Colombian initiatives in the Social Appropriation of Science and Technology: tendencies and challenges for a broader understanding of these dynamics

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Abstract

This aritcle is aimed at broadening Colombia's understanding of the social appropriation of science and technology, particularly the types of actors who promote initiatives in this sphere. Using a chain referral sampling methodology, a hundred such initiatives in Colombia were identified and documented, which were promoted by civil society, the State, business, the research community and mediators. The article further analyzes these iniciatives and indicates the challenges they represent, especially in breaking down the traditional approach to the social appropriation of science and technology in Colombia and replacing it with more participative strategies.

Keywords: Social Appropriation of Science and Technology; public participation in science and technology; Colombia.

In the past ten years the notion of the Social Appropriation of Science and Technology (Sast) has been incorporated into Colombia's science policy. The concept was publically introduced in Colombia through the Science, Education and Development Mission in 1994 (Posada et al., 1995). Since then the country's science policy has started referring to it, to give a single label to activities and programs which, in this context and in others, were known by other names, including the popularization of science and technology, the communication of science and technology, and the public communication thereof.

Although the use of the term is based on the assumption, in many cases rhetorical, of the importance of fostering greater public participation, involving a wide range of actors in building science and technology, the actions that have mainly been encouraged by the Colombian National Science and Technology System to put it into practice have concentrated on supporting what are known as legitimate Sast efforts and assumed to provide a bridge between the expert audience and the lay audience, both of which are usually seen in an essentialist, standardized light.[1] In this respect, Felt (2003) and Daza and Arboleda (2007) found that 76% of the investment that the Colombian National Science and Technology Office (Colciencias) made in this area from 1994 to 2004 was concentrated on developing initiatives aimed exclusively at science communication, such as science museums, science education materials and science fairs. Other studies have suggested that these types of activities have become the favored mechanisms for fostering relations between science and society, and that they mainly consist of working with children and youths and promoting inductivist, empirical notions of the production of expert knowledge (Pérez-Bustos, 2010; Franco Avellaneda, Pérez-Bustos, 2009).

The policy has emphasized an idea of Sast that is mainly managed by mediators responsible for carrying out certain types of practices. This has led to an explicit lack of knowledge about the role that other actors play in promoting initiatives aimed at supporting inclusion and participation in the production of expert knowledge.[2] Along these lines, it has been impossible to understand how these dynamics can be promoted by actors traditionally seen as an integral part of the science and technology systems – i.e. the production sector, the scientific community itself, and government agencies (Sábato, Botana, 1968; Arocena, Sutz, 1999) – nor how highly heterogeneous actors can be involved, such as civil society, whose role in dynamizing and socially controlling scientific production has nonetheless been identified (Etzcowitz, 2008; Marone, González del Solar, 2007).

The main objective of this article is to broaden understanding of these actors' roles in Sast dynamics in Colombia. Acknowledging the emphasis that the studies on this topic have had in this country and in other contexts (Daza, Arboleda, 2007; Pérez-Bustos, 2010; Gregory, Miller, 1998; Kasperowski, Nolin, 2003; Felt, 2003) and recalling the propositions of the triple helix (Etzcowitz, 2008) and Sábato's triangle (Sábato, Botana, 1968), the article considers the types of Sast initiatives promoted by five groups of actors in particular, namely: the State, the production and business sector, the research community, civil society, and mediators.[3] To distinguish one actor from another, the ground rule was to identify their different, specific functions; however, in some cases, they proved to be of a hybrid nature.

The initiatives were identified using the chain referral sampling methodology (Granovetter, 1976; Biernacki, Waldorf, 1981; Platt et al., 2006) and were documented by

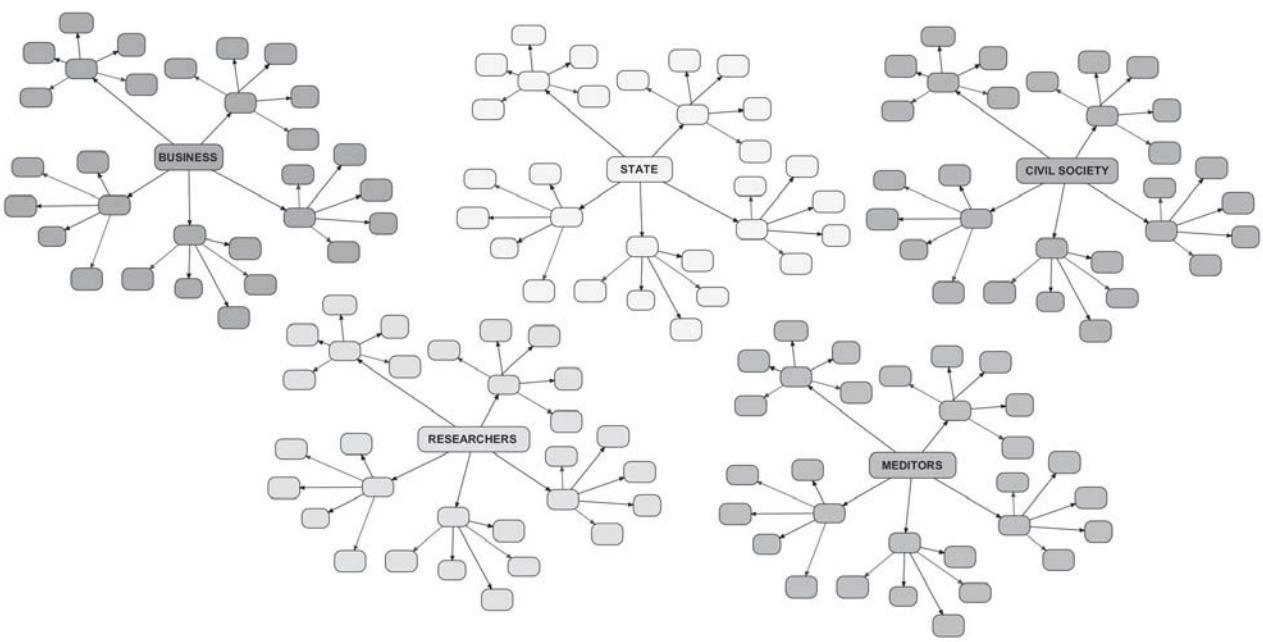
gathering information on the types of institutions that back them, the activities they promote, the objectives that guide them, their target audience, and their area of influence, among others. The following sections describe the methodological approach that oriented the study; followed by a discussion of the tendencies found in the general chain referral schema and the chain referral schema for each actor. The last section draws some conclusions and indicates the challenges they imply for science policy.

Methodological approach

In order to identify and document the types of Sast initiatives the different groups of actors are involved in, a non-probabilistic sampling method was chosen, known as snowball sampling or chain referral sampling. This methodological approach yields information that helps track hidden, hard-to-access populations, using the relationships that exist between some of their known members (Platt et al., 2006). In this case, considering the high profile of mediators, taken to be the legitimate promoters of these initiatives, in giving more visibility to the Sast proposals initiated and carried out by other actors, the challenge was to identify this 'hidden' population. Bearing this in mind, the chain referral sampling started with interviews with experts from each of the system's 'helixes', namely: civil society, business sector, research community, the State and mediators.

Those experts gave referrals of five or more initiatives they knew about which they believed represented examples of Sast initiatives.[4] These initiatives constituted the seed referrals for identifying the Sast proposals for each of the five groups of actors (Biernacki, Waldorf, 1981). The goal proposed for this chain referral sampling exercise was to identify and document one hundred Sast initiatives, twenty promoted by each of the proposed groups (Diagram 1).

