# CO-PRODUCTION OF GEOGRAPHIC KNOWLEDGE FOR THE SOCIO-ECOLOGICAL RESTORATION AND DEMOCRATIC GOVERNANCE OF URBAN-RURAL RIPARIAN ZONES IN MEDELLIN, COLOMBIA.

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Alexis Saenz Montoya

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Examining Committee Members:
Dr. Allison Hayes-Conroy, Advisory Chair, Department of Geography and Urban Studies
Dr. Victor Gutierrez Velez, Department of Geography and Urban Studies
Dr. Hamil Pearsall, Department of Geography and Urban Studies
Dr. Ryan Burns, External Member, Department of Geography University of Calgary

## ABSTRACT

Progressive scholars have found in community-engaged research and participatory methodologies a synergistic approach for pursuing transformative co-production of knowledge to understand the complexity of critical social and environmental issues. According to Jasanooff (2004), the co-production of knowledge is "the simultaneous process through which modern societies form their epistemic and normative understandings of the world." This dissertation project has sought the co-production of geographic knowledge in socio-environmental research on stream restoration, co-produced between academics and community activists in Medellin, Colombia. Specifically, the intent of the research has been to examine the latent power of affect and feeling to promote the ecological care of streams and their surrounding basins, and to understand the possibilities of mapping the desires that local ecological actors have for stream restoration.

Papers one and two also made key contributions to understanding how environmental and social actors surrounding La Honda stream are or could contribute to a scenario of the stream basin's ecological care. In paper three I detailed my work on the *ElAtlas* initiative. There I documented the rich historical process we went through to build *ElAtlas*. I described how the initiative involved the convergence of different participatory approaches in GIS, such as Public Participatory GIS (PPGIS), and Volunteered Geographic Information (VGI), and richly detailed the three different stages of the initiative.

## ACKNOWLEDGMENTS

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# CHAPTER 1
# INTRODUCTION

*Many specialties will arise, some of them more closely connected with history, and others with physical sciences; but it is the true duty of geography to cover all this field at once and to combine in one vivid picture all separate elements of this knowledge: to represent it as an harmonious whole, all parts of which are consequences of a few general principles and are held together by their mutual relations*. (Kropotkin, 1885, p.18)

Progressive scholars have found in community-engaged research and participatory methodologies a synergistic approach for pursuing transformative co-production of knowledge to understand the complexity of critical social and environmental issues. According to Jasanooff (2004), the co-production of knowledge is "the simultaneous process through which modern societies form their epistemic and normative understandings of the world." This dissertation project has sought the co-production of geographic knowledge in socio-environmental research on stream restoration, co-produced between academics and community activists in Medellin, Colombia. Specifically, the intent of the research has been to examine the latent power of affect and feeling to promote the ecological care of streams and their surrounding basins, and to understand the possibilities of mapping the desires that local ecological actors have for stream restoration. In this introduction, I discuss the location and context of the research (briefly mentioning methodology), then the conceptual foundations of the dissertation, and finally the theoretical, methodological,

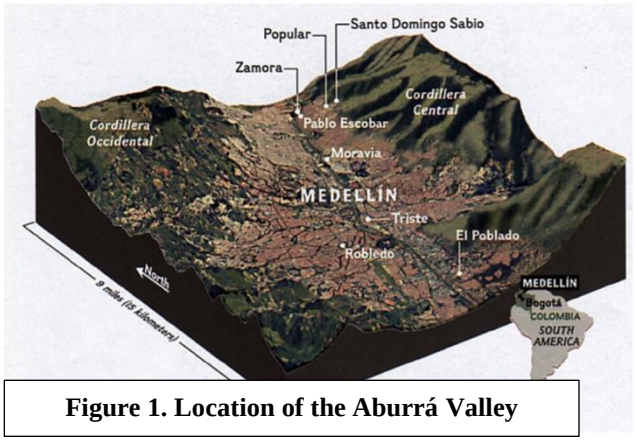


**Figure 1. Location of the Aburrá Valley**

and empirical contributions this dissertation offers to the discipline of geography and the interdisciplinary study of environmental activism and organizing.

Context:

The fieldwork for this dissertation took place largely in the Aburrá Valley, which is located in the south-central side of the state of Antioquia, Colombia, in the middle of the Central Range of the Andes (Figure 1). The Aburrá valley has ten municipalities with a population of three million people including the city of Medellin, which has been a significant economic and industrial hub of the country for over a century. This valley is crossed by a large river – The Medellin River – and over one hundred streams that run through the ten municipalities and feed the river. This hydrological system has been affected by human activities such as disposal of solid waste in the beds of streams, settlements in high-risk areas on the river bank, deforestation at the mouth of streams, channelization of previously meandering streams, and domestic and industrial wastewater discharge without pre-treatment (Giraldo et al., 2014). Responding to this problem, local authorities have implemented several processes of ecological restoration in the last two decades. In 2016, environmental authorities in the Aburrá Valley initiated a new initiative of restoration in the Medellin river ecosystem with a plan focused on the nineteen main streams in this hydrological system called “Plan Quebradas.” This initiative is led by the "Area Metropolitana", the main environmental authority in this valley and the local government in each municipality. Conceptually, this new plan proposes an articulation of public, private and community actors to develop projects on sanitation, reforestation, and environmental education. The educational component seeks to changes socio-cultural

relationships with streams as the primary factor in ensuring sustainable restoration of the Medellin River.

Despite an apparent desire to connect with communities surrounding these 19 principal streams, Plan Quebradas does not outline a clear vision of how to define and achieve a "successful" process of socio-ecological restoration of urban streams and specifically, what could be the role of the environmental community-based groups in this process. A previous study developed by community leaders (Alvarez 2017) describe a lack of communication and integration among environmental community-based groups in the upper, middle, and lower course of "La Honda" stream, one of the streams included in Plan Quebradas (Figure 2). The lack of a clear target – restoration "success" – is an obstacle to integrating visions, and the affective motivations behind them, in order to implement collective actions in the stream basin. Thus, my research has sought to contribute to the integration of the efforts of diverse environmental community-based groups in the "La Honda" stream basin from a scholar - activist approach. To be clear, La Honda is one of nineteen streams included in the "Plan Quebradas," and it is located in the North - East of Medellin (Figure 3).

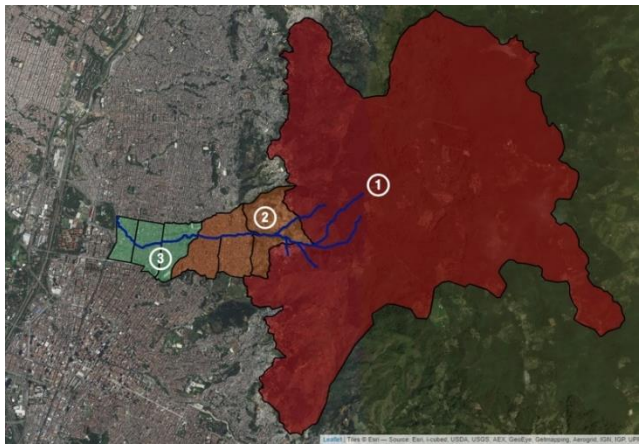


**Figure 2. Upper Course (1); Middle Course (2); and (3) Lower Course of La Honda stream**


**Figure 3. La Honda Location**

My originally proposed research questions (Figure 4) were oriented around this overarching objective. Out of these research questions have emerged the three papers of this dissertation. The **first paper** examines how cultural legacies of streams influence current processes of socio-ecological stream restoration. Streams like La Honda have often been seen (and experienced) as dirty and dangerous places, and continue to be used as dumping sites. The first paper examines how streams are socio-ecologically produced as "affective atmospheres," which "press upon" local environmental actors, often motivating them to generate activities that care for La Honda stream and its surrounding basin (Anderson 2009). The **second paper** uses a combination of remote sensing and participatory methods to understand the visions of environmental community-based groups for socio-ecological restoration in the upper, middle, and lower course of "La Honda" stream. The **third paper** describes the extended methodology behind this work, which began almost six years prior with the development of a participatory GIS project called *ElAtlas*. I document the evolution of *ElAtlas* and how it led, ultimately, to the dissertation work I accomplished in the last two years.

Methodological Premise:

As described in **paper three**, the empirical and methodological premise of this dissertation came out of discussions with environmental leaders near La Honda stream, at a local event. The event was co-sponsored by an initiative called *ElAtlas* that I have led for the past six years, which seeks to enhance the potential for connection and collaboration between scholars and community leaders, young organizers, and activists. *ElAtlas* as an initiative has aimed to make geographic and GIS methods useful to these groups through careful, critical, and reflexive collaboration. A key lesson from collaborations with community groups involved in the initiative (loosely called the *ElAtlas* network) has been that affective networks forged between community-based groups may be seen as a key driver in processes of socio-cultural and environmental transformation. Affective networking between groups develop and grow when opportunities for shared sensorial and emotional moments are supported, either from inside or outside the network.

**Figure 4. Research Questions**

What role can affective networking among environmental community based - groups play in defining and achieving 'successful' stream restoration in the context of Plan Quebradas in Medellin, Colombia?

