compromises medium and long-term planning (RAMALHO; DE SOUZA; PROVETE, 2025).

This financial volatility also impacts human resources development, since the interruption of scholarships and grants weakens academic trajectories and reduces the ability to retain young researchers in strategic areas. In addition, the acquisition and maintenance of cutting-edge equipment, as well as the acquisition of highly perishable and low-demand supplies, tend to cause delays in schedules and compromise the maintenance of sensitive laboratory infrastructures, according to the study by Ramalho, De Souza and Provete (2025).

In other words, the binomial of science and technology depends on stable and predictable investments to generate long-term innovation, and countries with sharp budgetary fluctuations tend to exhibit lower global competitiveness and greater institutional vulnerability (OECD, 2021). In this sense, even with the record contribution from the recent INCTs call for proposals, the persistence of an unstable financial environment jeopardizes the consolidation of robust scientific networks and the continuity of highly complex research agendas, which require multi-year investments and continuous inter-institutional coordination.

3.4 Knowledge Transfer to society

Another frequently cited limitation refers to the difficulty of transforming research into results applicable to society, especially when dealing with areas related to public health and the national health system, the Unified Health System (SUS). For example, according to Braga, Costa and Bahia (2025), there is criticism of the limited integration between researchers, public managers and the productive sector. This gap can significantly reduce the capacity to convert scientific discoveries into effective policies and/or innovations for the population, highlighting a mismatch between academic production and social application (BRAGA; COSTA;

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BAHIA, 2025).

Similarly, the gap between converting scientific production into concrete results for society is frequently cited, especially in areas directly linked to public health and the Unified Health System (SUS). Studies such as those by Braga, Costa and Bahia (2025) have shown that the distance between academic research, policy formulation and the implementation of technological solutions remains significant in Brazil.

This gap largely stems from the fragmentation between universities, public managers, and health services, which limits the incorporation of scientific evidence into decision-making processes and reduces the capacity to respond to emerging problems. Braga, Costa, and Bahia (2025) point out that the low integration between researchers, managers, and the productive sector compromises the effectiveness of scientific discoveries, hindering their translation into public policies, clinical protocols, assistive technologies, or organizational innovations that could directly benefit the population.

Furthermore, Braga, Costa, and Bahia (2025) have emphasized that the absence of structured mechanisms for knowledge transfer and innovation in health exacerbates this mismatch between academic production and social application. In many cases, the results generated by research networks—such as the INCTs—remain restricted to the scientific environment, without advancing to stages of validation, scaling, or technological incorporation, due to a lack of interinstitutional articulation, regulatory barriers, insufficient translational funding, and low participation of the productive sector in strategic research agendas.

This scenario reinforces the need for more robust science, technology, and innovation policies, capable of promoting collaborative environments, strengthening public-private partnerships, and creating instruments that facilitate the adoption of scientific evidence (BRAGA, COSTA, BAHIA; 2025).

In parallel, the structural limitations regarding investment in Research and Development (R&D) by the private sector in Brazil, which is significantly low, tend to reduce the capacity to transform scientific knowledge into technological, industrial, or social innovation (MAZZUCATO, 2024). According to the same author,

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this means that even when National Institutes of Science and Technology (INCTs) generate promising results or international collaborations, the practical impact of these results, for example, in industry or public policies, may be limited or take a long time to materialize. This predominantly public dependence on funding science makes progress highly vulnerable to changes in government, economic crises, or shifts in political priorities. As an example, the severe cuts in funding made between 2019 and 2022 for research, scholarships, infrastructure and innovation, from R$25.3 billion (4.8 billion USD) to R$17.1 billion (3.25 billion USD), affecting projects, laboratory maintenance, and the training of qualified human resources (MAZZUCATO, 2024).

3.5 Geographical context

Regarding geographical issues, even with the recent expansion of INCTs, we still see significant regional inequalities in the distribution of these research networks across the country. Studies such as that of Resende et al. (2025) demonstrate that the historical concentration of scientific infrastructure, qualified human resources, and consolidated research institutions in certain regions continues to strongly influence the allocation of new institutes. The North, Northeast, and Central-West regions, traditionally less favored in terms of structural investments, continue to receive a significantly smaller fraction of the resources allocated to the Program, perpetuating a pattern already identified by Cavalcante (2011) within the scope of the National System of Science, Technology and Innovation (MARENCO, 2024), even though the recent 2024 call for proposals sought to mitigate this traditional favoritism (BRASIL, 2025).