Diagram 1: Chain referral sampling schema



Besides identifying initiatives, the chain referral exercise also enabled us to establish connections between some actor groups, while also identifying where groups were isolated from others. These aspects will be discussed in greater depth further on.

After identifying the initiatives, the next step was to document them. To do so, a form was used, which was completed along with the promoter of each Sast proposal. The form asked about the type of actor that promoted the initiative – based on the promoter's main social function and aligned with the above-mentioned five categories –, the year the initiative started, its duration, the periodicity of the activities, the status of the initiative (underway or not), the type of organization promoting it, and the contact information for the organization and the contact person. In addition, specific information was gathered on the initiative: the topics on which it was based, its objectives, the activities and methodologies used to develop the Sast proposal, the target audience, the location, and the area of influence. Finally, the interviewees were asked about possible partners in the initiative and financing sources. To give continuity to the chain referral sampling, at the end of the form each promoter was asked if they knew of other similar initiatives that they could refer.

The chain referral sampling of the Sast initiatives was characterized by a series of idiosyncrasies in the documentation process that give a better understanding of the Sast dynamic itself. Firstly, instead of referring cases that were similar in nature, that is to say, promoted by the same group (business, civil society, mediators, the State or researchers), some interviewees furnished information on initiatives promoted by other groups. Secondly, instead of referring to initiatives run by other groups, they tended to give self-referrals of their own programs or initiatives. That was particularly true of the initiatives promoted by the State and by mediators. The cases of self-referral were not included in the documentation, as that would have given more visibility to some promoter institutions than to others.

The tracking process also presented two limitations. First of all, some contacts gave referrals of initiatives that were no longer underway or were one-offs, which made access to information and the contact person difficult. Such was the case of initiatives promoted by organizations that had entered into one-time contracts for conducting initiatives which expired when the contract expired. This dynamic is very particular to the nature of self-management through which many such organizations survive, and is associated with their low level of institutionalization (Pérez-Bustos, 2009). The second limitation was seen when the referrals given led to initiatives on which no or limited secondary information was available. This caused an overdependency on the answers of the contact person or promoter; and hampered the tracking process.

Sast tendencies

This section analyzes some general information on the identified initiatives. Some detail is given on how the chain referral process was carried out and what that tells us about Sast in Colombia. Also, the article goes into more detail on three tendencies in the documented initiatives in particular: the types of activities, the topics they cover, and the participation dynamics.

Overview

Out of the hundred documented initiatives, 79 are underway and 21 have been completed or were one-time initiatives. As to the frequency of the activities, there is evidence that the majority of the initiatives (74) have on-going activities rather than annual, monthly or weekly ones. That means that activities are carried out continuously throughout the initiative. As to project duration, 23 initiatives have a duration of two years, 28 last two to five years, and 49 last over five years; this is evidence of the management efforts that the different actors have expended to ensure the continuity of their projects and programs.

Regarding the type of actors promoting the initiatives, the initiatives forwarded by business, the State, civil society and researchers are conducted by organizations of the same nature. However, in the case of mediators, there is no one type of organization promoting the initiatives; indeed, they are conducted by diverse actors that wind up playing the role of Sast mediator. Chief amongst these are non-governmental organizations (NGOs), universities, museums and publishing companies.

Although the initiatives are promoted by one actor, they are conducted in conjunction with other organizations and have various sources of financing. The main source of financing for the initiatives promoted by the production sector is the producer's own resources and the support of other private businesses. However, to develop the initiatives, the programs are executed together with strategic allies involved in different ways. These are mainly foundations and/or organizations of a civil nature, the research community and other businesses.

As might be expected, the initiatives promoted by State actors are financed with public resources and developed in partnership with researchers (through research groups), mediators and other State agencies. The mediators have diverse sources of financing: not only their own resources and public monies, but also support from the private sector. To carry out their activities, they establish alliances with other mediators and the research community, mainly for developing science communication materials.

Much like mediators, researchers are also supported by a mix of resources, mainly public ones (principally Colciencias) and co-financing, where they contribute their own resources provided by the educational institutions to which they are affiliated for their research projects and groups. Here the lack of private investment for developing Sast initiatives was the most marked. As far as partnerships are concerned, researchers conduct Sast initiatives in conjunction with other research groups, and State agencies approach them to conduct the research required for their programs.

Finally, the initiatives promoted by civil, non-profit organizations are mainly funded by international cooperation agreements and their own resources, and in some cases they receive financial support from State agencies. To carry out their programs, they establish alliances with other civil organizations (foundations, professional and trade associations, NGOs) and State agencies.

Regarding the area of influence, generally speaking there is a tendency to conduct Sast initiatives mainly in the Andean region of Colombia.[5] The cities with the highest numbers of initiatives identified were Bogotá, Medellín, Manizales, Bucaramanga, Pereira, Armenia,

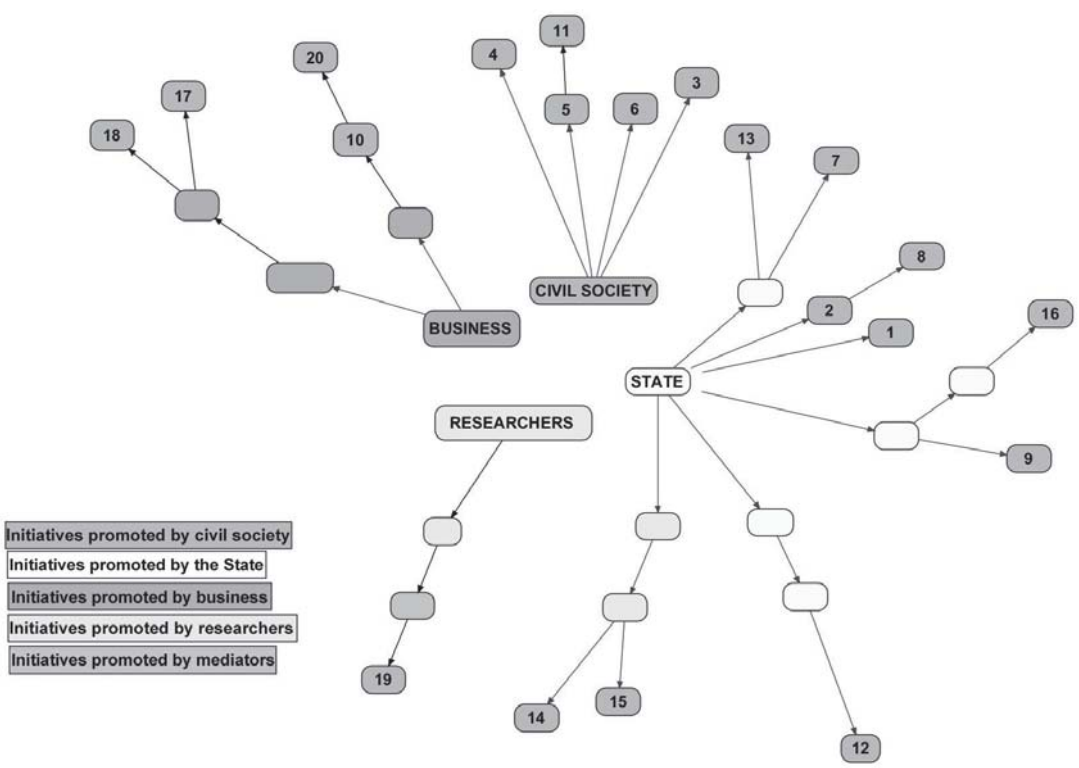
Popayán and Pasto. The regions that follow are the Pacific region (especially Nuquí, Quibdó and Buenaventura) and the Caribbean region (Cartagena, Barranquilla, Riohacha and Santa Marta). The regions with the fewest Sast initiatives were Orinoquía and Amazonía. Furthermore, 58 of the hundred initiatives operate mainly in urban areas, 31 in rural areas, and 11 in rural and urban areas alike.[6] Also, 45 of the documented initiatives stated that their work was nationwide, either because they carry out activities in different cities throughout the country or because they have a nationwide impact (e.g. mass media).