- What kinds of place-making has been associated with urban streams in Medellin? What is the role of perception and feeling in mobilizing actions towards ecological restoration of streams among environmental community-based groups? Are there any barriers – affective, economic, and/or political – that prevent collaboration between groups?
- What are the visions of environmental community based - groups for socio-ecological restoration in the upper, middle, and lower course of "La Honda" stream? What similarities and differences exist between the visions of those diverse community groups, and between those groups and environmental authorities?
- What is the role of GIScience and Remote Sensing in understanding place and placiality in processes of socio - ecological restoration? Can Remotely Sensed data be used to mobilize affective networking invested in stream restoration?

It is through the *ElAtlas*, network that I got to know leaders from seven environmental groups working in the study site areas. These groups were the nodes through which I developed a research design that integrated qualitative ethnographic methods with participatory GIS into experience-centered research events in order to explore the 'placialities' of urban streams as they relate to possible ecological restoration (Sui, Elwood & Goodchild, 2013). Throughout each stage of the participatory process, and similar to Young and Gilmore (2013), mapping activities were understood as affective activities that generate data not only about the socio-environmental processes or places at hand, but also about how to motivate action. **Paper three** describes my methodology and methods in detail, with a focus on PPGIS and VGI activities. The dissertation involved (1) in-depth group interviews with environmental leaders and actors in the La Honda stream basin, (2) stream habitat walks with environmental actors and local residents in the upper, middle, and lower parts of the stream (EPA 2012), and (3) a final networking event to socialize my findings and think of next steps. I also conducted individual interviews with environmental authorities and professionals involved in the local government's "Plan Quebradas," which I juxtapose to interviews with local community actors in **paper one**. Finally, I also used strategic remote sensing methods and analysis coupled with some the above methods, which are thoroughly described in **paper two**.

Conceptual Foundations:

A central premise of this research is that interpretations of "success" in processes of socio-ecological restoration of urban streams are a touch point between how people make sense of streams as places and what actions they take (or do not take) towards streams.

Thus, my overall project maintained a central focus on *stream placemaking*, despite not expressly focusing on this concept in the three papers. I paid attention to not only the meanings environmental community-based groups attach to streams, but also the feelings associated with particular streams. I also paid attention to how environmental and social actors use (or can use) feelings and affect to shape place-making and generate networks of ecological and/or social care. The below areas of literature, briefly characterized, have been central to the overall conceptual foundations of this dissertation.

*Placemaking and Visceral Geography*

Current debates in human geography have established a broad spectrum of work that emphasizes the affective and emotional aspects of personal and social life (Anderson, 2016). One significant contribution in this spectrum is the notion of 'visceral geography,' which was proposed by Hayes-Conroy (2010) in order to understand "how bodies feel internally – sensations, moods, and physical states of being – in relation with material, social space." The relational aspect of the concept is important, because it allows researchers to connect what seem to be individual concerns or experiences with broader cultural patterns and socio-political dynamics (Hayes-Conroy and Martin 2010, Hayes-Conroy J. and Hayes-Conroy A. 2010, Hayes-Conroy A. and Hayes-Conroy J.). The research has used the methods and concepts of visceral geography in order to broaden the scope of work on place-making to include people's emotions, feelings, and sensations as well as their thoughts, perceptions, and beliefs, in relation to streams.

The focus on placemaking in this research also enabled a closer sense of collaboration with communities and community groups involved in the research. Through investigating

and discussing the dilemma of ecological restoration of streams with these actors, the work co-generate knowledge about how people envision the future of the urban streams they are most effected/affected by. In addition, the group-nature of the research methodologies (as briefly characterized above) enabled participants to enhance the social, emotional/visceral and intellectual basis for the creation of affective networking that could not only strengthen their environmental actions but also generate new insights about the networked politics of streams as places. (Pierce, Martin & Murphy, 2011).

*Sustainability Science & Ecological Restoration of Urban Streams:*

Sustainability science has proposed that interdisciplinarity is necessary for finding solutions to current environmental problems on multiple scales. Within this interdisciplinary scenario, both physical science and social science disciplines must be involved, as well as community actors. Kates et al. (2001) argued that sustainability science seeks to understand the fundamental character of interactions between nature and society. In other words, sustainability science asks us to examine different ontological and epistemological visions, as part of scientific inquiry into environmental dilemmas, paying particular attention to the relationship between human beings and nature in the Anthropocene era. Similarly, Bettencourt & Kaur (2011) have asserted that sustainability necessarily requires collaboration between perspectives in developed and developing human societies, among theoretical and applied scientific disciplines, and that it must bridge the gap between theory, practice, and policy. In sum, traditional methods in social in natural sciences need to move toward interdisciplinary approaches to build bridges of cooperation between sciences and other disciplines and non-academic stakeholders.

Additionally, these new conceptualizations and methodologies must be integrated into the everyday life of societies to influence public policy, governance, and social behavior. Particularly with respect to the ecological restoration of urban streams, some studies have analyzed that a successful process involved a long-term process of technical intervention in terms of infrastructure and sanitation linked to foster cultural transformation of local communities in their relationship with streams. Riley (2016) proposed that the benefit of ecological restoration of urban streams go beyond an economic view and it includes the re-creation of a "sense of community" and re-establishing a "sense of place" (2016, p.23). In other words, ecological restoration is a socially engaging and inclusive process. Restoration embraces the interrelationships between nature and culture integrating societal and environmental objectives (Smith et al. 2016; Riley 2016; Lave 2010; Fischenich 2006).

*Place-based GIS and Remote Sensing:*

Originally geographic information systems were developed in a positivist framework for storage and processing of spatial analysis used just by academic experts and governmental agencies (Foresman, 1998). However, a paradigmatic shift took place in the late nineties. McConchie (2015) defined this new age as “Neogeography” which is “constellation of new mapping practices and populations on the geospatial web” (p.874). Neogeography has opened new possibilities for alternative democratic forms to use and disseminate geographic information such as open source GIS, web mapping, volunteered geographic information. Sui et al. (2013) argued that "Multiple new technological advances during past the past two decades have indeed unleashed the potential of a

geographer within everybody." (p.9). Volunteered geographic information (VGI) is one of these advances. VGI was coined by Michael Goodchild in 2007 when he referred to the popular practice of observing, collecting, and producing geographic information by those who have no formal training in geospatial data collection and analysis (Goodchild 2007). VGI is now said to be producing an era of "civic engagement" (Brovelli et al 2016), linking the informal world of human discourse with the formal world of digitally represented geography. (Goodchild 2011a; Roche, 2016)). In other words, "The contrast between latitude and longitude on the one hand, and references to places on the other."(Goodchild, 2011b). Along the same lines, Sui (2015) states that:

> GIS has been dominated by perspectives from space using Cartesian coordinates according to Euclidean geometry. The massive amounts of VGI in general, and geotagged or location-based social media data, in particular, seem to revive our approach to the world from the perspective of place. (p.9).

Goodchild and other GIS scholars proposed a new interpretation for the first law of geography proposed by Tobler (1970) "everything is related to everything else, but near things are more related than distant things." They argued that original statement has abundant and essential practical ramifications and is formalized as the foundation of geostatistics. However, they proposed that with the current innovations in GIScience it is possible to propose a contemporary interpretation: "everything is related to everything else, but things located in the same place are more related than things separated by borders." (International College of Territorial Sciences, 2016, my emphasis).

However, in recent years, online communities of remote sensing practitioners are continuously interacting, interchanging and producing new methodologies to store and analyze remote sensing data on the Geoweb in cloud computing platforms such as Google Earth Engine and Landsat on AWS (amazon web services). These Platforms

bring massive computational capabilities to bear on a variety of high-impact societal issues including deforestation, drought, disaster, disease, food security, water management, climate monitoring and environmental protection. (Gorelick, et al., 2017). Cloud computing platforms could make possible the integration of *platial* data with remote sensing analysis. This dissertation combined traditional geostatistical remote sensing analysis with *platial* data provided by local communities to understand the process of placemaking in ecological restoration of streams in Medellin. This participatory work is described most directly in **paper three**. Public participatory methods have demonstrated be useful to promote social, environmental change around the world (Elwood, Goodchild, & Sui, 2012).

Key Contributions and Broader Impacts:

This dissertation makes key theoretical, empirical, and methodological contributions, as well as policy recommendations. With respect to contributions to *theory*, **paper one** uses the case of La Honda stream to develop and analyze the potential practical and political utility of Ben Anderson's concept of "affective atmospheres." The concept of affective atmospheres indicates the ways in which specific environments, places or ambiances "press upon" people, encouraging or prompting specific feelings (Anderson 2009, 77). While the concept has always had understated practical and political importance, **paper one** works to make visible and concrete how affective atmospheres can be shaped for specific ends e.g. stream restoration. **Paper one** argues that rather than just *being affective,* ecological atmospheres like La Honda stream and its basin, have strategic affective touch points that could be put to use to inspire community-driven care and

socio-ecological transformation of the zone. I make this theoretical argument through developing the concept of eco-affective network governance. In **paper one** I also argue that such affective drivers should be a central facet of a revised *policy* initiative within Plan Quebradas that more democratically includes the work of community actors in stream restoration.