This regional concentration not only reflects historical inequalities but also limits the capacity to democratize access to high-level research in peripheral or remote areas. Although the most recent calls for proposals from the National Institutes of Science and Technology (INCTs) have incorporated decentralization criteria, as well as mechanisms to encourage the participation of institutions outside the South-Southeast axis, it is understood that such measures have not yet been sufficient to substantially alter the national landscape.

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According to Resende et al. (2025), structural inertia, marked by disparities in laboratory infrastructure, availability of PhD researchers, pre-existing collaboration networks, and capacity to attract resources, still hinders the emergence of new scientific centers in less developed regions. As a consequence, a significant portion of the research potential of these regions tends to remain underutilized, perpetuating asymmetries.

Furthermore, the very dynamics of scientific collaboration networks tend to reproduce these territorial inequalities. Even though the INCTs promote co-authorship and integration among groups from different regions, studies such as those by Cavalcante (2011) and Resende et al. (2025) show that researchers located in consolidated centers are more likely to occupy central positions in the networks, influencing research agendas, funding flows, and training opportunities. This means that, despite institutional efforts, scientific collaboration can, paradoxically, reinforce existing regional hierarchies instead of mitigating them. In other words, the challenge of reducing regional inequalities remains central to strengthening the Brazilian scientific system and consolidating a truly national science, technology, and innovation policy (MARENCO, 2024).

3.6 Aspects of inequality

According to Kobayashi and Rigolin (2015), studies on gender and science are fundamental, as they are dedicated to investigating and debating the ideological dimensions of gender in the production of scientific knowledge, contributing to the deconstruction of stereotypes and naturalizing representations. The authors warn that of the projects approved in the INCT call, approximately 85% are coordinated by men, and only 15% are coordinated by women. In other words, these data suggest the vertical and hierarchical exclusion of women at the top of scientific careers, which is also present in the INCTs. The authors also show that, among the thematic areas of the INCTs with female leadership, the area of Ecology and Environment stands out with six Institutes, followed by the areas of Humanities and Applied Social Sciences and Health, each with four Institutes. The thematic areas of Agricultural Sciences and Agribusiness (2) and Engineering and Information

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Technology (1) were those that gathered the fewest women.

The authors further warn that when comparing the distribution of these INCTs by thematic area, it is found that male leadership is superior in all thematic areas and, moreover, in two of them – Exact Sciences and Energy – there are no female leaders. That is, the argument that in certain careers there is a “feminization of academic hierarchies”, a gender division in science, where there is a concentration of women in the so-called “soft” areas, including Health, Social Sciences and Humanities (MARTINS et al. 2025).

In recent years, studies such as those by Martins et al. (2025) discuss the granting of scholarships and scientific productivity grants in Brazil, highlighting that gender inequalities persist strongly. Although women represent the majority among recent PhDs and those beginning postgraduate studies and research, they remain underrepresented in the most prestigious positions in the funding system—for example, only about 11.2% of researchers with senior-level productivity grants (PQ/CNPq) are women. These disparities occur even when women demonstrate similar academic performance and scientific output, suggesting that structural factors—such as gender biases, male-dominated academic networks, and stereotypes about competence—continue to shape access to scientific careers (VALENTOVA et al., 2017).

Furthermore, even in fields where female presence has grown significantly (such as some areas of health, humanities, or biological sciences), underrepresentation persists in traditional "hard-focus" areas (brazilian abbreviation STEM – exact sciences, engineering, mathematics). In these fields, women are less likely to obtain higher-level productivity grants, hold leadership positions in research groups, or have their production recognized with the same weight as that of men. This suggests that, even with increasing gender diversity at the base, the power and prestige structure remains unequal, perpetuating the marginalization of those who do not fit the dominant traditional profile (BARROS, 2020).