Sast chain referral results

It can be seen from Diagram 1 that the expectation was that by initiating the chain referral process with the seed references identified by experts from each group of actors, at the end of the process, each of the twenty initiatives from the five groups would have a different origin. However, the referral process wound up being far from homogeneous and predictable. Below is a description of the results for each group of actors under study.

For civil society (see Diagram 2), the chain referral process shows that nine of the twenty documented initiatives were referrals made by State actors. In addition, only four of the twenty initiatives promoted by civil society were referrals made by peer actors. The production sector (business) referred three of the twenty initiatives promoted by civil society, and the groups that least referred this group's initiatives were the research community (2) and mediators (1).

Diagram 2: Chain referral schema of civil society initiatives

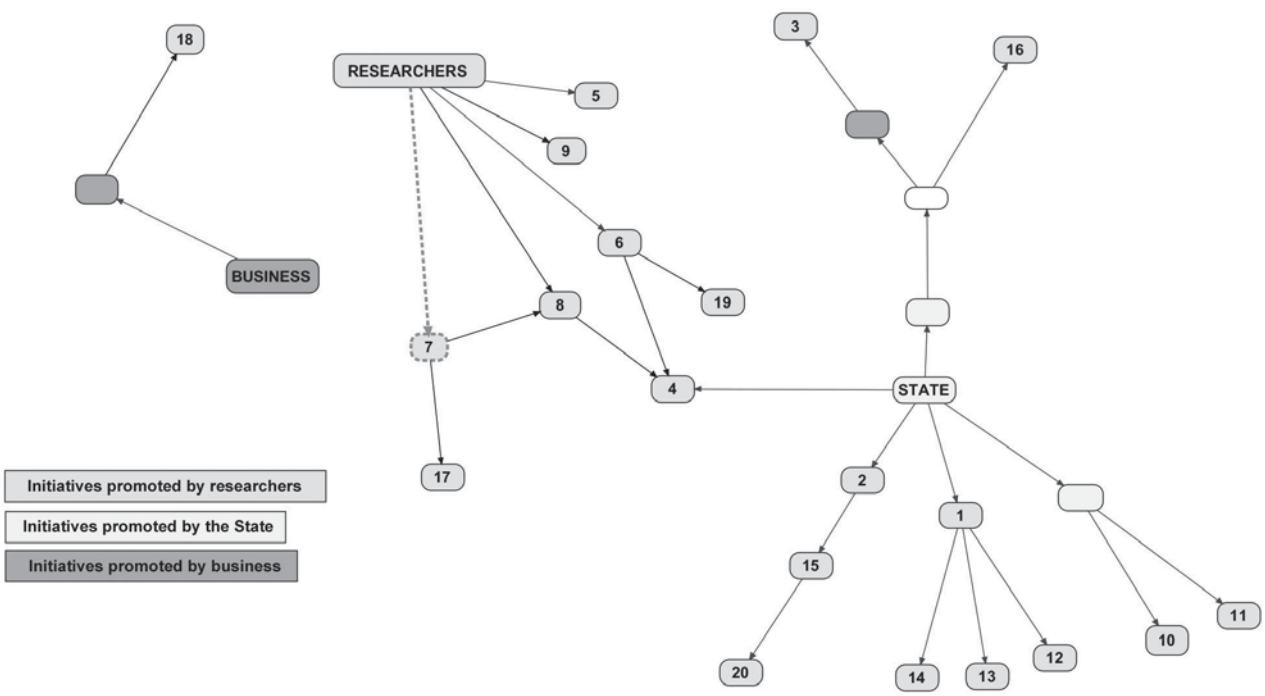


There are two aspects well worth mentioning regarding the chain referral sampling process for the civil society initiatives. The first is the fact that the referrals made by the expert we initially consulted are not very representative. This implies that these initiatives are widely dispersed and that there is little articulation among them, especially if we remember that they were referred more by other groups than by their own group. The second aspect of interest is the fact that so few referrals were made to this group by mediators and researchers, which could indicate that they have poor relations with civil society in their Sast processes.

The chain referral process for the initiatives promoted by the research community started mainly with referrals by State actors and the research community itself. Here the tracking path evidenced that 11 out of the twenty documented initiatives stemmed from referrals given by the expert consulted from the State (Diagram 3). Also, the expert consulted for initiatives promoted by researchers referred eight of the twenty documented initiatives. The remaining initiative was tracked back to a production sector referral. The expert for the civil society initiatives and the expert for mediator initiatives did not offer any referrals for initiatives by the research community.

It is interesting to note that no initiatives by researchers were referred by mediators, whose function is supposedly to communicate expert knowledge. Likewise, civil society did not refer any such initiatives, which raises questions as to the degree of interaction between researchers and the community their science and technology research is geared towards. Another aspect worth highlighting here is the high percentage of referrals made by the

Diagram 3: Chain referral schema of researchers' initiatives



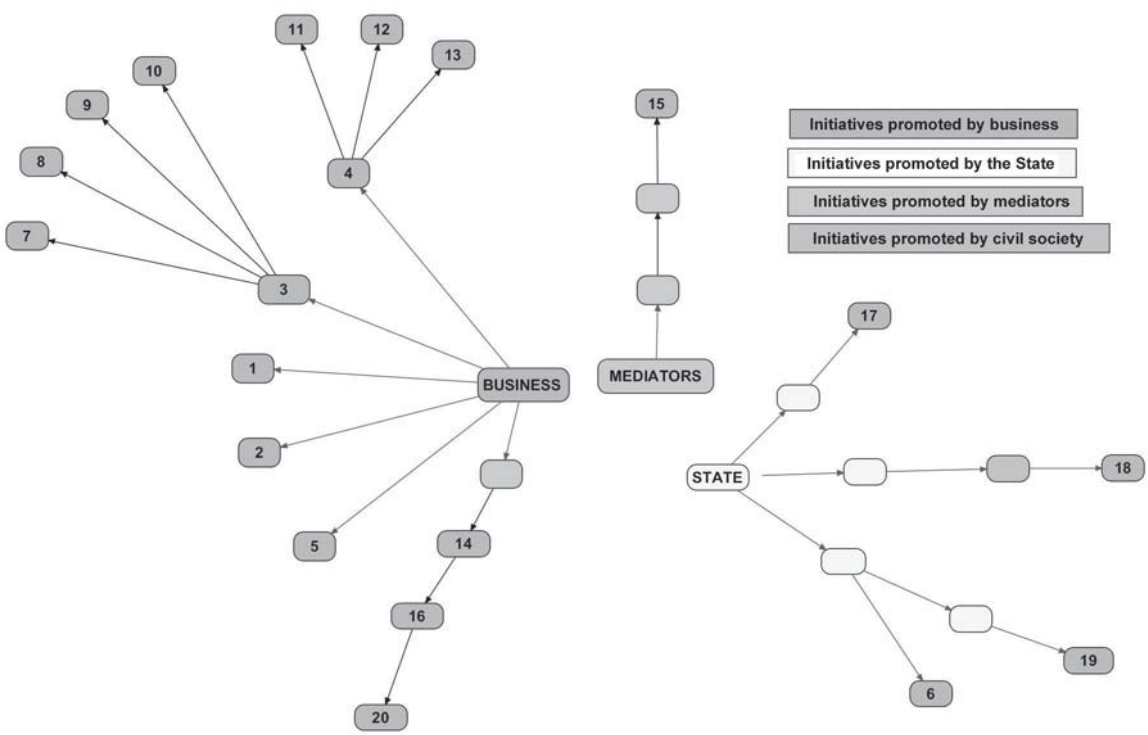
State, which can be explained by the financial dependency of such initiatives on public resources, as mentioned above.