*Empirically*, this dissertation makes key contributions to understanding the extent to which environmental and social actors surrounding stream basins like La Honda are or can contribute to a scenario of the basin's ecological care. I begin to lay out these empirical findings in **paper one** with a discussion of how environmental actors think and feel about La Honda stream, and an analysis of what drives their local environmental actions. I also detail in this paper the differences held between young and old actors regarding relationships with authorities and professionals involved in the local government's Plan Quebradas. These empirical findings are extended in **paper two**. This paper integrates various data types in order to geovisualize desirable futures for La Honda Stream. The paper explore two future scenarios, one based on official plans and regulations and the other based on the visions of community environmental groups. **Paper two** finds important contrasts in these two visions of ecological restoration, not only in terms of the visions themselves, but in terms of the spatial configuration of different land covers and uses, which would result in different environmental and social outcomes. **Paper two** also serves to further demonstrate how enabling better outcomes requires the engagement of local communities.

My methodological contributions are centered in **paper three**, which details my work on the initiative mentioned above called *ElAtlas*, a scholar-activist initiative to make

geography and Open-Source geospatial technologies relevant in Community-engaged Socio-Environmental Research. **Paper three** details the historical process to build *ElAtlas*, which I have directed for the past five years. The initiative involved the convergence of different participatory approaches in GIS, such as Public Participatory GIS (PPGIS), and Volunteered Geographic Information (VGI). The paper details the different stages of this initiative since its origins as a participatory mapping project until the current state as a platform for the co-production of geographic knowledge between scholars and community organizers in Medellin, Colombia. In describing the third and current stage of *ElAtlas*, **paper three** describes in detail the participatory methodology of this dissertation on La Honda (the stages of which I briefly mentioned above), and how this project came to be a project as part of the broader *ElAtlas* initiative. **Paper three** also discusses the collective reflexivity about risks, failures, and challenges, as well as the positive outcomes in the collaborative transdisciplinary analysis of different socio-environmental issues in the Colombian Context.

A policy-oriented participatory goal of this research has been generate an inclusive vision of ecological restoration through examination of local processes of stream restoration in the Medellin river watershed. **Paper two** and **paper one** partially accomplish this goal. Ecological restoration of urban streams via Plan Quebradas (begun in 2016) represents a timely opportunity to pursue active participation of community groups and to grasp the problem of sustainability in the city as a collaborative and participatory matter. This research has underscored the importance of prioritizing social engagement in the process of ecological restoration, and furthermore paying attention to affect and feelings.

The research events described in **paper three** have helped in a small way to enhance networks among different groups involved in ecological restoration, including community groups, environmental authorities, and academic researchers. The support and resources I have provided through this participatory work for enhancing networks is both practical and affective – it not only creates new possibilities of collaboration for groups working on their projects for socio-ecological restoration, but it also can create positive feelings between those groups, which can lead to lasting collaboration and affective network governance in the city. Additionally, the project arguably has promoted transformative learning with environmental community-based groups and their communities in developing new public dialogues about the ecological restoration of the streams.

In summary, this dissertation has sought to find small but tangible ways to make geography relevant for communities working in socio-environmental transformation. One of my motivations for being a geographer came about sixteen years ago when I journeyed as community organizer the streets, roads, and trails of 'deep Colombia' looking to build peace in different regions affected by the most terrible horrors of the war. In one of my trips, I found a white book, left open. The book cited a phrase written by the geographer Yi-Fu Tuan, about his concept "topophilia," referring to it as [paraphrased] 'the set of affective relationships and positive emotions that human beings maintain in a certain place.' This phrase stuck with me, and has somehow inspired my work in the framework of academic activism, seeking to make geography an *affective* and effective discipline to positively influence the places we inhabit.

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# CHAPTER 2
## ARTICLE 1: ECO-AFFECTIVE NETWORK GOVERNANCE AND THE ECOLOGICAL RESTORATION OF STREAMS IN MEDELLIN-COLOMBIA.

Introduction:

The creation of affective networks and specifically eco-affective networks for territorial governance has been a common grassroots strategy in different regions of Colombia, although this strategy has never been given a name. This paper documents the use and potential uses of eco-affective networking in relationship to the ecological restoration of rivers and streams. Affective networks base their work in the creation of affective ties to other people and specific places in order to generate feelings that spark and maintain collective effort towards specific territorial goals (such as peace, sovereignty, or environmental stewardship); in other words, grassroots groups develop a praxis of affect, which strategically effects relationships within communities as well as between communities and their territories/environments.

This governance strategy has theoretical overlap with depictions of what geographer Ben Anderson (2009) calls "affective atmospheres." The concept of affective atmospheres, as Anderson describes it, is meant to portray the ways in which any given environment, or aspects of that environment, generates a "mood" or "ambiance" that affects people, producing feelings. These feelings are obviously experienced as personal, yet affective atmospheres are also impersonal, as Anderson explains, because they "belong to collective situations" - i.e. they are larger than the individual experiencing them. Attending to affective atmospheres, Anderson insists, involves inquiring "How does an atmosphere 'envelope' and 'press' upon life? (Anderson 2009, 77). In Colombia, the strategic production of affective networks by grassroots groups can be read as conscious,

and politically purposeful intervention in the shaping of affective atmospheres. Eco-affective networks are particularly interesting here because they represent a direct attempt to modify how aspects of the natural environment "envelope" and "press upon" life, in order to mobilize support towards ecological ends (such as stream restoration). This paper argues that the affective play involved in eco-affective networks could be better understood to support alternative forms of democratic governance for the ecological restoration of urban streams in Medellin Colombia; my empirical findings show that affective atmospheres may shape the possibilities for the political empowerment and engagement of local communities in environmental governance (c.f., Peltola et al. 2018). The article is structured into four parts. The first part reviews the prospective intersection of Atmospheres, Riparian Zones, and Eco-Affective Network Governance through a review of relevant literature. The second part then uses this conceptual background to develop the concept of eco-effective networks, in part through two examples from Colombian grassroots movements. The third part develops a case study about the perceptions and feelings of environmental community-based groups that mobilize actions towards the ecological restoration of La Honda Stream located in the north-east of Medellin-Colombia. This section describes the affective atmospheres in the upper, middle, and lower sections of the stream, as well as the perceptions about governance and ecological restoration of community and governmental actors. Finally, the fourth part proposes a vision of eco-affective network governance applied to the ecological restoration of the "La Honda" stream and its riparian zones.

Atmospheres, Riparian Zones, and Eco-Affective Network Governance:

The study upon which this paper is based brings together three distinct realms of scholarship that, while related, have rarely come together. These are (1) geographic work on affect, emotion and feeling, particularly work relating to activism or grassroots efforts at transformation (2) scholarship on environmental governance and network governance, and finally, (3) sciences of land use, urban watersheds, and riparian restoration. In this paper, I focus on the first two, but mention the third. I am interested in how processes of affective mobilization could influence, and/or be put to use in creating new forms of democratic governance that empower community-based groups to have a more central role in the ecological restoration of urban streams and riparian zones that most influence them. My interests are not divorced from the particularities of the Colombian urban context. Recent social protests in Colombia have demanded a more open and democratic process in policy and decision making about current social and environmental problems affecting the country. With respect to ecological issues in particular, decision-making has long been in the hands of those at the top of administrative and economic hierarchy, and has largely prioritized the interests of a neoliberal economy that permits destruction of many diverse ecosystems (as well as social systems) in different regions of Colombia (Chaves-Agudelo et al., 2015). My study attends to this problem through attention to local, small-scale participation in ecological governance related to urban streams.

*Affective Atmospheres and Visceral Geography:*

At this point, the literature on the role of affect, emotion, and feeling in grassroots activism and community organizing is well established. This work includes decades-long attention to how emotions and bodily feelings shape social movements from within interdisciplinary social movement scholarship (e.g., Roelvink, 2010, Goodwin et al 2009, Bayat 2013) and political geography/ecology (e.g. González-Hidalgo & Zografos, 2019; Bosco 2007, Clough 2012, Arenas 2015), as well as more recent attention to affective and 'visceral' dimentions of social movement mobilization and creative community engagement (Hayes-Conroy & Sáenz- Montoya, 2017, Hayes-Conroy et al 2020, c.f. Butler 2014). Collectively, such work has made clear that (1) politics at any scale are always intertwined with emotion and feeling, (2) that social movement organizations, corporations, and authorities alike know this and actively intervene in affective dimentions of social and political life, and (3) that the motivation or mobilization of individuals and groups through emotion/feeling/affect is not separate from motivation through ideas/thought/analysis (e.g. Hayes-Conroy and Martin 2010).

Two relatively new ideas within the above literature deserve more attention. The first, already mentioned, is Anderson's notion of affective atmospheres, which has recently been applied to work on activism and social movements in order to try to tease out the linkages between affect and space/environment therein. The concept of affective atmospheres describes the malleable space/environment in which people come to *feel* (be affected), without assuming everyone in that space/environment feels the same way. As de Jong (2017) explains,

> Perhaps of greatest importance, affective atmospheres do mediate capacities to affect and be affected. Yet, at the same time, atmospheres are always felt differently; there are thus always possibilities for individuals to act other than the affective atmosphere (p. 855).

De Jong's work employs Anderson's concept of affective atmospheres to show how feelings, moods, and states of emotion are not just immediate products of activist events but can also be considered as part of a broader underlying 'setup' (Butler 2015), that supports or denies certain kinds of activity.

