The problem of scientific policies in Central America (1980–2020): the tension between innovation and social cohesion in a global context

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ABSTRACT
This article frames and contextualizes the formation and reformulation of scientific and technological institutionalism in Central American countries. It establishes an interpretation of the perceptions of scientific policies in Central America in a comparative manner, starting from the definition of the objectives, goals, and perceptions built around scientific and technological public policies in order to determine the weight exerted by innovation and social cohesion approaches during the formulation and discussion stages.

KEYWORDS
Central America; Science; social cohesion; scientific policy; State reform

O problema das políticas científicas na América Central (1980–2020): a tensão entre inovação e coesão social em um contexto global

RESUMO
O artigo enquadra e contextualiza a conformação e reformulação da institucionalidade em ciência e tecnologia em vários países da América Central. A partir daí, estabelece uma interpretação das percepções sobre o problema das políticas científicas na América Central de maneira comparativa a partir da definição dos objetivos, metas e percepções construídas em torno das políticas públicas em ciência e tecnologia, a fim de ditar o peso que as abordagens de inovação e coesão social tiveram durante as etapas de formulação e discussão.

PALAVRAS-CHAVE
América Central; inovação; sistemas nacionais de ciência e tecnologia; coesão social; Políticas de CTI

El problema de las políticas científicas en América Central (1980–2020): la tensión entre innovación y cohesión social en un contexto global

RESUMEN
El artículo enmarca y contextualiza la conformación y reformulación de la institucionalidad en ciencia y tecnología en varios países de América Central. A partir de allí establece una interpretación de

PALABRAS CLAVE
América Central; innovación; sistemas nacionales de ciencia y tecnología; cohesión social; Políticas de CTI

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1. Introduction

Within public policy studies, a series of criteria and debates are often taken for granted which have been historically marginal both in their conception and their implementation: in short, the idea of the “applicable recipe” has been a ghost that has haunted the field of political and historical research.

In principle, the analysis of public policies arises from a fundamental concern: the orientation of research so that it may be conducive to effective action (Meny and Thoenig 1992). In their beginnings – toward the first half of the twentieth century – public policies dealt with methodological issues or with the creation of tools at the service of Governments and politicians, relegating theoretical musings to the background. Thus, policy science was primarily born to steer action without a second thought further questioning it (Del Castillo & Quintana 2015). Today, this position is clearly unsustainable since it becomes compulsory to consider the gaps, both theoretical and practical, that arise from the implementation of solutions aimed at promoting social welfare. In the context of a “technological society” (Queraltó 2003), or of a late global capitalism based on the knowledge economy (Marquina 2014), the formulation of public policies for development is deemed inconceivable without the key role played by science, information technology, and communication, as well as by the production of knowledge, both at the centers and global peripheries.\footnote{For the case of Latin America, see Kreimer (2006).}

As part of this debate, the relation between techno-scientific development and public policies, according to Albornoz (2009, 65–66), emerged with greater strength after World War II through the implementation of a “linear model” of thought focused on “the financing of basic research as a stimulating starting point of the creative process and transfer of knowledge to the social environment.” Although the criterion persists, contemporary debates regarding productivity, competitiveness, economic growth, social welfare, and others, also enter the equation. This entails the elaboration within political circles of new models of development, of State, and of a view toward the future (García 2011).

As a result of this scenario, since the 1980s a new field of research emerged within studies of science, technology, and society (STS) for the analysis of State and government actions in this direction (Kreimer et al. 2014). As science, technology, and innovation (STI) policies consolidated during the 1990s as the essential paradigm for countries’ development, academic research concerning this topic has continued to increase; both in innovation discourse, as in critical positions to this approach (25–26).

Within these positions, a group was formed by those questioning the real impact of new technologies under the neoliberal development model for improving people’s quality of life (Dutrénit, Puchet, and Moreno 2013). The most outstanding were those
that proposed the study of STI policies starting from questions about the generation of knowledge alongside the creation of more egalitarian societies (Casas 2016; Vessuri 2003). According to Becerra and Juárez (2014), in the past decades a series of perspectives on STI were promoted, aimed at poverty alleviation along with social and inclusive development, under a constructivist approach of technology constituting “agents of social change” (Viales 2016).

In the case of Latin America, this trend has made it possible to systematize and advance in the recognition of the reflective contribution that some disciplines can develop, not necessarily related to a “hard” paradigm of scientific endeavor. Among other elements, the contributions of STS have not only strengthened interregional dialogue and discussion, but have also made it possible to overcome “academic dependency” and position commensurate concepts and points of view (that travel from North to Global South and vice versa), while studying with greater specificity Latin American experiences and challenges in the implementation of mechanisms that bring to light the possible relationships of power immersed in scientific, technological and political exchange (Vaccarezza 1998; Kreimer 2006; Aguirre and Gupta 2009; Thomas 2010; Medina, Costa and Holmes 2014; Kreimer and Vessuri 2018).

In a classic reference article, Dagnino, Thomas, and Davyt (1998) already warned about the possibilities of integrating, from the field of STS, a vision that transcends economic bias and that instead focuses its gaze on the (mis)encounters between technological transformation and management and the achievement of scientific public policy. From this approach, in the works of Albornoz (1997, 2007, 2009) remarkable reflective lines have been developed which have allowed us to face the “single thought” that circumscribes this field within a presumed technicality, especially in the paradigm referring to technological innovation. Instead, the STS literature contributes to rethinking this field as a fertile ground for introducing reforms conducive to reducing gaps and strengthening the bonds of the social fabric, or what has been called “scientific policies for social cohesion or inclusion” (Cozzens and Santos 2008; Viales 2010, 2016; Casas 2012; Cozzens 2012; Thomas, Fressoli, and Becerra 2012; Casas, Corona, and Rivera 2014; Niembro 2015; Schiefer and Noll 2017).