For the initiatives promoted by the production sector (business), the referrals were mostly made by its own actors. The chain referral process shows that 16 out of the twenty documented initiatives were referrals given by other production sector actors. Two of the twenty initiatives promoted by the production sector were State referrals (Diagram 4).

Turning to the initiatives promoted by business, it is worth mentioning that this group is the one that came closest to what was initially expected to be the dynamic of the chain referral sampling process; indeed, its central referral nucleus is business itself. Here the lack of researcher referrals for the business initiatives is interesting; evidencing the mirror image of the dynamic seen in Diagram 3. The tenuous, virtually non-existent articulation between these two groups of actors casts into doubt the very premise of the science and technology system and its driving agents for Sast, which, as mentioned above, is dependent on the interaction established among the State, the business sector and the academic world (Sábato, Botana, 1968; Arocena, Sutz, 1999; Etzcowitz, 2008; Marone, González del Solar, 2007). The chain referral sampling process results show that although the State seems to have knowledge of Sast initiatives promoted by business and researchers, business agents and researchers are ignorant of each others' initiatives.

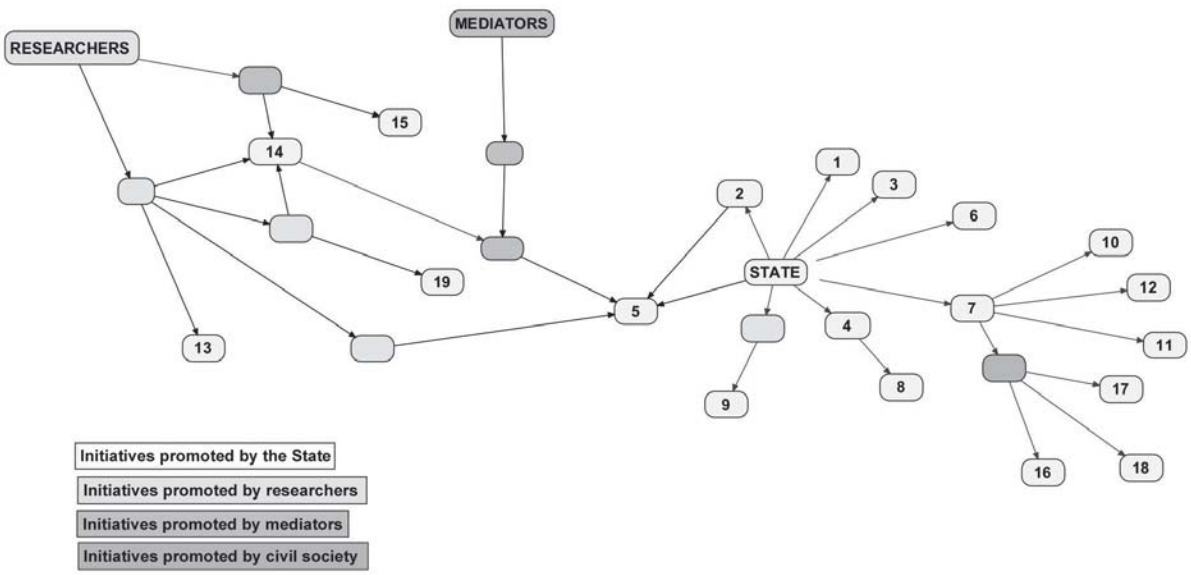
For the documented initiatives promoted by the State, the main sources of referral were State actors themselves; the expert for the State alone gave seven referrals of initiatives,

Diagram 4: Chain referral schema of business initiatives



and other State actors referred another four. Civil society, the research community and mediators gave referrals for three, four and three of the documented initiatives, respectively. Nonetheless, out of the referrals given by mediators, two were not new because they had already been given by other groups (Diagram 5).

Diagram 5: Chain referral schema of State initiatives



As was seen with the business initiatives, the chain referral sampling for State initiatives shows that the main referrals for State initiatives came from its own actors. However, the network configured for the State does connect with mediators and researchers, which is not the case of the production sector, which would appear to be more autonomous and less interconnected. So, recalling the chain referral process for business and for researchers, this once again emphasizes the limited articulation between the State and business for Sast initiatives.

As for the initiatives promoted by mediators, 11 out of the twenty were referrals made by other mediators, although out of these only four were referrals by peer actors, with the other seven being seed references made by State agents, and it was the State expert consulted who referred four of them. Another group that gave referrals to mediator initiatives was the community of researchers, accounting for six of the documented initiatives, two of which were also referred by the mediator expert and the business expert. In this chain referral process, the groups that gave the least referrals to the initiatives promoted by mediators were business (referring four initiatives) and civil society, which only referred one of the documented initiatives (Diagram 6).

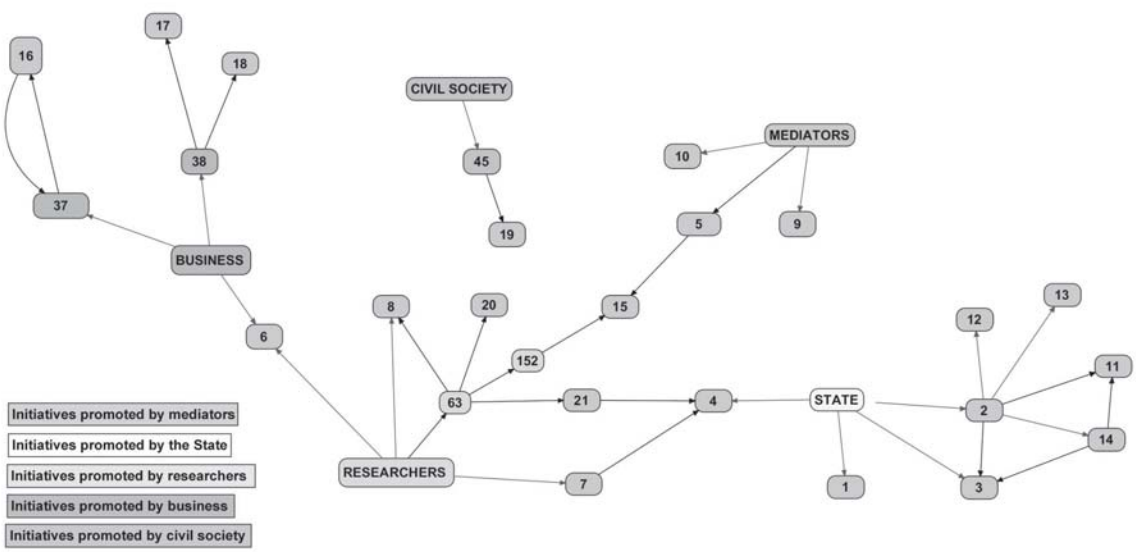
It is interesting to note that the network of referrals to mediator initiatives includes referrals by all the other groups. Researchers, civil society, business and the State gave referrals to initiatives by mediators, which would tend to corroborate the emphasis public

policy gives to mediators in Sast initiatives. However, when this diagram is compared with the previous diagrams, the role of mediators stands out for exactly the opposite, i.e. its low referral to other actor groups, in particular researchers and civil society.