The second relevant idea, is Hayes-Conroy's concept of somatic sovereignty. Developed through visceral geographic research that paid attention to the role of sensation, feeling, and emotion in motivating young peace activists, somatic sovereignty refers to the "ability to collectively control the structure of territorial relations through which bodily feelings and sensations emerge" (Hayes-Conroy 2018, 12). Somatic sovereignty is necessarily partial in the 'control' that it exerts, and like the concept of affective atmospheres, is considered to be collective yet non-deterministic – i.e. it does not "press" on everyone in the same way. Interestingly, Cloke and Conradson (2018) describe affective atmospheres in a similar way – "relationally constituted structures of feeling – that both emerge through and impact on the in-situ experience of a place" (362). What somatic sovereignty adds, then, is a specific political intentionality to the experience of place. In this paper, I discuss eco-affective networks as a means to co-produce the experience of urban streams as places, and thus to invigorate new ways to democratically govern their use and their meaning in the urban landscape.

*Network Governance and the Environment*

The second realm of scholarship that I engage with in this paper is the concept of network governance. I am particularly interested in how network governance could contribute to the empowerment of community-based groups in decision-making processes related to the ecological restoration of urban streams. According to Sorensen & Torfing (2007), the study of governance networks is a novel research field that is founded on the 'discovery' of nonhierarchical forms of governance based on a negotiated interaction between a plurality of public, semi-public and private actors. This form of governance seeks to overcome management failures of the past that may have resulted from rigid, hierarchical, fragmented, conventional, top-down, ecological government-centric approaches (Muñoz-Erickson et al., 2016). These alternative ways of governance establish the conditions to move toward more systems-based, flexible, and participatory strategies that foster social learning through governance networks (Van der Brugge and Van Raak 2007). A focus on governance networks, in some cases, has also been shown to reframe ecological resources in favor of grassroots movements (Dupuits & Pflieger, 2017). Similarly, Muñoz-Erickson et al. (2016) claimed these networks could structure power through differential flows of information, knowledge, and other resources. Provan & Kenis (2008) identify three main types of network governance based on the distribution of power among a plurality of actors and the mechanisms in the process of decision making. These types are: (1) Participant-Governed Networks, a form of governance in which the members of the network themselves rule all the decisions, without a separate entity; (2) Lead Organization–Governed Networks: an approach in which the members of the network share the responsibility for the majority of decisions,

but a central entity also exists that regulates the mechanisms of governance; and (3) Network Administrative Organization, a form of governance in which a separate administrative entity controls the network and its activities centralizing the process of decision making. With respect to restoration events and activities around La Honda stream, the current governance strategy conforms most closely to Network Administrative Organization because the local government controls the resources and decisions about the implementation of restoration activities, however, the 'network' they control is mostly one of professionals and hired work, and therefore they have little control over what happens on a day to day basis around the stream.

In this regard, arguably, the current conditions of La Honda Stream are a result of multiple overlapping forms of ecological governance. While the local government (authorities and professionals) make largely arm-chair decisions about what, when, and how to implement new policies relevant to stream restoration, local environmentally-active community groups (in the stream basin) generate activities that affect both the physical space (e.g. plantings, cleanup) and local residents attitudes towards the stream. There is relatively little coordination and cooperation between local authorities and community organizers, and incentives for participation among community organizations is still scarce. The little amount of cooperation that exists between these two realms, sets up a few community leaders in temporary positions, fulfilling the desires of technocratic experts, with limited attention paid to the need for long-terms community engagement in processes of ecological restoration. This paper examines an alternative approach that takes seriously the creation of community networks for long-term ecological care, based on affective ties between residents and the stream basin as well as among residents. In

this approach, governance is conceived of as a network of collective production of knowledge/feelings about, and interaction with, specific natural environments.

*Urban Riparian Restoration*

While this paper does not directly engage with the science of urban riparian restoration (see Paper 2), I use the context of riparian restoration to discuss eco-affective networks. In the everyday life of urban citizens, economic, political, logistical, and cultural challenges have been identified that curtail the ecological restoration of urban riparian zones in the global South (Wantzen et al., 2018; Wantzen et al., 2019.) Conventional forms of governance have not made much progress in promoting solutions to such everyday challenges, but governance networks that emphasize the creation of affective atmospheres may be a missing link in fostering change.

Colombia as an Exemplar of Eco-Affective Network Governance:

"Affective network governance" is a concept that is arguably already at play in Colombian politics, although it has never been given a name. Building from the ideas of affective atmospheres and network governance, described above, I define it here as a process of partial governance of particular spaces or territories through the creation of affective ties among people and between those people and the territory at hand. In this paper, I add the qualifier “eco” to describe the actual and latent power that affective network governance has for addressing ecological challenges. In particular, I am interested in the extent to which the ecological restoration of urban streams, can and should be based in the creation of affective ties and the sharing of somato-sensorial

experiences among community-based groups en-route to or alongside longer term processes of socio-ecological urban activism (c.f. Verlie 2019). In order to examine the actual and latent power of eco-affective networks, in this section, I provide two illustrations of eco-effective network governance from the recent history of Colombia – “Legion del Afecto" and "Rios Vivos." I will then use these illustrations in the next section to explore the community engagement and activism around urban streams in the city of Medellin, Colombia.

*The Legion del Afecto:*

From 2004 to 2015, the *Legion del Afecto* (trans: Legion of Affection) advanced across Colombia as a peacebuilding network that based its labor in the exploration of Colombian territory by young people from low-income urban communities. This grassroots movement/initiative was supported by the national government and other institutions of international cooperation. The *Legion del Afecto* was not explicitly “environmental,” yet one of the premises of the initiative was that any potential advancement towards peace in the country would require the protection of biodiversity as well as new ecological consciousness in urban and rural areas. The *Legion del Afecto* Network advanced through the creation of affective ties among and across communities


**Figure 5. The Eco-affective network of Legion del Afecto Integrating Environmental community-based groups in different departments of Colombia.**

affected by the war and poverty, usually through strategically planned series of events that enabled emotional communication and shared sensory experience (see Hayes-Conroy 2018). Yet, the creation of affectionate ties did not stop at the human world, as the *Legion del Afecto* also encouraged through these events the creation of positive emotional ties to specific rural spaces and landscapes, mountain ranges, rivers and watersheds, which the youth involved would not otherwise have had the opportunity to know and experience. These events motivated hundreds of youth to extend their peace work to Colombia's natural areas (both rural and urban), protecting forests and rivers, and creating new spaces for the interchange of knowledge between local experts in biodiversity and social leaders. Forests and rivers became a focal point of their work because youth were able to witness first-hand the ways that forested zones protected waterways and the importance of reforestation of riparian zones in different regions of Colombia. They created a network through which they 'governed' (partially) the interchange of knowledge and mutual support for the fostering of ecological restoration and biodiversity protection in urban and rural areas of Colombia articulating the municipalities of Quibdo, Samana, Circasia, Cartago, Cartagena del Chaira, San Vicente del Caguan, Puerto Rico, Medellin, San Luis, Cali, Bogota, Chiquinquirá, Barrancabermeja, and Tibu (see Hayes-Conroy and Saenz Montoya 2017, Hayes-Conroy and Hayes-Conroy 2016, Barberena 2007, RSS-PNUD 2004).

*Rios Vivos:*

A second grassroots movement that has based their work on an intensive establishment of networks of cooperation to protect Colombian rivers, as well as the cultures around them, is the social movement *Rios Vivos* (Translation: Living Rivers). Rios Vivos became particularly well known in the past five years, as they organized local community-based groups to build a broader network and affective ties to resist the threat imposed by the mega-project "HidroItuango." In the north of the department of Antioquia, Rios Vivos built a network of fifteen community-based groups bringing together fishing communities, gold-panners muleteers, farmers, cooks, homemakers, merchants, among other activities of rurality affected by the megaproject. Rios Vivos resisted the megaproject by drawing on local desire to care for and protect the Cauca River and the cultural legacy of local communities in relation with the river. In this legacy, the river is a living being that provides necessary goods to the communities around it, such as the fish, the minerals, the fruits, and the sacred plants that grow up in its riparian zones (Rios Vivos, 2014). Rios Vivos also drew upon anger and the frustration for the social and environmental injustice caused by national and international companies that are

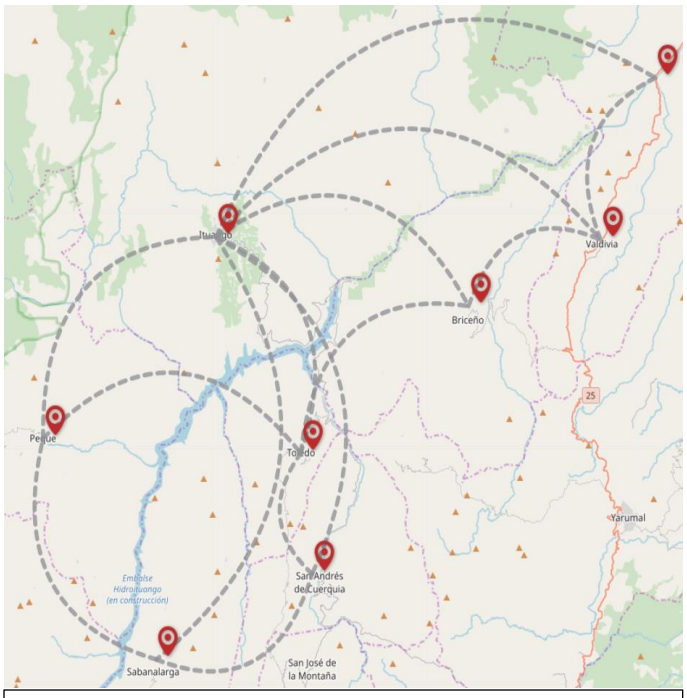


**Figure 6. The Eco-affective network of Rios Vivos integrating environmental community-based groups in different municipalities of Antioquia.**

exploiting the natural resources around rivers and streams (Temper et al., 2015). Some members of *Rios Vivos* have been killed for defending the rights of communities (MCR Vivos, 2013). Yet, through their work to build a network in the municipalities of Ituango, Toledo, Peque, San Andres, Briceño, Sabanalarga, Puerto Valdivia, and Valdivia, they are creating an alternative (partial) mechanism of governance that strengthens the ecological and cultural heritage of the Cauca River Canyon, while supporting (partial) sovereignty over the territory's water and energy (MCR Vivos, 2014).