The development of this line of thought has been of vital importance for a region like Latin America, with historical economic disparities, where the search for alternative ways of development, focused on social inclusion and sustainable development, must inevitably go through the formulation of public policies (Dagnino and Thomas 1999; Arocena and Senker 2003; Stubrin and Kababe 2014; Sandoval-Romero, Mongeon, and Larivière 2018).

In this context, Vasen (2016) has recently begun to talk about a possible “post-competitive turn” in the theoretical frameworks on STI policies in Latin America, this in terms of the integrative objectives and goals of governments, where the the axis of “innovation for social inclusion” becomes an important object of analysis for the study of public policies in developing countries, such as in Central America. Thus, although the social cohesion scheme constitutes an essentially contested concept (see Gallie 1956) in the literature (ECLAC 2010), its multiple approaches preserve the essence of its concern to expand the economic approach and incorporate a perspective that is engaged with the social use of the technology and innovation (see Invernizzi 2020).

Starting from a substantive debate with a Latin American perspective, the main interest of this article lies in the STI policy that aims at development and social inclusion, with
specific reference to the case of Central America. For its analysis, it focuses on the formulation and discussion stages, starting from the basic texts of governmental nature for several Central American countries, underscoring the explicit references on this matter. The approach of this work is exploratory and its relevance lies in constituting a first systematization and analysis exercise, with a comparative approach, of the object of study. First, it performs a contextual review that allows organizing the reformulation process of the institutional framework in the field of Science and Technology in the region. Subsequently, it was established that a review is made of the regulations arising from the context surrounding the reforms in the area that occurred in the 1990s. Finally, it centers on the analysis of the scientific policies in force in the Central American countries and provides an insight on the connection between the scientific policies observed and the innovation and social cohesion approaches.

2. The reformulation of the STI institutional framework in Central America

According to Albornoz (1997, 95), from its very beginning the debate regarding the crux of scientific and technological policies has revolved around the “deployment of innovation capacities of society through linking different actors.” Their possible linkage or de-linkage has changed and has not been stable over time.

For this reason, the issue of scientific policies in Central America – and in Latin America, by extension – is not entirely new, especially when considering that since the early 1960s, in tune with the developmental paradigm boom, attempts were made in the region to promote States’ participation in the implementation of programs aimed at boosting domestic industries as economic and social development strategies (Albornoz 2013; Casas 2004). In this context, together with an increase in the bureaucratic and organizational capacity of States, first signs suggest the capacity for advocacy of public policies on science and technology in the region (Viales 2010).

With the arrival of the economic crises experienced by Latin American countries toward the end of the 1970s and beginning of the 1980s, countries turned their attention to a different type of development, characterized by a new “outwards” linkage where exports became the ultimate goal, which Dagnino, Thomas, and Davyt (1996) refer to as the “substantive reformulation of the government intervention pattern”: the realignment of both domestic and international elites which implied a connection between these capitals with dynamics not experienced in previous stages of scientific policy development.

An analysis of the historical trajectory of the Latin American Thought on Science, Technology, and Society (PLACTS, for its Spanish acronym) reveals trends that, in general

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2For Roth (2008),

Public policy is presented as an object of analysis that can be subdivided into several stages which in turn can be studied separately (influenced by positivism). These stages correspond, in the following order, to: problem definition and development of the agenda, formulation, decision (or legitimation), implementation, and lastly, evaluation. This fragmented vision allowed – particularly up to the 1980s – for the realization of significant research, specialized in one or the other stage, or in all the process understood as a (logical) sequence of stages. Likewise, it enabled the development of “partial” theories for each one of the process sequences. (77)

3Casas, Corona y Rivera (2014) carried out a similar comparative study for Argentina, Bolivia, Brazil, Colombia, Costa Rica, Chile, Ecuador, Mexico, Uruguay, and Venezuela. A comparative study focused on Central America is nonetheless still pending.
terms, have been articulated in two stages: first, during the 60s and 70s; then during the 80s and 90s (Dagnino, Thomas, and Davyt 1996). Though this can be broadly affirmed, the particular situation of each Central American country during the second stage deserves a thorough review, as the context of external debt crises on the one hand, and the civil wars on the other, articulated very particular dynamics.

Guerrero (2016, 94) states that “the Central American subregion is not an isolated element in the configuration of international trends on science and technology.” These countries were impacted by a first stage of orientation from the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), followed by a subsequent stage marked by the Washington Consensus: namely, of opening, adjustment, and privatization, with consequences for “state institutions that developed some type of scientific knowledge, making way to a merely administrative conformation of science.”

This change in the orientation of policies has coincided with important transformations in the production of knowledge, a process that is also palpable in various regional scientific institutions. According to Gibbons et al. (1997), there are two ways of knowledge creation: the traditional way, conceptualized as mode 1, characterized by the relevance of scientists in the definition and solution of problems, under a highly hierarchical environment, disciplinary and homogeneous. In contrast, mode 2 of knowledge production supposes a fundamental change, as it is guided not precisely by academic interests, but by social and economic interests, and is constituted under an interdisciplinary, heterogeneous and heterarchical environment. These economic interests have been shown in scientific policies, as Guerrero’s work has shown in the case of the Arias Sánchez (2006–2010) and Chinchilla Miranda (2010–2014) presidencies in Costa Rica (Guerrero 2020). This change has stimulated the creation of different institutions in charge of producing knowledge outside of the more traditional spaces such as universities, which has created a much more complex scientific environment, with larger and much more interconnected actors (Gibbons et al. 1997). This environment is easily observable in the different instruments of regional scientific public policy, where business groups, research institutes, think tanks and laboratories participate in the formulation of said policies, and also in various research projects oriented towards social problems and environmental, and elaborated from different inter- and multidisciplinary approaches, such as STS (Chavarría 2019).