Before going into detail on the other tendencies found, it is worth briefly highlighting two preliminary conclusions from this Sast chain referral sampling process. First of all, there is a tenuous link among the State, business and the research community. Although the literature on the topic states that the interaction of these actors is essential for making national science and technology systems dynamic, it is concerned with the generation of science and technology per se. Although Sast is claimed to be a key process in configuring such dynamics because it mobilizes social and production innovations, knowledge transfer, community dialog and community strengthening, the way these actors (business, the State and researchers) articulate their Sast actions, or why they fail to do so, is a moot point, considering that this is an explicit social process by which science and technology is produced, and which goes beyond this sphere (Bensaude-Vincent, 2009).

Secondly, the chain referral process reveals the importance of the role of mediators, the only group referred to by all the others. They are interconnected among themselves through mutual referrals, but fail to refer to other groups they would be expected to know because of their mediating function, such as civil society, the research community and business. This phenomenon is noteworthy: first of all, it ratifies the tendency thought to be proper to the science policy of insisting on defining Sast as an activity undertaken by mediators and based on the investment involved. And it simultaneously contributes to thinking that these actors have come to see themselves as autonomous from the public with whom they work and the knowledge they translate and put into circulation (Bensaude-Vicent, 2001). Another interesting point in this investigation of where Sast is headed is that this correlation between Sast and the mediator function also seems to be repeated in the Sast

Diagram 6: Chain referral tracking schema of mediators' initiatives



activities that are forwarded by business, civil society, the State, and the research community. More on this issue is covered in the next section.

Sast activities

To enrich the analysis of the data gathered during the mapping, this section proposes some typologies of Sast activities, identifying interactions between them and the profile of the actors that contributed the information for this exercise. Based on the above, some tensions and points of interest are identified, constituting questions to be answered in future studies.

The processes of knowledge circulation, negotiation, exchange and transformation are deemed to be an integral part of Sast. To make them more tangible, some typologies are proposed, which, without being exhaustive, express the different ways Sast can be put into practice. They are: (a) production of communication materials in different formats for the purpose of making the results of science and technology research or general S&T knowledge known to diverse audiences; (b) knowledge management and/or production, understood as the possibility of gathering, systemizing, circulating and using knowledge for specific ends; (c) citizen participation or social mobilization, seen as opening spaces for expressing, discussing, reflecting on and transforming realities depending on the needs or particular interests of communities in specific contexts, where knowledge plays a strategic role; (d) innovation and entrepreneurship, understood as the possibility of transforming products, processes or forms of organization; and (e) individual and/or institutional positioning, understood as the exercise of providing visibility for actions designed to produce or use knowledge, to gain social validation or appreciation in certain contexts.[7]

The above typologies relate to the nature of the actors defined during the process, even if there is not always a direct correlation. Thus, for mediators, an emphasis on communication material development is expected, whereas civil society would be more involved in citizen participation. The State and researchers would relate to knowledge management and/or production, whereas business would be more geared towards innovation and entrepreneurship and individual positioning.

Using these typologies as a starting point, the findings showed that the hundred documented initiatives (Graph 1) present a marked tendency towards the production of communication materials (61). Nonetheless, other activities were well represented, such as knowledge management (39) and citizen participation (29), while activities such as innovation and entrepreneurship (19) and individual or institutional positioning (16) were less in evidence.

Next, the tendencies amongst each of the groups studied was configured, enabling a characterization of how they materialize their Sast processes.

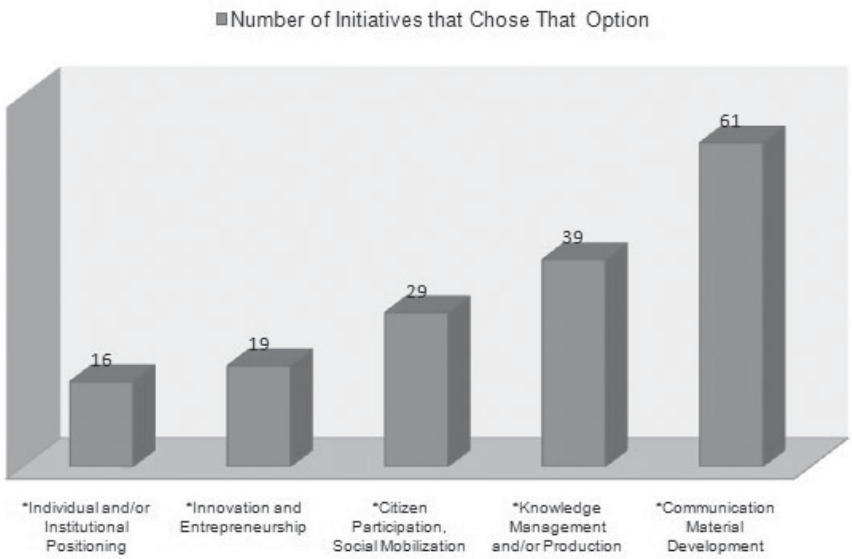
First of all, the study found that the initiatives that the State acknowledges as Sast are mainly the development of communication material (11), with cases such as the Mente Nueva (New Mind) television series produced by Colciencias and Universidad Nacional, and the Colombian Ministry of National Education's Colección Bicentenario (Bicentennial Collection). The State's other activities were categorized as knowledge management and/

or production (8) citizen participation or social mobilization (6) and innovation and entrepreneurship (3).

The materials the State produces basically have the following three objectives: (i) to showcase scientific work being undertaken in Colombia, mainly via Colciencias, the actor with the most referrals in this area; (ii) to help boys, girls and youths to learn science and technology at school, by means of teacher supervision or training, for instance; and (iii) encouraging innovation and/or entrepreneurship. Under knowledge management and/or production, there was a wide range of activities, the most common of which were aimed at training or knowledge exchange among individuals with different levels of expertise in a given topic, developing research projects involving the community, and conducting studies of different types, an example of which is the Bogotá Botanical Garden's Agricultura Urbana (Urban Agriculture) program, which includes research, development, training and community work. Citizen participation is expressed in activities that promote changes in attitudes, develop competences – e.g. the Ministry of the Environment, Housing and Territorial Development's program, Lavado de Manos con Agua y Jabón (Wash your hands with soap and water!) –, and produce knowledge, rather than ones that involve citizens in decision making or policy building processes, as might be expected. Innovation and entrepreneurship is represented by training and technical assistance activities.

For the business group, 13 initiatives involve communication material production, nine work on innovation and entrepreneurship, eight seek individual or business positioning, six do knowledge management, and three state that they work in citizen participation processes. These activities have a very pronounced practical orientation, where improved competitiveness is sought through developing suppliers, workers and communities of interest, thus enhancing production processes. Several of them have an environmental focus and are mobilized through training exercises and community intervention and supervision. The materials developed and the activities carried out generally involve topics

Graph 1: Secondary objectives of the initiatives



directly related to the company's business, so they also imply a degree of institutional visibility and positioning. A good example is Comunidades de Alimento (Food Communities) conducted by the WOK restaurant chain. It trains the farmers who supply the business in sustainable farming and fishing practices, and it researches the way the restaurants' inputs are produced in Colombia.