The point of the above illustrations is to identify a shared practice in these grassroots movements of the creation of affective, emotional, shared sensory experiences among individuals who, when linked together, may collectively hold some power to shift, however partially and fleetingly, governance over a given forest, or river, or watershed. The work is to not only foster affective relationships between different people that are capable of working towards immediate goals, but also in doing so, to foster affective relationships between people and forests/rivers/watersheds. This kind of affection is absent in dominant political narratives and delegitimized through settler-colonial social norms (Singh, 2018). This affective networking is meant to create multiple extended possibilities of feeling in particular places in order to inspire the long term labor of ecological restoration. Networked bodies work to build and sustain atmospheres of ecological restoration and "the agency to govern" this process (Slaby & von Scheve 2019, p. 89).

The more empirically rooted point of the above illustrations is to emphasize possibility: I contend that the kinds of experiences held in the example of these two eco affective networks could support the establishment of processes for the democratic governance of

ecological restoration of rivers and streams in urban areas of Colombia. This rest of this paper explores the possibilities of implementation of these alternative mechanisms of governance in the ecological restoration of streams and its riparian zones in Medellin Colombia. In the last 30 years, the city has been affected by high levels of pollution in the Aburra River and its streams. Several river and stream restoration programs have been implemented during this time (Restrepo-Muñoz, 2014). Yet, these programs have largely been implemented by government actors, embedded in hierarchical processes of decision making, which have minimized the role of environmental community-based groups. Meanwhile, during this same time period, Medellin has become well known for its grassroots activism (Hayes-Conroy et al., 2020, Valencia and Montoya 2010, also see medellinjoven.com). Grassroots networks in Medellin have implemented powerful strategies to combat the social and environmental effects of violence and inequity. I argue that the potential of these groups has been underestimated in governing the ecological restoration of the city's streams. As in the cases of the *Legion del Afecto* and *Rios Vivos*, eco-affective networking between local social and environmental groups could help to create eco-affective networks that effectively support processes of ecological restoration.

## Methodology and Context

The city of Medellin developed as an important economic hub in the Aburra valley, in the Andean mountain chain, characterized by abundant sources of water. In the portion of the valley corresponding to Medellin alone, there are more than four thousand streams. However, processes of industrialization and urbanization in the valley during the twentieth century worked to reinvent streams as sewage systems or garbage dumps, with

little other environmental value. Later in the 20th century, planning authorities recognized the environmental severity of neglecting streams. Several programs and plans have taken place in the last three decades to restore the ecological balance of the Medellin river and its streams, including the costly Medellin River Sanitation Program (IDB 2009) and the building of linear parks around the main streams (Agudelo 2014). However, these interventions, while important, failed to generate widespread change both with respect to the environmental condition of the river and its streams, and with respect to the cultural view of rivers and streams as a nuisance or dumping grounds. Also, neither of these recent interventions included widespread engagement of local communities living near streams during this process (CTA & Á. M. D. V., 2018). In 2016, the newest initiative of ecological restoration of streams began, with a focus on nineteen of the principal streams from the ten municipalities of the Aburra Valley. This initiative, called *Plan Quebradas*, is led by environmental authorities such as Area Metropolitana and the local governments of each municipality. *Plan Quebradas* seeks to establish a synergy among the public, private and community actors to develop projects on three main components: sanitation, reforestation, and environmental education. Significantly, this last component seeks to changes socio-cultural relationships with streams as the primary factor in ensuring sustainable restoration of the Medellin River (CTA & Á. M. D. V., 2018). My research focused on one of the nineteen streams included in Plan Quebradas, called "La Honda," located in the northeast of Medellin. Below I justify my choice to focus on this stream, describe the methods I utilized to generate the empirical data in this paper, and describe the stream itself.

*Methodology: Why La Honda stream?*

I grew up playing around the streams of the Northeast of Medellin; these places are embedded in memories of my childhood adventures. I remember that the polluted streams of my neighborhood were a playground for my friends and I. We spent many afternoons exploring vegetation, insects, and birds jumping rock by rock in the contaminated water. In that moment of our lives, contaminants were not a big problem for us. My mother did not know that the stream was our secret place to play. On weekends, we walked one hour from home to a cleaner stream in the middle of the mountains for swimming. Thus, I recognize streams as having complex and dual meanings for urban residents in Medellin, many of whom came to the city from rural areas. Streams and rivers have long represented one of few places of recreation for low-income families. Yet, as they have increasingly become sites of disposal and waste, as well as geological and social instability, they have also come to represent danger and decay. Today, as a geographer, those memories of streams as places of collective joy have motivated my research for contributing to the ecological restoration of streams in Medellin.

The idea for this research began in a socialization activity of the *ElAtlas* Participatory Mapping project in the northwestern zone of Medellín, in which I was taking part (see Paper 3 for a detailed description of this project). At this meeting, one of the leaders working around the "La Honda" stream questioned me as to what Colombian geography is doing to contribute to the ecological restoration of streams? This probing inquiry led to a conversation with this environmental leader and prompted my decision to focus my research on La Honda stream. In addition, the northeast of Medellín has been my area of

community and academic work during the last 16 years. In this area, I already have strong affective ties with community-based groups. Thus, I chose to "study home" (Hayes-Conroy 2005).

But there are other, more empirical reasons for choosing La Honda. The upper and middle parts of the "La Honda" stream are located in an area of the city that has been affected by social tensions due to new land zoning norms. These norms are meant to reduce the urban sprawl in the edges and slopes of the territory. Yet, over the last twenty years the riparian zones around the "La Honda Stream" in the upper and middle parts have been key areas where rural communities, displaced by armed conflict in their home regions, have found a precarious home. They are now struggling to remain in the territory. Tensions between these displaced communities and local authorities have focused on municipal plans for the construction of a green belt to stop urban sprawl and enable ecological restoration in the periphery of the city. Because of these contextual conditions, the La Honda stream basin is an area of significant research value for understanding the potential role of communities in ecological governance in Medellín.

*Methodology: Critical Geo-Storytelling*

Critical geo-storytelling is a methodology to co-generate and analyze different kinds of empirical data, while simultaneously contributing to the transformation of complex socio-ecological problems through strategic telling or re-telling of stories relevant to particular socio-spaces or socio-environments. Critical geo-storytelling is a methodology through which we, as critically-oriented geographers, can invigorate social consciousness in the political realm based on cultivating empirically- and conceptually-

informed social justice ideals. (c.f. Ballvé 2014). I have built my storytelling of La Honda stream through a combination of interviews, Public Participation Geographic Information Systems (PPGIS) and stream habitat walks.

Methodologically, this project built from my previous work on social transformation in Medellin, including especially trials with experience-centered ethnographic work (Hayes-Conroy and Saenz Montoya 2017). An arm of this earlier work developed an online platform/database and on-the-ground network known as *ElAtlas* (mentioned earlier), with a wide variety of grassroots groups in Medellin. The present study utilized *ElAtlas* as a basis from which to engage environmental groups who are currently working in the study area. Working with other members of the *ElAtlas* youth board, I established communication with seven environmental community-based groups that are working directly with ecological restoration in the stream. These groups provided the individual contacts for generating group interviews, and other activities (described below) with local leaders and other participants who have been active in the stream basin.

**Figure 7. Participatory research activities with local communities**

*Interviews:*

The study organized in-depth group interviews centered on specific logistical and experiential elements related to streams and stream restoration with leaders of environmental community-based groups. The study developed a total of seven in-depth group interviews (representing the seven groups working in the study area), each of which involved between 2-3 people (the leaders of each group), and took about three hours. The interviews were linked to PPGIS activities through the provision of printed satellite images of the territory. Environmental group leaders marked points with geometric figures and keywords in response to a series of questions that were divided into three phases. In the first phase, questions centered on the collective feelings about the streams and their emotions in the daily work of ecological restoration. In the second phase, they identified points around the streams where their activities take place. In this phase, we explored the sense of place of the streams through the geographical narrative of the environmental leaders. Finally, in the third phase, the leaders of environmental community-based groups physically drew on the printed satellite images to indicate scenarios of desirable future futures for different riparian zones of the "La Honda. " stream. At the same time, all the narratives and descriptions were recorded through cell phones in audio files.

