How research groups cope with gaps in science, technology, and innovation policy in Colombia

The case of a nanotechnology research group

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1 Context

The success of science, technology, and innovation (STI) programs depend on the contributions of researchers, their networks and interactions with policymakers and implementers. Despite this recognition, the literature on STI policy retains a top-down focus. A bottom-up perspective is needed to appreciate how the research community responds to a given policy or program and the influence of the research environment.

We argue that STI policies should be evaluated in the broader context of the institutional framework, and pay attention to both policy design, implementation and response from the research community. To assess the impact, contributions, and limitations of policy instruments, it is important to investigate who the research community and local actors interact with, and the influence of the institutional framework. It is essential to understand local strategies and practices within this broader context of regional, national, and international influences that might impact how the research community or research groups respond to given policies or funding opportunities.

2 Empirical Approach and Main Findings

The overarching research question asked what are the survival strategies of research groups (RGs) in the context of policies and instruments to promote STI at the national, regional, and institutional levels? The study focused on 'survival' because the scarcity of resources emerged as the key issue. Within this question, we investigated how researchers adapt to different policy instruments and funding sources, and the role of the research group leader and home institutions.

Methodology — Our examination of STI policies and instruments from a bottom-up perspective utilizes a detailed case-study of a research group based at a Colombian public university. The research groups was devoted to the development of nanocomposites to decontaminate water. Semi-structured interviews and document analysis (STI policies, policy instruments, project documents, scientific publications, press releases and work documents) informed our research.

STI policies in Latin America — From the nineties, science policy in Latin America has focused on strengthening S&T as a means of increasing economic productivity. In 2009, Colombia altered this singular focus by passing a law that directed the STI system to support economic development while promoting public welfare and regional development. The expanded ambition of the STI agenda, however, was not supported by a larger budget. The budget as a percentage of GDP remained one of the lowest in the region.

The law promoted the notion of a system and networks, consistent with social studies of science that underlined the importance of networking and informal exchanges to the generation of knowledge and innovation. Personal social networks facilitate access to resources and sharing of knowledge. Likewise, negotiations with funders allow researchers to understand their priorities and mobilize resources. In Latin America, the evaluation of STI policies has privileged scientific production, and the incentives created by this approach have directed attention away from linking science to the local context and socioeconomic objectives. Consequently, research and use of knowledge generated by scientists often has little relevance. As the links between science and industry can be strengthened, there is an opportunity to build capacity to make effective use of social knowledge.

STI policy instruments — STI policy instruments include research grants and subsidies for laboratories and institutes, and support for networking. With the increasing emphasis on competitive grants and scientific cooperation, there is a growing need for management skills, especially for large research projects, and for communication capabilities to reach industry, politicians, and the public. At the same time, the intended purpose of research grants now includes resolving broader societal problems such as poverty, conflict and environmental sustainability.

STI investments seek to promote technological development and application but there is little funding support to scale innovations from the laboratory to commercial use and/or broader societal impact. Moreover, university promotion criteria and incentive mechanisms reward academic publishing rather than societal impact. In the technology development field, for example, these funding and incentive schemes help explain

why university spinoff companies are still scarce. Field research points to the need to align funding instruments and incentive schemes to support policy objectives.

Research Groups Strategies — RGs interact with STI policies and their instruments, learn from these interactions, and develop their own strategies. Research groups have been shown to promote research quality, allowing affiliated researchers to reach national and international standards, and collaborate internationally. Moreover, researchers who participate in collaborative networks are also better positioned to access resources than those working in relative isolation. Within such groups, intellectual and organizational leadership is important. The leader plays a significant role to the entrepreneurial and intellectual culture and performance of RGs.

In Colombia, policy instruments have been implemented since the mid-1990s to encourage RGs, and quality criteria have been established. It is important to understand how RGs react, organize, and make decisions when faced with changes in the policy landscape. The organizations to which RG members belong can also exert an influence and can play a role in bridging the gaps between national STI policies and the instruments that affect RGs.

Colombian RGs and STI policies and programs — This study investigated a RG created in 2004 in the field of fundamental and applied physical chemistry within the Universidad Industrial de Santander. This group worked on the development of nanocomposites to decontaminate water. The study examined the Research Group's interactions with national STI policies, program, and instruments, and analyzed the role played by its home institution.