For the research community group, 15 initiatives were identified that carry out activities aimed at knowledge management and/or production. They are research projects that have involved the community thanks to their participative research methodologies and the breadth of their communication initiatives throughout the process, inviting peers and providing opportunities for interested persons or potential beneficiaries to get to know the project. Such is the case of the Institute Von Humboldt project, Páramo Andino (Andean High Barren Plateau), where work is done with the communities in the region of the high barren plateaus to develop sustainable management and conservation practices for the ecosystems there. These are also activities that involve and/or are related to training projects. Communication material production is the second activity that researchers most emphasize (8), in some cases as a byproduct of the research processes and in others as an end in itself. Only four of the initiatives record citizen participation actions involving very specific communities in processes directly related to managing their surroundings. There will be further discussion of this in the next section.

Civil society concentrates on citizen participation and social mobilization actions (14). It also has a strong component of communication material production (10). The other activities involved to a lesser extent are knowledge management (6), innovation (5) and individual positioning (2). The activities have a very strong practical element, with training processes and knowledge exchange among peers, and are very closely connected to everyday practices, meeting the needs of a primarily economic output nature, which also explains the component of innovation and entrepreneurship. However, they also involve health needs, communication, and environmental and resource preservation. PBA's Programa de Innovación Participativa con Pequeños Agricultores de la Región Andina (Participative Innovation Program with Smallholders in the Andean Region) and the Fondo de Acción Ambiental para la Niñez program, Rutas de Aprendizaje Mercados Verdes (Learning Routes for Green Markets), are two examples of the types of projects that focus directly on developing sustainable production practices in specific communities, with different work processes that either involve them or are aimed at them.

The mediators group shows a very strong concentration in one activity: 19 initiatives in communication material production. Some clear examples are Museo del Oro's Maletas Didácticas (Teaching Aid Schoolbags), Ángela Posada Swafford's Aventureros de la Ciencia (Science Discoverers) series, or Chigüiro Editores' magazine, *Explorando el Planeta* (Exploring the Planet). Knowledge management and/or production (4) and citizen participation (2) appear to be much less important, both related to peer exchange for mediation in training or reflecting on their activities. There was only one chain referral to the community (civil society or researchers). Finally, individual or institutional positioning was mentioned twice in reference to self-legitimization and making initiatives commercially feasible.

The activities of this group were found to be in line with expectations. However, the restricted range of strategies used may reinforce the limited knowledge that mediators have of the other groups, such as researchers or civil society, as discussed in the previous section. Likewise, this may accentuate the role that these activities designed to produce educational and communication materials have of being more of an effort at self-legitimization than an instrument for inter-sector articulation, considering that they appear to be carried out independently, with hardly any participation by the other actors in the process.

The tendency described here regarding the types of activities and the emphasis that the different groups place on generating educational and communicative materials raises several questions about how science and technology is communicated in Colombia. What types of science and technology discourse are presented in these materials? And what types of educational and communication mediation do they promote? Also, what differences are there among the materials on the same topics produced by the different groups?

Participation dynamics

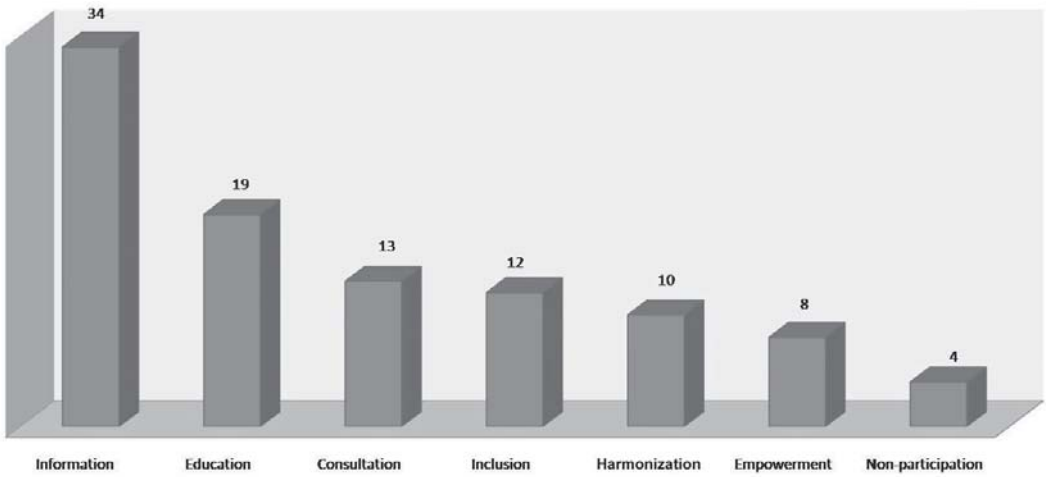
Using the typologies described above to represent the different ways of conducting Sast activities, this section investigates the relationships between the groups leading the initiatives and the target audiences of these initiatives. To find out how much the different stakeholders intended to be the beneficiaries of these initiatives are actually involved in the Sast processes, the initiatives were first analyzed and then an interpretation was made of how participation was incorporated into the approach adopted by the entity promoting the initiative.[8] With this in mind, seven dimensions were described to characterize the interactions between the initiatives and their stakeholders. It is important to clarify that the dimensions were not put on a hierarchy – none of them was seen as ideal – but were merely used as a way to understand the distinct nuances that a participative process can have.

The seven dimensions considered were: (1) non-participation: no actions are proposed to involve the target audiences; (2) inclusion: different stakeholders are involved during the process to ensure that their concerns and initiatives are taken into account; (3) information: information of use for understanding the problem and the possible solutions are presented to the stakeholders; (4) empowerment: the stakeholders are able to lead and develop the initiative on their own; (5) consultation: the stakeholders involved give their feedback on the problem and possible ways to solve it; (6) education: this includes training or development processes in science and technology to strengthen the competencies and skills of the stakeholders involved; (7) harmonization: forums are proposed for the different stakeholders to deliberate and analyze the decision together. Graph 2 shows the distribution of the initiatives by each of the dimensions.

As can be seen from Graph 2, most of the initiatives focus on participation through information. This trend was found in each of the groups under study, and will be investigated further below.

For the mediators group and the State, the initiatives are mainly of an informative nature (12 and 10 initiatives, respectively), examples of which being some museums, published materials and audiovisual products. However, it would be premature to say that

Graph 2: The initiatives, by type of participation



this tendency towards participation through information implies that the target audience has a merely passive role. It is likely that some of the initiatives in the chain referral involve collective building in which the different actors involved participate actively and intentionally.

Researchers also share this tendency (5). A good example is Universidad del Cauca's Sistema de Información Regional del Agua (Water Regional Information System), whose purpose is to guarantee access to strategic information on the availability of water resources, thus constituting a tool for automating water resource management. In second place, two very distinct dimensions were seen: non-participation (4) and harmonization (4). In the initiatives that demonstrated no participation, the researchers' work is assumed to be oriented towards Sast, but their perspective is that this does not require them to work in conjunction with the target population of their research. As to harmonization, a good example is the initiative developed by Universidad de Nariño called Evaluación y Desarrollo de Alternativas de Mitigación del Cambio Climático de Diferentes Agroecosistemas (Assessment and Development of Alternatives to Mitigate Climate Change in Different Agro-ecosystems). This is a project where agro-forestry sciences are used as an option for climate change mitigation and adaptation. The objective is to achieve small and medium scale forestation development on farms and cattle ranches, providing the potential beneficiaries with patches of forest and agro-forest that would contribute to optimizing land use, efficient carbon capture, and improved environmental, landscape and economic conditions, as well as complementary sources of income for the communities involved.