In this context, peace treaties in the region undoubtedly posed a challenge to the growing political and economic elites, related to overcoming a belligerent past and prompting their insertion into a globalized world with stable democracies, according to expert opinions on openness of a new development style implemented by most Central American countries.

The so-called democratic transition was promulgated as a sufficient condition for the creation of a new public institutional structure focused on the production of scientific and technological knowledge:

In other words, the conception of a knowledge-based economy pushes an agenda of a direct relationship between scientific knowledge and economic development that has been applied worldwide. Its persuasion mechanism for underdeveloped countries has been the promise to tackle social inequity through the revitalization of the economy by boosting productivity and competitiveness based on scientific progress [ … ] (Guerrero 2016, 94)
This way, by the beginning of the 1990s all these influences on the reconfiguration of the existing institutional structures had turned latent (see Figure 1). In fact, the studies of uneven development of STI policies in Latin America, in a broad way, have already been explained based on the application and speed of the State reform processes during the decade (Loray 2017). The crisis of paternalistic models and the subsequent opening – post internal armed conflicts – to international trade encouraged the entry of the services sector, and in a broad way, reinvented the debate on the need for scientific development in different countries (Lora 2007).

As shown in Figure 1, the 1990s marked a political and State transition in the Central American region which included the creation of new ministerial posts and/or governing bodies dedicated to planning in the field of science and technology. In the past, such functions had been relegated to other departments overseeing education and planning.

According to Morales and Rivera (1994), the introduction of regulations aimed at restructuring this sector sought, in general terms, to promote a series of strategic areas including:

- Formulation and implementation of national policies on science and technology.
- Intensification of the scientific and technological development of countries due to structuring of the global economy.
- Modernization of productive sectors.
- Dissemination and promotion of science and technology.
- Regional integration of science and technology at the Central American level.

To obtain an effective compliance of the objectives set forth by these public policies, Lahera (2000, 2) asserts that there are at least two broad approaches: the first is what has been called the State reform, “focused on improving certain general conditions in all public policies, such as training, public management, computerization, performance indicators, and personnel policies, among others.” The second approach, carried out by the Executive, refers to a “sustained integrated effort to make certain that the entire Government delivers its very best in relation to a specific policy.”

In Central American countries the initiatives for the formalization of these portfolios responded to State Reform programs, through the articulation of scientific and technological infrastructure: Morales and Rivera (1994) refer to a “technological endogenization process” in the sense that it represented an increase in national capacities for

![Figure 1. Timeline. Creation of science and technology institutions in Central America. Source: Own elaboration.](Image)
coordinating own processes of adoption and use of technologies, both foreign and domestic, aimed at boosting production for intensifying competitiveness.

In short, the different State Reform programs in science and technology in the region made it possible to direct endeavors both in State policies at the medium and long term – as in the linkage between strategic sectors related to production – in search of more favorable conditions for introducing private investment initiatives in Research and Development (R + D). Thus, the mutation of the State’s functions and the philosophy of New Public Management were understood as an effective evolution of the private management concept or business model (Waissbluth and Larrain 2009, 541), presented as the backdrop in a series of changes at the productive and administrative level.

3. The creation of the National Systems of Science and Technology and their incorporation into legislation

At present, largely as a result of the above-mentioned context, the Central American states have begun to acknowledge the importance of scientific and technological development arising from the higher levels of the regulatory pyramid: their current political Constitutions still enclose the express motivations and aspirations of the State regarding support and dissemination in this field.

Table 1 shows the Magna Carta commitments related to the promotion of scientific and technological research. The mentions range from the most general topics concerning support for education, arts and science – as in the case of Costa Rica and Nicaragua – to the more explicit which acknowledges the promotion of scientific endeavors in the linked R + D line – as in Guatemala. The Political Constitution of Panama further establishes that the formulation of national scientific policies as compulsory to this effect.

With the constitutional foundations laid and having surmounted, in a first instance, the adverse climate experienced by the juncture of the Central American war, the 1990s loomed as a propitious moment for the construction and reconfiguration of new national systems of science and technology for elites and international organizations, which until then had been disjointed or dispersed throughout the institutional structure. These new systems created a linkage between a set of institutions, entities and bodies of the public and private sector, as well as the institutions responsible for research management and superior education, whose activities were there outlined (Lemarchand 2010).

The national systems of science, technology, and innovation were created using three levels of articulation, established through the creation of complementary bodies with specific functions for management support. Generally, the first level in charge of policy planning was comprised by a National Council presided by the Minister responsible or, when applicable, by an Executive-appointed official. The Council constituted a collegiate body whose members were representatives from sectors and institutions provided for in the law. A second promotion level was comprised in a greater measure by the programs established in the scientific policies; while a third, that of execution, by the other institutions that make up the system (namely, research centers or NGOs in charge of performing R + D).

The formalization and reformulation of the national science and technology systems in Central American countries, until 1990, was driven by the enactment of a series of regulations that would lay the foundations for the organization and planning of the sector –
although incipiently in some countries: mentions are made of specific laws that regulated R+D from a sectorized perspective (Albornoz 2009).

In the case of Costa Rica, the enactment of the Law on Promotion of Scientific and Technological Development (No. 7169) intended, among other purposes, to support the transformation and modernization of programs in the productive sector which, since the previous decade, had experienced changes in line with the neoliberal development model, sponsored by the structural adjustment programs developed in the country during the last two decades of the twentieth century. This resulted in State support for the promotion and motivation of the already established enterprises dedicated to R+D, both to increase their competitiveness at the domestic and foreign markets, and to promote the creation of new technology-based companies. At this point, it was feasible to begin considering the emergence of a productive sector more linked to the research and development of science and technology (Morales and Rivera 1994).