Additionally, I undertook individual stakeholder interviews with environmental authorities including those mentioned below in the section on actors to collect descriptive data about their perception of streams as well as technical and attitudinal data regarding the process of ecological restoration of streams and their relationship with environmental community-based groups.

Stream Habitat Walks:

The study also involved three “stream habitat walks,” which according to the EPA (2012) "is an easy-to-use approach for identifying and assessing the elements of a stream's habitat, which consists primarily of visual observation of stream habitat characteristics, wildlife present, and gross physical attributes." Environmental groups in the study area had a prior interest in habitat walks, and the project worked with these groups in undertaking these events (i.e., sponsored these events for the groups). Thus, stream habitat walks also became a way to participate and observe the environmental groups in action. There were three walks in the upper, middle, and lower course of "La Honda" stream. In each walk 15-20 people participated as members to local environmental community-based groups.


**Figure 8. Location of Environmental groups in the study area**

In this study, the stream habitat walk was used as a vehicle for learning about the intersection of physical, cultural, and affective attributes of streams, and for mapping the actions that community-based groups have been developing in the ecological restoration of streams. The stream habitat walk, undertaken as a group, is also meant to function as a "shared sensory experiences," which allows participants to engage in both verbal and non-verbal exchange through a common activity like a shared meal, or walking together (Hayes-Conroy 2010). In these stream habitat walks, we collected data about places

around the stream using three smartphones collecting audio recordings, and pictures, and short videos (with the help of two assistants from the ElAtlas team).

*Networking Meetings for Validation:*

At the end of all of this work, I also held a networking meeting with representatives of the seven community-based groups in order to socialize and validate the results.

*Context: Participants and Actors*

There are three categories of actors relevant to La Honda stream: institutional, academic, and community actors. My research conducted individual and/or group interviews with individuals from each of these categories. Institutional actors included officials in the city's Office of Environment and others in the municipal government (i.e., relevant individuals from the Aburra Valley Metropolitan Government offices). The academic actors included professionals in the Institute of Science and Technology of Antioquia "CTA", who developed the technical studies about the current state of the streams and proposed some projects of intervention.

The community actors participating in my research included leaders and participants from seven community-based groups adjacent to the stream: (1) The *Mesa Ambiental Comuna 3*, a community environmental committee that bases their work on the concept of bio-territoriality and receives financial support from the city's Office of the Environment. (2) *Retazos*, a cultural and environmental-based group that uses experiential education to work with the childhood and the youth in the district. (3)

*Triangulos*, a cultural and environmental groups that use dance, music, and theater to foster a process of ecological consciousness. (4) *Agroarte***,** a city-wide environmental collective, focused on urban agriculture, who maintains a library in the nearby neighborhood "La Cruz" for environmental and literacy activities. (5) *Mi Raza*, a social and environmental community-based group that implemented with the support of the Secretary of Environment of Medellin processes of environmental education in the comuna for fostering the protection of streams and stop with the conceptions of these places as dumpsters. (6) *Founders of Barrio La Cruz*, a social and environmental community-based group that has worked in the process of the historical memory of the neighborhoods la Cruz and la Honda, and they have extensive knowledge about the social and ecological transformation of these neighborhoods. And (7) *Mesa Ambiental La Honda*, an environmental community-based group with influence in the upper side of the neighborhood La Honda, who organizes environmental education activities (including stream habitat walks) to promote ecological restoration and recycling.

*Context: La Honda Stream*

La Honda stream is broken, ecologically and socially, into three parts: lower, middle, and upper. Each of these parts have distinct sights, smells, tastes, sounds, textures, and energies. As part of my research, I walked this stream multiple times. I tasted its clean water in the upper section, sparkling from the spring. I smelled the toxic air of its channelized waters in the middle part. I touched the vegetation that grows up around it. I heard the sounds of an owl. These physical aspects of the stream environment constitute, in part, their ability to affect or "press upon" the people who experience the

stream. They help to shape the stream's multiple, dynamic affective atmospheres. Still there is more: the perceptions and stories of those who live, work, or organize by the stream, the bureaucratic structures that enable and disable its would-be restoration, and the relationships that form because or in spite of its presence. Below, I briefly describe the three sections of the stream moving outward from the city: Lower La Honda, Middle La Honda, and Upper La Honda.

*The Lower Honda, the urbanized Stream:*

Along the east side of the Botanical Garden of Medellin, the polluted waters of La Honda stream joins with the stream, "El Molino." This intersection is one of the few locations in the lower part that the built environment does not cover the stream. In the area between the botanical garden and 45th St., in the neighborhood Manrique, the stream La Honda is almost an invisible entity, almost imperceptible, even though the stream runs underground carrying the wastewaters of their households. A little further up, the stream is visible in the backyards of packed-together urban houses. These are the only places in this section where actions of ecological restoration seem possible. The restoration of riparian zones in this area would imply the redesign of the city, relocating whole neighborhoods and main streets.


**Figure 9. The Lower Honda, the urbanized Stream**

*The Middle Honda, The Riparian Zones and the urban sprawl:*

The middle section of the stream is the most diverse in terms of both experience and ecological activism. From the neighborhood named "la Honda" to 30th St. the stream runs into a high slope. These morphological conditions have prevented urban sprawl, at least in the riparian zones, due to high risk of landslides. However, further up towards the urban-rural border, flatter riparian zones were settled by displaced rural communities who came to the city in the past three decades. These processes have sped up the ecological degradation of the riparian forest and many recreational ponds. In this zone, the stream often smells and looks like a trash dump or a sewer. Yet, a few hundred meters upstream between 39th and 45th street, the community has been protecting an area of urban forest. During the last year, the local government built a new system of sanitation for this area; the environmental leaders hope that these interventions could produce positive change in the ecological functionalities of the stream.

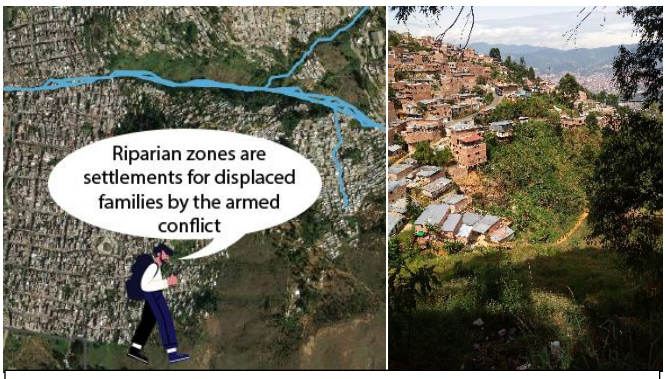


**Figure 10. The Middle Honda, The Riparian Zones and the urban sprawl**

*The Upper Honda, The Riparian Forest:*

The upper part of the stream is located in a rural area, towering above the city in the district of Piedras Blancas. Here the stream is divided into three branches, two that run underground and a small creek that runs clean in the middle of a pasture. In the early morning, the stream is often covered by clouds. There are rural houses here, who connect the water of the stream for their households using hoses. Two hundred meters higher, there is a high brush area connecting with the cloud forest that belongs to the reservoir of the protected Arvi Park. There is high biodiversity in this area, including, birds, owls, butterflies, and multicolor insects. In the middle of the forest. At the very top, the spring of the stream can be found amidst moist grasses and rocks. The water is (arguably) clean enough to drink.


**Figure 11. The Upper Honda, The Riparian Forest**

Affective Atmospheres of Stagnation or Change?

> Affective atmospheres are shaped by their multisensory properties: how spaces and places are physically encountered via their visual, haptic, aural, olfactory and taste properties is central to the feelings they generate, (Lupton, 2017, p1).

In this section I use data from individual and group interviews with participants involved in local community-based groups surrounding La Honda stream in order to juxtapose

differences in how the stream environment "presses upon" local actors. I argue that the varied ways in which La Honda *affects* these actors matters to the potential mobilization of actors around stream restoration. While a strong and organized eco-affective network does not yet exist between local groups, the below commentary also suggests that such a environmental governance strategy could work, and could offer new paths to urban stream restoration. All of the participants in the below quotes had already participated in a group stream walk along La Honda prior to being interviewed.

*In what way does La Honda "Press Upon" Local Actors?*

La Honda stream, from about 37th St. to 39th St. is most often perceived negatively, as expressed by members of the *Mesa Ambiental* of Comuna 3 (district 3):

> La Honda is a dumpster; I think it is the most polluted stream in the city. (Jose)
> The area between 37th and 39th is a place to feel sadness, because it smells pretty bad, there are a lot of mosquitoes, and nobody makes nothing for cleaning this stream. Whatever thing that is not collected by the trash truck is thrown away directly to the stream. (Raul)

Yet, despite the current state of the stream, participants took pride in their knowledge of the stream, and their memories of past events that took place there. For example, two older community leaders took satisfaction in informing me about recent changes to the geomorphology of the stream.