Most of the business initiatives are in the dimension of consultation (7); that is to say, they present problems to the different target audiences involved and they invite their comments to complement their proposals. One such example is the Selva Nevada initiative, Comercialización Frutos de la Biodiversidad Colombiana (Commercialization of Fruits Representative of the Colombian Biodiversity), in which business works with peasant, Amerindian, and Afro-Colombian n:communities to identify organic and non-timber

forest products. After identifying them, Selva Nevada develops food products for the national and international markets. It is important to clarify that the consultation process may or may not take the involved communities' feedback into account; this is an aspect for future research. Another dimension with a good number of initiatives in the business group is education (6). Representative of this is the initiative led by Prodensa called Proyectos Educativos Para la Difusión de Prácticas de Manejo Integral de Residuos Sólidos Reciclables Escolares en Instituciones Educativas Departamentales del Norte de la Sabana de Bogotá (Educational Projects for the Dissemination of Total Management Practices for Recyclable Solid Waste from the Departmental Schools in the Northern Area of the Bogotá Savanna). This project seeks to inform and sensitize the community about caring for the environment, and to promote ecological awareness and a culture of appropriate solid waste handling and recycling.

The civil society group promotes initiatives in the dimensions of empowerment (5) and inclusion (4). Corporación para el Desarrollo Personal y Comunitario 'Encuentro' (Corporation for Personal and Community Development 'Encuentro'), from Santa Marta, has an empowerment initiative called Gestión Ambiental Participativa Como Aporte a la Construcción de Paz y Desarrollo Sostenible en la Cuenca del Rio Toribio y Su Zona Costera (Participative Environmental Management as a Contribution to Building Peace and Sustainable Development in the Toribio River Basin and its Coastal Area). The purpose of the initiative is to provide peasant and fishing communities with a life alternative that will enable them to substitute their current source of income – the cultivation of illicit crops – with agroecological and aquaculture production, using applied research for lobster farms, environmental conservation, organizational strengthening, and public policymaking. In the inclusion dimension, a fine example is the Oro Verde (Green Gold) initiative led by Fundación Amigos del Chocó. It seeks to support and engage with communities devoted to traditional gold and platinum mining, for them to comply with standards of environmental and social responsibility.

The participation analysis also identified whether the documented initiatives were undertaken jointly by the different actors involved or if they were designed by one group and then oriented towards others. The analysis identified a certain type of relationship between the actors involved and the manner in which the processes were built. In the first case the individuals are direct, active participants in the process, whereas in the second case they appear as recipients of the process.

Reviewing the initiative objectives, we found that 74 of the projects were designed by promoters and oriented towards a recipient or beneficiary audience, whereas only 26 were developed jointly by the different stakeholders involved in the problem at hand.

Museum-type projects, such as Maletas Viajeras (Traveling Suitcases), Museo Interactivo Abracadabra (Abracadabra Interactive Museum), Casa de la Ciencia de Buga (Buga House of Science) or Exploramóvil, among others, evidenced a more top-down approach to their content production. Indeed, the groups and individuals to whom the exhibits are oriented have no say in the design processes. Of course, that does not necessarily imply that the visitors' characteristics, languages and interests are not taken into account, only that such information is most likely gathered using other mechanisms.

Meanwhile, projects that are born as a component of broader social processes tend to take their target audiences into account in the initiative design and development process. One example of this is Páramo Andino (High Mountain Plateau), a project that seeks to devise and promote policies for the conservation and use of the high, barren plateau at the local, regional, national and eco-regional levels. Participative management plans are designed and implemented which constitute environmentally friendly models for production activities that include zoning and conservation strategies. These activities are also supported by participative communication materials whose creation involves the rural and the urban communities living near the ecosystem.

Generally speaking, this analysis shows that while the information dimension prevails, there is little in the way of inclusion of the different stakeholders in devising and carrying out the Sast projects. This tendency is associated with an emphasis on the activities themselves, which leads us once again to wonder what types of mediation are present in these participation models.

The foremost topics and how they relate to the context

The foremost topics relate to the two tendencies described above: the emphasis on materials development and the degree of participation in the context of information processes. With this in mind, the documented initiatives mainly cover the following topics: environment and habitat (55); technological development (34), basic sciences (32) and health (25). There is also some interest in traditional knowledge (15) and cultural heritage (9).

These tendencies can be related to two aspects in particular. Firstly, there is a prevailing linear development model that reinforces the above-mentioned tendencies in respect to Sast financing and articulation among the groups. Secondly, there are discussions regarding the western ideal of modernity when it comes to the environment, which raise questions that merit attention in future studies.

As to the first point, a broad interest in technological development and basic sciences was found. Of course, they are conducive with the idea that Sast is a process that is materialized in dissemination and participation through information which is enabled by large-scale public investments, and also private investments in the case of the business group. In a linear development model, it would appear that this emphasis is associated with the concept that science and technology can foster greater social wellbeing, thus ratifying the idea of a deficient, needy society that is ultimately benefited by Sast initiatives, given that the topics are defined and prioritized by others rather than by the beneficiary target groups (Daza, Arboleda, 2007; Pérez-Bustos, 2009). This again points to the need to do research on the conceptions and approaches of basic sciences and technological development and the types of education and communication mediations involved in Sast processes.

The second point to be discussed relates to the generalized interest in environment- and habitat-related topics and the smaller number of initiatives mobilized around traditional knowledge and cultural heritage. Here, the question is what aspects of the environment and habitat are being promoted and what type of local context and audiences support them? Although these two topics are globally associated with the emergence of

so-called collective rights or third-generation rights, the scant emphasis seen in such initiatives on the issue of local and traditional knowledge leads to the intuitive perception that the initiatives may address the issue abstractly, but may not necessarily promote a heterogeneous conception of the environment that could be articulated with a culture that would help transform the paradigm of western modernity of the separation of man and nature (Leff, 2004; Escobar, 2005).

It is along these lines that the above questions regarding the types of discursive representations and science and technology practices that the initiatives contain and the mediations that make them dynamic must be oriented. They must inquire what development, nature, society and culture paradigms and projects the initiatives support and how. This also should be included in future studies.

Having completed the general analysis of the topics, we will now present a detailed discussion of the topics preferred by each group under study. First the groups that make up the triangle proposed by Sábato and Botana (1968) will be addressed, then mediators, and finally civil society.

For the first group under discussion, comprising the State, business and researchers, the findings show that the State and researchers share an interest in technological development (5 and 11 initiatives, respectively), basic sciences (5 and 8) and the environment (7 and 11). Business only shares with them an interest in the environment (14) and it does so including two priority topics: traditional knowledge (6) and farming and livestock sciences (6). The correlation between the State and researchers may be explained by the fact that scientific research is mainly financed by public resources, and these Sast initiatives fall into this category. One example is the initiative developed by the Pontificia Universidad Javeriana research group in immuno-biology and cellular biology with the support of Colciencias. It has been developing a project for harnessing traditional knowledge about medicinal plants and utilizing these plants to obtain bioactive compounds to fight cancer. This project involves working with rural communities and seeks to create a business that will take advantage of Colombia's biodiversity in the future.