In Table 2 one can observe the synchrony between the enactment of the regulations oriented towards the creation of institutional structures in science and technology. Though the governments of the 1990s were willing to make reforms in that direction, not all of them ended up formalizing such a system, and the steps taken arose only as an aspiration. Such were the cases of Honduras, Nicaragua, and Panama, who preferred the way of an executive decree and whose institutional framework was not completely molded until well into the new century.

The case of Honduras is unique. Since the enactment of the relevant Executive Decree (No. 55-92) during the Callejas Romero administration (1990-1994), the science and technology system had been structured around a central institution: the Honduran Council of Science and Technology (COHCIT, for its Spanish acronym). This entity had stood as the country’s governing body in the field of scientific and technological development until well into the 2000s. In 2008, the Zelaya Rosales Administration (2006–2009), by means of Executive Decree No. 013-08, elevated COHCIT to the category of Ministry. Furthermore, it included the innovation component as part of this body’s responsibilities. Subsequently, in 2010, the functions of COHCIT were passed on to the National Direction of Competitiveness and Innovation of the Technical Secretariat of Planning and Cooperation (SEPLAN, for its Spanish acronym), but without prioritizing the technological competitiveness area. It was not until 2013 that given the approval of the Law on

| Country         | Year of enactment | Section and content                                                                 |
|-----------------|-------------------|-------------------------------------------------------------------------------------|
| Costa Rica      | 1949              | 89. Among the cultural purposes of the Republic are: [...] to support private initiatives for scientific and artistic progress |
| Panama          | 1972              | 79. The State shall formulate the national scientific policy destined to promote the development of science and technology |
| Honduras        | 1982              | There is no express reference                                                       |
| El Salvador     | 1983              | 53. The State shall promote research and scientific work                               |
| Nicaragua       | 1987              | 125. The State promotes and protects free creation, research, and dissemination of science, technology, arts, and literature, and guarantees and protects intellectual property |
| Guatemala       | 1993              | 80. The State recognizes and promotes science and technology as fundamental bases for national development. The law will regulate as appropriate |

Source: Own elaboration based on the constitutions of the six countries.

Table 1. State promotion of science and technology in the constitutions of the Central American countries.
Promotion and Development of Science, Technology, and Innovation (No. 276-013), the Secretariat of Science, Technology, and Innovation (SENACIT, for its Spanish acronym) was created, as well as the Honduran Institute of Science, Technology, and Innovation (IHCIETI, for its Spanish acronym), both essential components for the implementation of the Law with IHCIETI as the executing arm.

As for Nicaragua, Executive Decree No. 5-95 created the Nicaraguan Council of Science and Technology (CONICYT, for its Spanish acronym), in a first instance as an agency attached to the Ministry of Economy and Development. Later, pursuant to Executive Decree No. 14-02, the former 1995 decree was amended, and CONICYT became an attached body of the Vice-Presidency of the Republic. In 2006, the General Law of Education (No. 582) was passed, whose Articles 79 and 80 established a link between the educational sector and that of science and technology, thus turning CONICYT into an attached body of the Presidency of the National Education Council (CNE, for its Spanish acronym), with functional and administrative independence, and with a scientific-technical character. Since 2008, CONICYT has pushed a preliminary draft of a General Law on Science, Technology, and Innovation intended to articulate this last axis through a National Innovation System and to regulate, in a global manner, a field which until now had been maintained via decree. However, to date, it remains unapproved in the Legislative agenda.

Panama, on the other hand, by means of Executive Decree No. 108, created the National Secretariat of Science and Technology (SENACYT, for its Spanish acronym) attached to the Presidency of the Republic with an advisory nature, while the Science and Technology Commission was adjoined to the former as a collaboration agency. In 1997, following the endorsement of the Law for Guidelines and Tools for the Development of Science, Technology, and Innovation (No. 13), non-explicit items from the previous regulations were formalized, thus establishing the need for a National Strategic Plan in the area. Likewise, it created the National Secretariat of Science, Technology, and Innovation (SENACYT, for its Spanish acronym). In this spirit, in 1998 through the link between education and science and technology, the Science, Technology, and Innovation Clubs (CCTI, for its Spanish acronym) were founded via Law (No. 156) in all schools nationwide as student associations for their promotion from early stages.

**Table 2. Regulations on institutionality in science and technology in Central American countries.**

| Country     | Source                                      | Year of enactment | Presidency                  |
|-------------|---------------------------------------------|-------------------|-----------------------------|
| Costa Rica  | Law for the Promotion of Scientific and Technological Development (№ 7169) | 1990              | Calderón Fournier (1990–1994) |
| Guatemala   | Law for the Promotion of National Scientific and Technological Development (№ 6391) | 1991              | Serrano Elías (1991–1993)   |
| El Salvador | Law on the National Council of Science and Technology (№ 287) | 1992              | Cristiani Burkard (1989–1994) |
| Panama      | Executive Decree (№ 108)                    | 1992              | Endara Galimany (1989–1994)  |
| Honduras    | Executive Decree (№ 5592)                  | 1993              | Callejas Romero (1990–1994)  |
| Nicaragua   | Executive Decree (№ 595)                   | 1995              | Barrios de Chamorro (1990–1997) |

Source: Own elaboration based on Costa Rica (1979, 1982, 1986, 1990, 1999, 2007, 2011, 2015), El Salvador (2010, 2011, 2012, 2013), Honduras (2013, 2019), Guatemala (2005, 2008, 2015), Nicaragua (2010) and Panama (2005, 2010, 2015).
Subsequently, Law No. 50 in 2005 modified Law No.13, turning SENACYT into an autonomous body, thus leaving behind its “attached” condition. Furthermore, it was endowed with financial independence for which the National Fund for the Development of Science, Technology, and Innovation (FONACITI, for its Spanish acronym) was created through Law No. 168.