> Now I remember, it was the summer of 2002, or 2001, where there was a very long summer [dry season] and the stream dried, and then it only returned in the winter [wet season], and we didn't see life in the stream after that point, and we didn't see the great quantities of water that it used to have. … And the other [geomorphological memory] is the waterfall that divides La Cruz [neighborhood], that didn't exist and it appeared after a huge downpour, and for those who don't remember, that's what made the stream … it wasn't channelized at that point and

> it flooded all of the streets of Manrique (neighborhood) … after that they channelized it (David)

> In La Honda stream there were two, very famous swimming holes, the Charco de Cañas and the Charco de Tarzan. These swimming holes disappeared because civilization absorbed them with dirty water and because people started to build along the sides of the stream. (Antonio)

Others used their knowledge to describe the economic and physical necessity of the stream:

> This stream, no one takes care of it, but it saved us in 2010 or 2009, when a central pipe broke and we were without water for two weeks, thanks to this damn stream all of us were saved because everyone got water from here. (David)

> Many families get their water supply from this stream, not because they don't have EPM (public service) but because they want to save money. (Rodrigo)

Many other participants enthusiastically described their childhood memories of La Honda stream, depicting the stream as a source of positive affects:

> The water was clean, you could find snakes, you could find crabs, little crayfish, you found them there and, well, that disappeared. (Camilo)

> All of this [the riparian corridor around La Honda] was pretty much forest: scrubs, coffee, guamos (a legume producing tree). (Esteban)

Certainly, streams and waterways have long been a particularly important cultural gathering point in Colombia, where people go to take a break from work and to make a *paseo de olla* – an excursion to the water's edge where families and/or friends often bring ingredients to make a large pot of soup (sancocho). Participants described their relationship with La Honda stream and it's riparian corridor with nostalgia:

> People came here to swim and even to fish in the streams. Let's write about the emotions that the streams generate in us – happiness, because we used to come to swim, to make sancocho, people brought clothes to wash, you could even bathe here. (Monica)

> I got to know the best parts of streams and hydrological zones. In La Honda we would get together on Saturday to swim. Below here people made two natural pools that they damned with stones and up there above, in the spring, they also made another where people hungout together but now those customs are gone … and now you can't even do that because it is so contaminated. (Leonardo)

Clearly, such memories also often invoked sadness, regret, or despair at the changes that have happened:

> I remember when I was between 9 and 13 and I would go up with my friends to play in the whole stream. We swam, we made a kind of fence, a kind of damn to make a pool and we could dive in and well, and well, just now when we walked up there it made me sad because you can barely find the spring where it begins, and it sort of gets detoured and so down below on this side, everything is dry. (Cristian)

Yet, still others found signs of hope that something can still be done to give new life to the La Honda Stream:

> The part of the stream that goes down the mountain to La Cruz, that now sees very little water flow, what one feels is hope that still there is a lot of water in this place. You can feel it in the green plants that surround it. We could say that the earth feels that it is not dry. There is a lot of water although you don't see it in the stream. … You feel hope but also nostalgia to know that the people who lived here before talked about how the water came down. You feel nostalgia for the fact that each day there is a slow death [of the stream], well OK, but there is still hope to be able to do something. (Felipe)

All of the above quotations, in collection, paint a rich picture of the affective atmosphere around the La Honda stream basin. The affective atmosphere of the basin seems to be maintained in part through past memories of interaction with the stream as well as current frustrations with its state, and collective social activities within the stream basin. Below I describe recent organizational activities related to the stream basin.

*What do organizational activities around La Honda say about environmental governance?*

The production of the affective atmosphere of La Honda has much to do with its changing physical presence, the cultural and economic relationships local actors have with streams, and sensory-rich memories of the stream as a place. Yet, there is more: The actions and activities of nearby community organizing also directly and often intentionally drive the affective atmosphere of La Honda stream. For example, despite being viewed as a "dumpster" in the trajectory from 37$^{th}$ to 39$^{th}$ Streets, just a few hundred meters away, in the stream's trajectory from 39$^{th}$ to 45$^{th}$ Streets, there is already strong evidence of community-driven environmental governance. Various community-based groups such as la "Mesa Ambiental de la Comuna 3" have been working here to protect an area of urban forest. They do not all work together, and therefore might not yet be described as a network. Yet, many groups and individual actors partake in projects relevant to processes of ecological restoration, though they differ in background, activity, and strategy (due to the ages of their members). In particular, older adults tend to orient their actions towards collaboration with offices of the local government in order to build infrastructure that might mitigate risks to the stream environment. By contrast, groups conformed by young people do not often align with local or state politics, preferring to build grassroots networks through cultural activities and urban agriculture. Many coalesce, however, in their desire to enhance others' experiences with and attention to the stream environment, as the following environmental leader describes:

> We here look to create consciousness with the people. We ask the institutions that help us to reforest to think about the landscape so that we can show to the people that the stream can be the opposite of what it is now. (Elkin)

A number of local activists, including the artist-activist and a youth leader quoted below, described a similar desire to inspire local residents to care for, and have affection for, the stream:

> Let's say that art is all about affection, and from there we can talk about the struggles [of this area]. … in this case of building ecological care, [we must think about] historical struggles, the stories of this ravine … [these are part of] the affections for it, and then we can talk about what it has to offer. (David)

> Everyday human beings destroy [earth/nature], but there are some people working like little ants about this. It's life itself and having clean, uncontaminated streams creates an important atmosphere not only for the neighborhood but for the whole city. (Carlos)

Yet, within the community groups surrounding La Honda, there are contrasting visions of the best practices of governance that might achieve ecological restoration of the riparian corridor. While some (often older actors) blame individual households, and believe that the only solution is strong environmental law to punish polluters, the intervention of police forces, and the consolidation of a municipal green belt to stop illegal sprawl/building, such as the below two participants:

> Many people just don't care about the stream, they cut down the trees or make fires in the upper part, and they don't feel any feeling of guilt for affecting the stream and their neighbors, maybe the solution would be to create a natural reservoir to prohibit walking around these areas and implementing environmental fines." (Diego)

> It could be that private industry uses our water [for profit], but those who contaminate it are the poor people. We use the water, and pollute it upstream to do damage to our neighbor, so I feel like when I walk through these zones, I detest human beings. In clean parts, I relax and dream that maybe someday no humans will come here. The people who come up here and the first thing they do is burn it. The people here see a clean place and instead of taking care of it, they destroy it more rapidly. (Edwin)

Other actors, and other groups (often younger actors and activists) conceive that more than regulatory interventions, it is most important to create new, inspiring forms of environmental programming, aimed at achieving new or renewed affections among community members and between them and La Honda stream, and its broader riparian corridor.

> What motivates me to work on these environmental issues? What motivates me is that we don't know how to care for [the environment], and it motivates me that I have enough time, and academic preparation, and will and desire. If we have a healthy environment, we have life, and to see a dead stream like what La Honda is in this moment, and to give it life, clean it up, and give opportunity for new generations [is what motivates]. (Mariana)

> And what does your body feel when you do a walk like this in these foggy forests, that are a part of the stream basin? Well, we walk in the city up a steep hill, we are agitated and want to throw one's self down anywhere just to sit, but when we climb up here we stop a moment with the fresh air that is up here, and right away we feel energized, and we keep walking. So there is a lot of difference. (Leonardo)

> For creating alternative mechanisms of governance, the first step is building a new affectionate relationship between different community-based groups, and then recognizing the stream as an important part in the history of our territory. Ecological restoration must be based on affection for our environmental colleagues and for the stream." (Oscar)

> We would be able to do more if, for example, we did all of this engaging the people. The people would take care of this [the riparian corridor], but when we do what we do now [planting trees], it happens that in many parts the trees … dry up again because no one is taking care of them and no one pays any attention to that. So I say that what we need to create is a closeness [between people and the riparian zone], rather than fulfilling roles and objectives [from institutions], instead do something real that transcends and is replicatable. (Alex)

The above quotes make clear that many of the environmental leaders not only view their affective relationships with the stream as a motivating factor in their work, but that they also seek to create motivation in others through similar affective means. Such affective work is not recognized by the governmental and technocratic actors implementing Plan

Quebradas (whose ideas I mention in the next section). The democratic system in Colombia has historically been a centralist system, excluding poor communities and with high levels of corruption, which is evident in the lack of effectiveness in the development of environmental projects and ecological restoration. Because of this historical background, one of the arguments of this paper is that it is necessary to organize alternative forms of ecological governance, such as grassroots networks that not only allow the active participation of local communities, which have been excluded from decision-making processes, but that also recognize and value the affective work of local environmental leaders. Below I discuss current obstacles to such eco-affective network governance.

Assessing La Honda "On Paper": Technical and Governmental Actors:


**Figure 12.** Perceptions of Environmental Authorities about "La Honda". The sign reads: "La Honda, the garbage and debris make me feel sick."