Regarding the intersection of gender and race, the challenges become even more complex and structurally ingrained. Studies such as those by Cunha, Dimenstein, and Dantas (2021) demonstrate that female researchers

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simultaneously experience gender inequality and racial discrimination, a phenomenon that limits their visibility, reduces their opportunities for academic advancement, and restricts their access to scientific leadership positions. These studies also show that Black women, even when they exhibit productivity equivalent to that of their peers, face greater difficulties in obtaining research grants, coordinating groups, or integrating into prestigious scientific networks, highlighting that the Brazilian science and technology system still reproduces radicalized and gendered hierarchies that accumulate throughout the academic trajectory.

This reality reveals that simply increasing the number of women in science is not enough to promote equity, especially when internal inequalities within the women's group itself are not considered. As Cunha, Dimenstein, and Dantas (2021) point out, inclusion policies that ignore intersectionality—that is, the articulation between race, gender, class, and other social dimensions—tend to primarily benefit white women in already relatively privileged positions, failing to reach those who face multiple layers of exclusion. Thus, for programs like the INCTs (National Institutes of Science and Technology) to advance towards a more diverse and socially representative science, mechanisms for monitoring inequalities and institutional strategies that recognize and address these structural barriers that disproportionately affect Black women and other historically marginalized groups become indispensable.

Certainly, despite recent discussions and reports that seek to draw attention to these inequalities (and there are initiatives within the INCTs themselves and funding agencies to promote greater equity), there are still significant gaps. The persistence of gender and racial inequalities in access to scholarships, in the distribution of resources, in the recognition of scientific production, and in leadership opportunities demonstrates that the Brazilian science and technology system needs profound structural reforms that consider gender, race, and other dimensions of social and geographical inequality as a central part of ST&I policies (MARENCO, 2024).

3.7 Analytical Synthesis

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Table 1 below presents the Analytical Synthesis of the Literature on INCTs (2010–2025).

Author(s)	Year	Object of Analysis	Method	Main Conclusions	Identified Limitations
Mena-Chalco; Cesar-Jr	2014	Scientific production linked to national networks	Bibliometrics and citation analysis	Growth in inter-institutional collaboration	Database limited to specific indexing
Bozeman; Boardman	2014	Scientific collaboration and research centers	International comparative study	Networks expand impact and institutional coordination	A different context from that of the Brazilian system.
Kobayashi; Rigolin	2015	Gender in the coordination of INCTs	Descriptive analysis of leadership	Underrepresentation of women in coordination roles	Data restricted to the analyzed call
Sidone; Haddad; Mena-Chalco	2016	Co-authorship networks in the Brazilian scientific system	Network analysis (brazilian abbreviation ARS) and bibliometric	Increased centrality and density of networks; greater international integration	Does not isolate specific effect of INCTs; absence of

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		(including INCTs)	indicators		control group
Valentova et al.	2017	Gender inequalities in scientific productivity	Comparative bibliometrics	Persistence of structural biases	International data extrapolated to Brazil
McManus et al.	2020	Scientific impact of researchers affiliated with INCTs	Comparative analysis of publications and citations	Higher publication rate in high-impact journals.	Correlation does not imply causation; it does not control the systemic expansion of postgraduate studies.
OECD	2020	Excellence centers and international collaborative networks	International comparative report	Consortia increase critical thinking and coordination.	Not specific to the Brazilian case

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McManus; Baeta Neves	2021	National research and productivity networks	Longitudinal bibliometrics	Growth exceeding the national average	Absence of counterfactual variables
Cunha; Dimenstein; Dantas	2021	Intersectionality (gender and race) in Brazilian science	Qualitative study and critical analysis	Black women face cumulative barriers	National scope, not specific to INCTs.
Do Couto et al.	2024	Structural evolution of collaboration networks	Complex networks analysis	Expanding connectivity and scientific coordination	It does not examine social impact
Vasconcelos et al.	2025	Centrality and density of INCT networks	Longitudinal ARS	Consolidation of dominant scientific centers	Possible reproduction of regional hierarchies
Ramalho; De Souza; Provete	2025	Financial sustainability of INCTs	Documentary and budgetary analysis	Budgetary instability jeopardizes continuity.	Macro focus; lack of area-specific analysis.