For its part, in 1992, El Salvador passed the Law of the National Council of Science and Technology (No. 287) by which it was established as an autonomous decentralized institution attached to the Ministry of Economy and as the supreme authority in scientific and Technological Policies. However, the Vice-Ministry of Science and Technology would not be created until 2009 by way of Executive Decree No. 12 as part of the Ministry of Education, with the purpose of introducing educational technology into education centers, as well as linking scientific development, education, and productivity in the country. In 2012, the Law on Scientific and Technological Development (No. 234) was ratified, which outlined the basic institutional and operational instruments and mechanisms for implementing a National Policy on Innovation, Science, and Technology. In 2013, the National Council of Science and Technology (CONACYT) was restructured as a deconcentrated unit of the Ministry of Education reporting directly to the Vice-Ministry of Science and Technology. The new CONACYT would now be responsible for the role of state executor of national policies in terms of scientific and technological development and for stimulating innovation.

The Guatemalan case stands out for creating and consolidating the greater part of its institutional structure during the 1990s. In 1991, the Law on Promotion of the National Scientific and Technological Development (No. 63–91) was approved, establishing the general framework for the promotion, organization, and orientation of the country’s scientific and technological activities. By the same token, it created the National Council of Science and Technology (CONCYT) as the governing body, and the National Secretariat of Science and Technology as its support arm. In 1992, the Law for the creation of the National Fund for Science and Technology (No.73–92) was adopted, endowing the Council with a budget for program execution. Between 1994 and 1996, a set of regulations were ratified which specified the amounts allotted to the Fund and the roles of CONCYT. The new century witnessed the creation of the Support Program for Technological Innovation (PROINTEC, for its Spanish acronym) which began operations in 2004.

In Costa Rica, Law No. 7169 ratified in 1990, succinctly articulated the National Science and Technology System, while binding the National Council for Scientific and Technological Research (CONICIT,\(^4\) for its Spanish acronym), the Ministry of Science and Technology (MICIT, for its Spanish acronym), and the National Science and Technology Program. In 2012, following the situation surrounding the approval of the Central American Free Trade Agreement (CAFTA-DR) with the United States, a series of reforms began to emerge in Costa Rica. Among these was the notable Law on Transfer of the Telecommunications Sector of the Ministry of Environment, Energy, and Telecommunications to the Ministry of Science and Technology (No. 9046), which incorporated the Telecommunications sector to the former MICIT, then renamed Ministry of Science, Technology, and Telecommunications (MICITT,\(^5\) for its Spanish acronym).

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\(^4\)CONICIT, however, was created in Costa Rica in 1972 during the Figueres Ferrer administration.
In summary, it is worth underlining the fact that though the legislation that created the new institutional framework concerning science and technology in the region dates to the early 1990s, not all the assessed countries followed the same path. Costa Rica and Guatemala forged a system that by the twenty-first century was significantly consolidated due to the permanency of their institutions. The other countries, whilst having governing bodies created during the past decade, only a few years ago were still defining certain aspects of their institutional engineering, highlighting the introduction of the innovation axis both in the institutions and in the respective scientific policies.

4. STI policies in Central America and their connection with innovation and social cohesion

Among the conventional instruments owned by the governments for the effective implementation of their projects is so-called “Strategic Planning.” It comprises a management tool which, departing from a “situation analysis,” makes it possible to obtain a set of resources that ultimately prove useful when defining public institutions’ goals and the proper strategy for achieving them. According to Armijo (2011, 15) “from a methodological point of view, strategic planning consists of an exercise of formulation and identification of priority objectives, whose main characteristic is the establishment of courses of action (strategies) to achieve such objectives.” The “formulation exercises” mentioned by the author are accomplished, in short, under the National Development Plans (NDPs). From these – a sectorized perspective – derive ad hoc National Policies according to priority areas of intervention. To this effect, the National Policies on Science, Technology, and Innovation are of great interest under two major approaches: innovation and social cohesion.

Scientific policies are presented as aspiration, planning, and implementation tools at the medium or long term. However, these usually stem from the NDPs considering the provisions of the government in office, as well as the institutional background of the governing institution. Padilla, Gaudin, and Rodríguez (2012) believe that the lack of continuity in Central American scientific policies constitutes a major weakness in the region, due partly to the lack of State policies (long-term) and of consensus or agreements between the national political parties. Likewise, Emiliozzi, Lemarchand, and Gordon (2009) already affirmed that the countries of the Central American isthmus presented fairly sketchy STI policy schemes, with few possibilities of generating strategic articulation networks in the technological area.

Despite this, when examining the structure of scientific policies, the authors point out the existence of common elements, including the following:

- Recognition of the importance of innovation for economic and social development.
- Definition of objectives and strategic lines of action.
- Identification of priority economic sectors and specific approach toward them (selectivity).
- Acknowledgement of the systemic nature of innovation for the promotion of interaction between actors and sectors.

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5For a detailed view on the conformation of the political-scientific community and its role in the definition of STI policies in Costa Rica, see Viales, Arellano, and Granados (2012).
These elements stem from selected observation units (see Table 3); however, it is important to analyze the centrality of their existence. As for the innovation axis, Padilla, Yannick, and Rodríguez (2012) affirm that it has become so consolidated in the past decades that it is now considered essential in the NDPs. Nonetheless, the authors point out that the significance and dimension of the issue varies from one country to another, considering factors of institutional history such as those indicated above.