The priority interest of business in the environment and traditional knowledge may be understood in the context of what is known as corporate social responsibility. It seems to constitute a marketing exercise in which a 'good reputation' of being 'environmentally friendly' is consolidated for the production sector and to differentiate its products, thus enhancing customer trust and the chances of entering other markets that are more demanding when it comes to business footprints (Cepal, 2006). A good example for illustrating this point is Natura, which has a project involving recycling companies in Bogotá. It encourages its sales consultants to separate their domestic waste and take the recyclable materials to collection points managed by recycling companies.

The group of mediators mainly covers topics related to art, science and technology (15). Topics of this kind may be articulated with the prevailing interest in harnessing Sast initiatives as alternative educational methods: learning science through fun activities, or recreational learning, which is the diametric opposite of traditional schooling, allegedly marked by a book-based culture (Franco Avellaneda, 2008). This positioning is corroborated by the fact that the vast majority of the mediator initiatives target school-aged audiences

(13). It has been argued that the inclusion of art in the activities carried out in such initiatives is worthwhile because it stimulates learning and helps establish temporary socio-cultural relations (Reynoso, Sánchez, Tagüeña, 2005). However, it is not yet clear if that is the case of the initiatives documented here, considering that some of them could also be characterized as operating in individual positioning, which could suggest that the articulation between art and science is more of a marketing ploy than strictly educational.

The civil society group is not only set apart from the Sast network, as mentioned earlier (Diagram 2), but also has differentiated topic priorities: farming and livestock sciences (10), environment and habitat (9), and electronics and telecommunications (3). This last interest differentiates civil society from the other groups, and may be related to the context of most of the initiatives mobilized by civil society. They are mostly pursued in rural settings and, as mentioned above, have a local and municipal area of influence; also, the beneficiaries of 14 of this group's initiatives are peasants. Notwithstanding, there are civil society initiatives developed in urban settings, mainly aimed at preventive health, such as the project for preventing breast cancer called Al Pecho no le Des la Espalda (Don't turn your back on your breasts) or the project that provides training sessions on identifying and understanding colon cancer, both based in Bogotá.

The appearance of telecommunications may be associated with a recent interest in the public sphere in generating and financing processes for access to and literacy in information and communications technologies usage. This explains the type of public financing that backs these specific initiatives. Here, it would be worthwhile asking more about the usage and appropriation that this type of initiative promotes regarding such technologies.

Final considerations

Some Sast tendencies have been presented here, using a chain referral sampling exercise in which a hundred initiatives promoted by five different groups of actors were documented. The purpose of the exercise was to identify the articulations existing among these groups to position Sast initiatives, while also characterizing the types of activities, dynamics and topics covered. The chain referral procedure revealed that Sast is poorly institutionalized amongst civil society, and that when undertaken by mediators and researchers, it is highly dependent on public resources. It is designed not for localized activities, but rather for activities with a broad coverage, mainly of an informative nature, which begs questions as to how flexible the initiatives are when it comes to acknowledging local dynamics and knowledge. It further highlights a possible emphasis on standardized, one-way views of science and technology.

Also of note was the emphasis in Sast of the production of material for communication purposes and the tenuous articulation that mediators have with civil society and researchers, as well as business's independence from the State. These tendencies reveal some processes that one would believe would articulate actors, but that actually do not, as stated above. This apparently corroborates mediation as an inherent characteristic of Sast. Even more so, its materialization in the form of producing information communication products may justify the existence of the gap between those who know and those who do not, the

latter being the groups to whom the products are directed. It would also explain the role the process plays as a driver of business sector positioning dynamics, in which civil society is seen as a consumer and customer in actions that are isolated from researchers and the State.

These tendencies make us question the roles of these different groups in the science and technology systems. They could also serve to orient empirical studies designed to qualitatively understand how different groups participate and are articulated in different Sast mechanisms or initiatives, doing away with conceptions that associate such processes with information flows and rather orienting them towards understanding their educational dimension as producers of common sense. This done, knowledge transfer and management, information and harmonization could be seen to represent an educational dimension that must be understood and that has the potential to generate critical processes for science and technology and to corroborate the hegemonic, standardized notions regarding them. That, in turn, leads to questions about the emphasis Sast has on scholastic matters and how the educational dimension of Sast operates beyond schools and mediators.

In that sense, the exercise conducted here leaves questions to be answered. What is happening with the actors that promote Sast? Who are they? What role do they play and what interests motivate them? In addition, it invites questions about the content they promote, in particular the notions of science, technology and society that are reinforced by such initiatives. Only by advancing research in these directions will the next question find an answer: Is Sast truly an intentioned social process in which, reflexively, the diverse actors involved articulate with one another to exchange, combine, negotiate and/or debate knowledge, or is it rather positioned as a non-problem-specific marketing strategy, removed from its target audience and from the knowledge that it places in circulation?

NOTES

[1] In this study, such actors are called mediators.

[2] There is no indication that the mentioned emphasis clarifies the role of mediators. In reference to this aspect, Pérez-Bustos (2010) has sustained that such actors have been feminized by the Colombian Science and Technology system, which grants them a lesser standing than producers of knowledge. This feminization, states the author, stems from generally regarding the educational role that such individuals, whether men or women, play, as instrumental and banal, and from the fact that the target audience of their educational work is a civil society seen as infantile.

[3] The actors called mediators are understood in the sense proposed by Latour: "Mediators transform, translate, distort, and modify the meaning or the elements they are supposed to carry … No matter how apparently simple a mediator may look, it may become complex; it may lead in multiple directions which will modify all the contradictory accounts attributed to its role" (Latour, 2005, p.38-39).

[4] The following definition was used: SAST is an intentioned social process in which diverse groups of actors articulate with one another reflexively to exchange, combine, negotiate and/or debate about knowledge; motivated by their needs to use and interests in using, applying, enriching, among others, that knowledge in their own context and in their concrete realities. For the purposes of this article, this intentioned social process occurs through the mediation of knowledge acquisition, information, teaching-learning, circulation, transfer, transformation and/or production, among others, in which science and technology are the main subject.

[5] Here a reservation must be stated. For practical reasons to do with the place from which the chain referral sampling was initiated, the consulted experts were identified in Bogotá. Although the initial sampling yielded referrals of initiatives in other regions of Colombia, it is important to mention that

most of the initial initiatives were conducted in the Andean zone, which may have created a bias in the tendencies presented here.

[6] Out of the five groups of actors with which the work was done, at least half of the initiatives promoted by the State, mediators and the research community have a national area of influence. Meanwhile, the initiatives operating on a municipal level are conducted mainly by civil society (12), which focuses its activities on rural areas, municipalities and settlements. It is interesting that there are few documented initiatives with a local impact in which the actors are business (5), mediators (4) or researchers (3).

[7] To identify the typologies, the activities that the initiative promoters described on the form were classified. This exercise was performed by the research team and validated with the initiative promoters who had completed the form. The typology was called the secondary objective of the initiative. When the secondary objective was identified, more than one option could be selected.

[8] Citizen participation in science and technology is understood as an organized social process in which it is possible to exchange opinions, views and knowledge to facilitate interchange between different social groups concerning a problem in which scientific and technological knowledge plays a preponderant part and through which these actors are expected to make a specific decision (Colombia, 2010). The process implies negotiations among actors with diverse interests, needs, expertise and other factors that are not necessarily harmonious and that can even be conflicting.

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