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Braga; Costa; Bahia	2025	Knowledge transfer in health (interface with the Brazilian Unified Health System)	Qualitative study and policy analysis	Poor integration between research and implementation.	Evidence focused on the health sector
Resende et al.	2025	Regional distribution of INCTs	Regional statistical analysis	Persistence of concentration in the South-Southeast region	It does not analyze the effects of recent decentralization policies.
Martins et al.	2025	Productivity grants and gender inequality	Statistical analysis of promotion	Women underrepresented at senior levels	It does not focus exclusively on INCTs.

Table 1, Analytical Synthesis of the Literature on INCTs (2010–2025)
Source: The authors

The systematization of the fifteen identified and analyzed studies, presented in Table 1, shows a greater concentration of research in the scientometric dimension and collaborative networks, while aspects related to knowledge transfer, financial governance, and structural inequalities show less empirical density. Furthermore, a recurring absence of counterfactual designs and limitations in causal analysis are observed, reinforcing the predominantly descriptive nature of the available literature.

4. Final Considerations

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The recent trajectory of the INCT Program demonstrates its consolidation as one of the main structuring instruments of the National System of Science, Technology and Innovation in Brazil. From the 2014 Call for Proposals to the significant expansion observed in 2024, with a record investment of R$1.63 billion (202.3 million USD), the Program demonstrates the capacity for expansion and institutional adaptation, aligning itself with national strategic policies and international trends in the organization of science in large collaborative networks. The growth in the number of institutes and the thematic expansion indicate not only institutional robustness, but also political centrality in long-term scientific planning.

The results presented reinforce the quantitative and qualitative impact of the INCTs. The high scientific output, the increased density of co-authorship networks, and the growth in internationalization corroborate the literature that associates collaborative structures with greater productivity and academic impact. In this sense, the INCTs seem to fulfill their function of forming critical thinking, integrating dispersed competencies, and increasing the international visibility of Brazilian science.

Additionally, the Program has significant structural effects on human resources development and the consolidation of scientific ecosystems. The multidisciplinary and highly qualified composition of the teams demonstrates that the INCTs operate as centers for advanced training and interinstitutional collaboration. By integrating universities, research institutes, hospitals, and multi-user laboratories, they contribute to strengthening institutional capacities and creating environments more resilient to the fragmentation typical of developing scientific systems.

However, the sustainability of this public policy remains contingent on stable funding. The history of budget fluctuations and delays in the release of resources seems to compromise the predictability necessary for highly complex and long-term projects. Cutting-edge science depends on multi-year planning, continuous infrastructure maintenance and talent retention, elements weakened in contexts of fiscal instability. In other words, even with the recent record funding, while positive, it does not eliminate the structural vulnerability of the system.

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Another key challenge concerns the ability to convert the knowledge produced into concrete social and economic impacts. The persistent gap between academic production, public policy formulation, and technological innovation limits the transformative potential of the National Institutes of Science and Technology (INCTs), especially in areas such as public health and its articulation with the Unified Health System (SUS). The absence of robust technology transfer mechanisms and the low participation of the private sector in R&D reduce the effectiveness of scientific discoveries, prolonging the time between evidence generation and practical application.

Regional inequalities also remain a structural obstacle. The historical concentration of infrastructure and human capital in the South-Southeast axis tends to reproduce hierarchies in collaborative networks, even when there are formal decentralization initiatives. The centrality occupied by researchers from consolidated regions influences agendas, funding flows, and training opportunities, hindering the emergence of new scientific centers in less favored regions and limiting the democratization of access to high-level research.

Finally, persistent gender and racial inequalities reveal that the quantitative expansion of the Program has not been accompanied by structural transformation in the hierarchies of scientific power. The underrepresentation of women — especially Black women — in leadership positions and in areas considered strategic highlights deep institutional barriers. For the National Institutes of Science and Technology (INCTs) to advance as a state policy committed to excellence and equity, it is essential to incorporate monitoring mechanisms, diversity targets, and effective instruments for correcting asymmetries. Only in this way will it be possible to consolidate a robust, competitive, and socially representative scientific system.

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