The first regional policies of the 1990s and the beginning of the 21st century had as main objectives the institutional foundations for the development of “national science and technology systems.” Once the main scientific and technological leaders had been established, the different countries of Central America set objectives that were closely linked to the economic development of the region. Concepts such as innovation, economic development, human capital and competitiveness are central to the different programs developed, which indicates the strong business and economic component that has permeated these policies.

Undoubtedly, the unique thinking in science, technology and innovation, which Mario Albornoz (1997) identified, has guided regional policies, which has had an impact on the creation of neoliberal scientific policies (Guerrero 2020). The National Strategic Plan for the Development of Science, Technology and Innovation 2006–2010 of Panama proposes as a central objective the “competitive insertion of Panama in the world economy” (Panama 2005). Even when the objectives have to do with sustainable development and general well-being, the specific objectives tend to gravitate towards this same question: the National Policy of Innovation, Science and Technology of El Salvador of 2012, establishes as specific objectives to achieve well-being social “innovative entrepreneurship” and “business innovation” (El Salvador 2012).

Recently, most of these scientific policies have a central objective in common which is the progression toward “a knowledge-based economy,” understood as “one which creates added value to products and services, where new productive undertakings emerge and traditional industries revitalize with the adoption of new technologies” (MICITT 2015, 4).

A brief review of the goals established in the respective scientific policies examined here (See Table 4) reveals the weight of the innovation component, explicitly linked, in the cases of El Salvador and Nicaragua, with the development of R+D+I (Research, Development and Innovation).6 As for the innovation axis, the case of the National Policies on

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Table 3. Current STI policies in Central America.

| Country | STI Policy | Institutional Bodies |
|---------|------------|----------------------|
| Costa Rica | National Science, Technology, and Innovation Plan 2015–2021 | Ministry of Science, Technology and Telecommunications (MICITT). |
| El Salvador | National Policy of Innovation, Science and Technology 2013 | Technical Secretariat of the Presidency, Ministry of Economy, Ministry of Education. |
| Guatemala | National Policy for Scientific and Technological Development 2015–2032 | National Secretariat of Science and Technology (SENACYT). |
| Honduras | Data unavailable | Data unavailable. |
| Nicaragua | National Plan for Science, Technology, and Innovation 2010–2013 | Nicaraguan Council of Science and Technology (CONICYT), Vice Presidency of the Republic. |
| Panamá | National Plan for Science, Technology, and Innovation 2015–2019 | National Secretariat of Science, Technology and Innovation (SENACYT). |

Source: Own elaboration.

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6Honduras is still lacking a STI policy; however, the Strategic Institutional Plan of the IHCJETI (Honduran Institute of Science, Technology, and Innovation) 2016–2019 aims to fill the gap that the country’s vision has regarding STI. In this case, it is...
**Table 4.** Goals defined in the current STI policies of Central America.

| Country     | Goals                                                                                                                                                                                                 |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Costa Rica  | 1. Increase the amount and quality of available Human Capital in Science, Technology, and Innovation                                               |
|             | 2. Direct scientific research development towards the Excellent Science                                                                       |
|             | 3. Enable an innovation system centered on strategic steps of point by point design of high-tech products                                     |
|             | 4. Apply science and technology to meet the most pressing challenges of the Costa Rican society through the promotion of Social Innovation       |
| El Salvador | 1. Generate public goods and strengthen the enabling environment for RDI                                                                  |
|             | 2. Reinforce scientific research, technological development, and pre-competitive innovation (RDI)                                            |
|             | 3. Support business innovation for increasing their productivity and competitiveness                                                          |
|             | 4. Encourage innovative entrepreneurship                                                                                                     |
|             | 5. Disseminate and promote technology adoption and RDI absorption in the Salvadoran society                                                |
| Guatemala   | 1. Develop and strengthen the National System of Science and Technology                                                                       |
|             | 2. Support the development of productivity, quality, and competitiveness                                                                       |
|             | 3. Contribute in a scientific and technological way to meet, at the short term, the people’s essential needs                                   |
| Nicaragua   | 1. Promote the linkage of STI policies in accordance with the criteria of coherence, complementarity, and collaboration                          |
|             | 2. Create a favorable environment for improving business competitiveness and facilitating the implementation and financing of joint projects between the Academy and the productive and public sectors, aimed at contributing to the growth and welfare of society |
|             | 3. Upgrade the national capabilities for the use and development of technological innovations, through an increase in quality and efficiency of the national STI system |
|             | 4. Promote the evaluation of the results of research, RDI projects, and sectoral and territorial policy implementation, at both the individual and collective level |
|             | 5. Facilitate social participation of the beneficiaries and users of the results obtained from research and projects aimed at satisfying their needs |
| Panama      | 1. Science, research, technological development, and innovation for sustainable development                                                  |
|             | 2. Science, research, technological development, and innovation for social inclusion                                                          |
|             | 3. Development of business innovation and dynamic entrepreneurship for sustainable competitiveness                                                |
|             | 4. Build a robust institutional structure for science, research, technological development, and innovation                                        |
|             | 5. Strengthen governance capacity of the National Science, Technology, and Innovation System                                                   |
|             | 6. Strengthen the governance capacity of SENACYT                                                                                              |
|             | 7. Reinforce science and the national scientific capacity                                                                                  |
|             | 8. Strengthen and deepen the already built competencies and leverage the existing competitive advantages in the country                        |

Source: Own elaboration based on Costa Rica (2015), El Salvador (2013), Honduras (2019), Guatemala (2015), Nicaragua (2010) and Panama (2015).
Innovation, Science, and Technology of El Salvador stands out for developing a separation between business and social innovation concepts: the former, being most common, refers to the introduction of new or improved products into a “process, marketing or organizational scheme” within the company’s internal practices, while the latter is understood as a process of “elaboration and integration of new ideas for solving issues and challenges of society” (Government of El Salvador 2013). As for Panama’s scientific policies, there are efforts being made to transcend the standardized vision of innovation by introducing concepts such as “innovation for sustainable development” or “innovation for social inclusion.”