Adapting and balancing research agendas — In the presence of multiple policy instruments (e.g., institutional, regional, national funding schemes), RGs must respond to opportunities and adapt their research program to build their capacity. In the case-study, the RG maintained a core research agenda, supported in part by their teaching commitments and the university operating budget for their laboratory. Initially, the RG worked on short term projects to mobilize resources. This was enough to keep members active and develop projects with longer-term potential.

In this scenario, building a research core that was adaptable to multiple funding opportunities was a central element of the group's survival. This RG learned to leverage resources to support exploratory directions where there was no funding. Researchers and RGs learned to diversify their funding portfolio by capitalizing on personal and informal networks. International connections provided further possibilities for accessing additional resources. However, the lack of stable long-term funding has been detrimental to retaining graduate and doctoral students who left the RG prematurely.

The RG developed by performing a juggling act with available STI policy instruments. Internal and external funds were used to seed new directions that were important to the group. As such, the researchers made their research agendas more flexible in the short-term to achieve long-term goals. Through this juggling act, the RG balanced exploitation and exploration tactics to advance their research agenda.

The role of the home institution — The support of the home institution allowed the group to continue its work, even in the absence of externally funded research projects. To build capacity, the university provided grants for masters and doctoral students, and invested in infrastructure and laboratory equipment. University funding allowed researchers to meet with external peers and explore future project ideas. Through its infrastructure development program, the university's support of a technology park allowed the RG to extend its network and access specialized equipment. Access to this infrastructure and expertise allowed the RG to further strengthen its capacity and pursue international collaborations. Therefore, university funds provided some necessary resources for exploration, and this was further complemented with other programs that supported project management.

The intellectual leadership, adaptive capacity of the RG, the expansion of members' networks and collaborative activities, and the support provided by the home university allowed the RG to strengthening of over time. The national STI policy landscape provided numerous opportunities for researchers to develop but gaps in these instruments can slow scientific progress. The case study demonstrated how a RG responded to these gaps and what factors enabled the RG to develop.

3 Main messages for policy and practice

This case study looked at the role of RGs, their leaders, and their home institutions in addressing the gaps and tensions among different STI policy instruments. One observation was the importance of a strategy in guiding the RG to utilize short-term projects to build a longer-term research agenda. In this case, the group maintained a core research agenda while exploiting short-term financing. It was a juggling act between exploration and exploitation of funding sources in a context of scarce resources and limited national support. This balancing related to processes of knowledge generation and the way policy instruments and funding sources and conditions were combined.

Capitalizing on personal and informal networks enabled the RG to take advantage of some policy instruments. This case provides insights into the role of networks in building capacity to take advantage of STI policies. Learning how to develop and mobilize these linkages and combine different policy instruments was important.

Research outcomes with potential economic and social impacts resulted from the cumulative influence of several policy instruments, rather than a single discovery. In this sense, policy impacts were generated through the actions of the RG and their home institutions. By adapting and balancing activities to overcome funding gaps, the RG was able to demonstrate its contributions to the stated policy objectives of the funding program. The case study illustrated the "dance" among actors in the implementation of STI policies, a point that is not usually considered in the impact analysis of STI policies.

The assessment of STI policies and instruments tends to be narrowly focused on a given policy or program. This study highlights the importance of a long-term perspective as significant results can emerge from RGs who utilize multiple programs.

Evaluation of STI policies must take into account the interdependence of funding mechanisms and their cumulative influence on desire policy outcomes. In Colombia, little is known about the capacities and contributions of RGs and universities based on their interactions with different policy mechanisms. This study showed how a RG learned to navigate and utilize different policy instruments, and overcome gaps in the system in pursuit of a long-term research agenda that enhanced the skills and contributions of affiliated researchers.

Related Resources

Jaime, A., Lizarazo, M-L., Pérez, C., and Herrera, B. 2016. Innovación y tradición : Dinámicas de construcción de pertinencia para un desarrollo de descontaminación de agua basado en nanotecnologías en Colombia. In : Foladori, G., Invernizzi, N., and Zayago, E. (éds.). *Investigación y mercado de nanotecnologías en América Latina*. México : Grupo Editorial Miguel Ángel Porrúa.