Despite these efforts, it is possible to elucidate the persistent rhetoric associated with a linear innovation model (Viales 2010), in such a way that the innovation processes founded on basic and applied research, as well as technology production that generates competitiveness at market level can, per se, alleviate the most pressing social issues: as exemplified in the third goal of the National Plan for Science, Technology, and Innovation 2005–2014 in searching to “contribute in a scientific and technological manner to meet – in the short term – the essential needs of the people” (see Table 5). Though it is possible to identify an uptake in the innovation vision in the countries concerned, Padilla, Gaudin, and Rodríguez (2012, 39–40) insist that, in practice, the degree of development of the innovation systems in Central American countries is far from being homogenous, thus classifying the countries into three levels:

- On a first-level stand Costa Rica and Panama, for which innovation is a central part of their national plans and a long-term vision for development; likewise, their institutions transcend change of governments.
- On an intermediate level are El Salvador and Guatemala, for which the consolidation of an institutional innovation structure is within reach of a greater political will.
- Finally, for Honduras and Nicaragua, the authors deem it necessary to increase the national financial resources, both public and private, to reduce the dependence on international cooperation and advance toward the diversification of sectors in the development of technological capacities.

According to Viales (2010), it is from policies supported on this rhetoric that public policy making is generated with significant democratic deficits, while the dialogue process between policy makers and the civil society remains unclear. Among the scientific policies examined, those from El Salvador and Nicaragua lack an adequate level of detail in their consultation processes, while the rest of the countries are more explicit, highlighting the predominant participation of the Productive Sector and Non-governmental Agencies. Guerrero (2016) arrives at a similar conclusion when stating that “Central America continues to be complacent with the exogenous models that demand a linkage between the scientific policy and the productive sector, competitiveness or a knowledge-based economy” (97) In this scheme, the concern in formulating STI policies that seek to alleviate the deepening of social gaps and the citizen appropriation of technological innovation is, obviously, outside the central plane.

Worth underscoring that the NDP 2018–2022 did not take into consideration the STI variable and it was therefore taken up again by the IHCIETI strategic plan. Furthermore, according to its objectives, this document sets forth an explicit direct relationship between “innovation” and development.
Although the *Fifth State of the Region Report* (2016) revealed a slight improvement in the region’s social and economic aspects during the last five years, the rates of violence continue to grow, undermining social cohesion mainly in the countries located in the so-called northern triangle of the Isthmus. Therefore, the question regarding the outcome of STI policies in the region is more relevant than ever. The report provides several clues when pointing out that:

Many States continue to show a worrying inability to deliver basic services to their citizens, as well as to have a presence and complete control in their territories. Furthermore, the increasing fiscal deficits jeopardize the economic balance and limit the ability to cope with the action of powerful organized crime actors, a problem affecting all countries, though with different degrees of severity. (Programa Estado de la Nación 2016, 36)

As Casas, Corona, and Rivera (2014, 360) allege in their survey, we posit that in the Central American region the social inclusion axis appears as “a complementary objective in search of competitiveness and economic growth,” though its effectiveness is far from being evident. In this context, when speaking of scientific policies for social inclusion, we are dealing with the need of a new linkage between traditional actors who generate public policies and those that remain excluded from the information and knowledge exchange networks. For Viales (2010, 30), this need resides either in promoting new forms of dialogue through the participatory approach of public policies, or an informed participation that permits the redefinition of relations between the different actors interconnected with the construction of inclusion-oriented alternatives (Table 6).

None of the STI policies analyzed require a situation analysis in their preamble. They derive from the awareness of the high social degradation levels in the region during the past decade, thus reiterating the commitment of science and technology with their recuperation. In the case of Costa Rica, its construction process is reaffirmed as “a new form of social management of knowledge” which arises from the connection between

### Table 5. Innovation axis in STI policies of Central America.

| Country       | Innovation Axis                                      |
|---------------|------------------------------------------------------|
| Costa Rica    | Development → Innovation → Economy based on innovation |
| El Salvador   | Economic growth → Innovation → Productivity → Competitiveness |
| Guatemala     | Basic science development → Innovation → Technological Development |
| Honduras      | Innovation → Productive and social demands          |
| Nicaragua     | Innovation → Increased living standards and greater competitiveness |
| Panamá        | Business development → Innovation                   |

Source: Own elaboration based on Costa Rica (2015), El Salvador (2013), Honduras (2019), Guatemala (2015), Nicaragua (2010) and Panama (2015).

### Table 6. Social cohesion axis in the Central American scientific policies.

| Country     | Social Cohesion Axis                                 |
|-------------|------------------------------------------------------|
| Costa Rica  | Collective construction mechanisms → Social knowledge management |
| El Salvador | Principle of transversality                          |
| Guatemala   | Scientific-technological development → Social development |
| Honduras    | Knowledge and technology → Social demands            |
| Nicaragua   | Expresses the purpose of enabling social participation of beneficiaries and users of the results obtained in research and projects aimed at satisfying basic needs |
| Panamá      | Social Innovation → Inclusion                        |

Source: Own elaboration based on Costa Rica (2015), El Salvador (2013), Honduras (2019), Guatemala (2015), Nicaragua (2010) and Panama (2015).
diverse social actors and planning. To this end, the Costa Rican government has emphasized the implementation of platforms such as Open Government, based on the philosophy of citizen participation and collaboration in the implementation of public policies (MICITT 2015, 132).

El Salvador sets forth the principle of transversality in its scientific policy, which is understood as the commitment of placing “RDI at the service of citizens, social welfare, and sustainable development, with full and equal inclusion of the whole of society” (Government of El Salvador, 27). Nevertheless, the document does not describe the participative mechanisms developed therein, much less the possibility of learning about its consultation process.

In Guatemala, scientific policy is part of an extensive sectorized consultation process, since it begins by understanding “each region and its distinctive features, according to its cultural perspective” (CONCYT 2005). From this viewpoint, although Guatemalan scientific policy is considered by far the most explicit according to the consulted actors, the absence of civil society groups is worth underscoring. Likewise, in its scientific and technological contribution program for the attention of the population’s basic needs, the proposed “social and cultural research” category is not adequately developed for addressing the specific issues raised in the document. In the National Policy for Scientific and Technological Development 2015–2032 (See UNESCO 2017), the situation does not vary much from what was stated above: the policy recognizes the importance of the inclusion of different sectors in the matter such as Mayan and Afro-descendant populations. Furthermore, inclusion is conceived as a decentralization process to transfer “power, functions, and resources to the country’s territories” (60–61).

In the Honduran case, there is no mention of the participation of social actors in the formulation of IHCIETI policies. This despite the fact that the same document recognizes the democratization of decision-making as a guiding principle of scientific and technological development: “the scientific communities and the social and productive sectors, and the users or generators of science and technology must participate in the formulation and definition of the general policies in science, technology, and innovation” (IHCIETI 2019, 16–17).

Program number 6 of the National Policy on Science, Technology, and Innovation of Nicaragua responds to the articulation of the actors that comprise the innovation system. The Nicaraguan system provides the stimulus for generating networks that will support the joint development of innovation and social inclusion as a guiding principle. The program was conceived under strategic axes and lines of action which, in first instance, advanced toward a participatory public policy design. Nonetheless, it is important that these lines of action be proven and examined through their implementation during the policy’s validity period.

As in Guatemalan scientific policy, the case of Panama makes explicit reference to both the process and the actors consulted for the preparation of the document, which confirms a great number of participants from the productive sector as well as research centers, for the most part. Precisely, the policy proposes the implementation of the “Program for Science, Research, Technological Development, and Innovation for Social Inclusion,” which “aims to promote community development by utilizing education and technology as drivers, and to boost the participation and social integration of citizens with special needs, and other excluded vulnerable groups” (SENACYT 2015, 19). From this standpoint,
the plan promotes the formulation of social innovation mechanisms for an inclusive development from the education sector.

In short, to a greater or lesser extent, the reviewed scientific policies include in their proposals mentions that point out the need for a gradual integration of more actors in the early formulation stages. From a rhetorical perspective, the majority acknowledge the social role that scientific development should exert, though it is worth highlighting that not all of them specify programs dedicated to the implementation of such postulates. In addition to this, the idea of the social relevance of the STI policies is permeated by verticality; in other words, “it poses the existence of a magical bond with the attention to social issues. There are limited participation opportunities for civil society” (Viales 2010, 27).

This first social cohesion approach to the revised public policies allows us to verify what Vasen (2016) has already advanced for Latin America, namely, the limitations in the incorporation of topics of social interest in the formulation of STI policies. Although, as seen, there are some advances in terms of content, it seems that the “reformist trend” remains in terms of statements of intention. The verification of the implementation of scientific policies for social cohesion and inclusion must advance to a next level that may account for the mechanisms of participation executed in each country, while moving toward a political culture of feedback between the different sectors that comprise society. This aspect, as has been studied by Invernizzi (2020), can help promote new spaces for the democratization of innovation among civil society in the Central American region, which, following Padilla and Gaudin (2013), continues to allocate few state resources destined to STI areas, which translates into “implementation deficits” of scientific policies, short-termism and instability of lines in accordance with changes of government, among other problems.

5. Conclusions

As part of its economic openness and State reform processes, the neoliberal development model in Central America prompted changes through the organization of the Science and Technology sector in the region. In some cases, it modified the existing institutional framework with the purpose of building a National System of Science and Technology, while in other instances, it created a new one.

Both processes have five characteristics in common. First an important bias in the formulation and definition of the innovation-oriented issue of scientific policies: a prevailing global trend. Second, the basis for the consideration of science and innovation focused on the linear model of innovation. Third, a rhetoric partially derived from the linear model, according to which scientific and technological development constitutes a key element of development, and more specifically, of social development. Fourth, a democratic deficit in terms of citizen participation in the definition and formulation of issues concerning science, technology, and innovation, contrary to the strong participation of entrepreneurs and corporations. This implies a weak or null conceptualization of social innovation and science in its attempt to achieve a new social cohesion. Finally, the fifth characteristic does not seem to adjust to the neoliberal formula of “less State equals more growth.” Rather, the reforms of the 1990s concerning scientific policies were aimed at promoting the participation of the State as a dynamic agent, with differences in the public institution structure, although a State policy on this matter is still nonexistent.
Regardless of these characteristics, important progress has been made – at least in the problem definition and formulation stages – in acknowledging the central role played by science, technology, and innovation in the development of the countries in the region. Nevertheless, an open discussion is still pending on the scope of the concepts concerning these issues in the global context of the debate. Regardless of whether this conceptual and rhetorical level reaches its operationalization or not, it should certainly be considered as the core of analysis for future research work.

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