As mentioned above, my research also involved individual interviews with environmental authorities and professionals. For example[1], I spoke with a representative of the

[1] I also spoke with a representative from the *Oficina de Area Metropolitana* (Metropolitan Area Office), which is tasked with the responsibility of environmental regulation in the entire Aburra Valley, collaborating with ten municipalities and the private sector. Unfortunately, the designated person in this institution did not know how to answer the questions that we previously sent. At the

municipal Office of the Environment, in charge of overseeing Plan Quebradas, the newest stream restoration program in the Aburra Valley. Unlike my meetings with local community groups, we met on the 7th floor office in downtown Medellin, rather than by the stream. The representative was hesitant to inspire the possibility of real ecological change with Plan Quebradas, partially due to the overwhelming need to focus on the sanitation arm of the plan, especially around the informal settlements of the city. The representative reinforced the negative perception of urban streams, calling them an "ecological problem with no clear solution," and highlighted the sentiment that streams are perceived as dumpsters by calling attention to constant reports from local communities about garbage dumped there.

I also spoke with three members of the CTA (Center of Science and Technology of Antioquia), who worked on the elaboration a diagnostic analysis of each stream for Plan Quebradas. One of them had worked in different programs of ecological restoration over the last three decades, and our dialogue started off with the recognition of a lack of effective achievement of the goals of these programs despite the high quantity of resources invested in them. For example, *Instituto Mi Rio* (My River Institute), the first governmental institution created for the restoration of the Aburra River, centered decision-making processes within local government hierarchy. In this framework, community actors were only conceived as beneficiaries of the programs, with little empowerment for long term change. Instead, the "public outreach" of *Mi Rio* focused on

time of the meeting, they asked to print out a document written by the technical team, then started to read the text for answers. Our meeting was cut short after securing permission to obtain the document.

environmental campaigns that produced thousands of souvenirs to be distributed all around the city, leading people to think that *Mi Rio* was a company of T-shirts and caps. All three CTA professionals that I spoke with agreed that this legacy of Mi Rio has likely affected the capacity to recognize the proper role of local governmental institutions of in processes of ecological restoration, beyond annual targeted cleanups and souvenir campaigns to make citizens "happier" about their waterways. CTA officials were more hopeful about Plan Quebradas, hoping to change the legacy left by *Mi Rio* by focusing on the creation of new public-private partnerships. By targeting the private sector, they encourage a solution based in private investment in green and grey and infrastructure around the streams. Yet, in Plan Quebradas, stream-adjacent communities are still conceived as beneficiaries of the programs, as evidenced by the following quotes.

> We find that the communities confuse the plan with cleaning up streams, so they also expect us to go and clean up the stream and hire them to do the cleaning. (Other technically certified entities do this work) (Member of CTA)

> When we get to the communities to tell them this is a management plan without many resources, there is a certain amount of prevention because they expect resources to develop their activities and obtain economic benefits. (Member of CTA)

> We understand the frustration of the communities because there are a lot of things to do, and they don't find the resources for them. (Member of CTA)

> Most of the time, the complaints come for sanitation; we cannot attend to it because it is not our competence and the problem of solid waste, which is a problem of environmental education and citizen culture. (Member of Department of Environment)

> The problem of sanitation in the city is very complicated, and the "La Honda" stream is not the exception. Plan Quebradas does not have that approach to urban sanitation that is something that the communities want to resolve. Plan Quebradas has three main lines of reforestation, environmental education, and sanitation, but that sanitation line is exclusively focused on the rural areas. (Member of Department of Environment)

The only community-based group included when Plan Quebradas was socialized to communities was *La Mesa Ambiental de la Comuna 3*, mentioned above (whose leaders participated in my research). All of the other groups mentioned above know little about the implementation of the plan. The inclusion of *La Mesa Ambiental* is a step in the right direction, but also predictable, since they have often relied on their ties to, and funding from, the municipal government, for which they do various kind of implementation work designed by officials. The model is still largely top-down (i.e. hierarchical) and leaves little room for more democratic forms of environmental governance. That is not to say that other community groups do not want "their piece of the pie" in this model, as receiving government funding is a major method of survival for many community-based organizations in Medellin. However, the powerful affective influence that community leaders have on their communities' relationships to environmental like the stream basin becomes a commodity in this scenario. Government officials value it only when it has a purpose for them, yet the day-to-day process of creating and maintaining a particular affective atmosphere is most often developed through everyday unpaid labor (in a quite similar way to how government officials benefit from the community-based maintenance of peace/non-violence in the city, described in Hayes-Conroy 2018).

Based on my interviews with the above officials, I argue that the 'experts' charged with implementing Plan Quebradas are largely disconnected from the everyday reality of stream-adjacent communities. The framework for ecological restoration that they push is one of technocratic governance. Towards the end of ecological restoration, they see communities mostly as those who need to be taught to follow the rules and adapt their concerns to environmental regulations. They see the relationships that community leaders

have built over years and decades as commodities to be traded. While such an approach is unsurprising given that many programs of intervention in environment and health follow the "teach them" model of community engagement, yet Medellin has gained recognition for widespread, vibrant youth and community activism, so Plan Quebrada's failure engage communities on other terms is troubling. Furthermore, most city officials (elites) know little of the 'place' of streams like La Honda. Rather than an affective atmosphere filled with emotion, memory, and sensory experience, La Honda to them is just like any other stream – a public problem to be mitigated. I argue in the next section that the strategy of stream restoration plans like Plan Quebradas needs to involve an undoing of hierarchical governance and a movement towards widespread recognition of community expertise.

Eco-Affective Network Governance for the Ecological Restoration of Riparian Zones at "La Honda Stream."

*Policy Point 1: From Bureaucratic hierarchies to eco-affective networks*

The challenge of environmental policies in Medellín must be oriented from a change in the forms of governance, which must reduce bureaucratic hierarchies and prioritize the articulation of community-based groups in eco-affective networks in the territories. After knowing and dialoguing with institutional community actors, we identified that there is a lack of coordination and communication to generate non-hierarchical mechanisms of governance. From the perspective of local government, any community basis for the governance of environmental issues is meant to replicate

hierarchical structures in which communities assume the vision of the administration in turn without actively participating in the decision-making processes.

In this study, I identified two broad groups; the groups formed mostly by senior citizens who assume governance as a hierarchical system, in which they play a secondary role following technocratic actors. In the second category are groups formed mostly by young people who are motivated by alternative ways of seeking social transformation; they try to be independent and manage their processes with or in most cases without the support of the local government. Meanwhile, the severe environmental crisis that the city faces in terms of water as well as air pollution shows that the hierarchical system of short term six-month projects serves only to maintain bureaucratic payrolls without obtaining effective results. Thus, one of the conclusions of my research is that it is necessary, specifically, to look differently at the environmental groups formed by *young people*. It is not a matter of enrolling them in the same logic of failed governance reflected in the toxic air we breathe and the infernal sewers that the streams have become. On the contrary, the local government should finance the activities of these groups in favor of the ecological restoration of streams without compromising their political independence. I recognize that this task is easier said than accomplished, which leads into my second policy point.

*Policy Point 2: Economic Empowerment of Environmental Community-Based Groups*

The shift from hierarchies to networked governance must be based on a clear principle that environmental budget resources do not belong exclusively to the government institutions and should be democratically distributed to empower community-based processes. In the development of this research, we found that each new

administration in the city spends most of its time making diagnoses about the streams. In other words, the environmental problems of riparian corridors are over-diagnosed as hundreds of resources have been diluted without clear proposals or goals. In almost four years of the "Plan Quebradas", there is no real change in at least one stream in the city. These situations are producing the annoyance of environmental leaders about the distribution of resources, which benefit technical actors but do not generate a budget that contributes to strengthening the daily work of grassroots environmental groups.

The environmental budget should be oriented to support the daily actions that are taking place in the field by groups of young people. In the upper part of the La Cruz and La Honda neighborhoods, young people are helping to control fires in order to protect the riparian forest, and they organize streams habitat walks with kids to recognize and appreciate their territory. Similarly, in the middle part of the stream, resources can be used to help youth groups to protect the riparian corridor between the neighborhoods of El Pomar and Manrique Central. In sum, the actions that the young people are currently developing should be strengthened by supporting a networking process in the different areas of the stream, which can motivate new young people to join the cause for ecological restoration in Medellin.

*Policy Point 3: Long-Term Vision of Ecological Restoration*

The problems of bureaucratic hierarchies and uneven distribution of resources are linked to a short-term vision of ecological restoration. The projects focused on the ecological restoration of streams have periods of duration between six months and one year. In most cases, these projects are led by technical institutions without any affective

ties in the territory; once the project is finished, they never return. By contrast, many of the environmental leaders interviewed in this study have been working for more than 15 years. However, their work is not recognized by environmental authorities because they do not have technical certifications. The establishment of long term vision of the ecological restoration of streams requires a democratic dialogue for merging the visions of environmental leaders and governmental institutions. The planning of ecological restoration actions in the streams cannot continue to be done primarily from public offices and via technical actors located in downtown, Medellin. It must be done through an open community dialogue in each of the neighborhoods that allow the creation of affective relationships with environmentally valuable areas, including streams and stream basins, as well as bonds of trust between different actors.

*Policy Point 4: Affective Atmospheres of Care and Protection Enveloping Streams and Riparian Zones.*

A new approach for the empowerment of community actors in governance networks could be enhanced attention to the creation of affective atmospheres in streams and riparian zones. Such attention should start by strengthening community-based groups as local agents of ecological and social change. Youth based groups are already at the forefront of creating substantial changes to affective atmospheres in Medellin that have been shown to be politically meaningful (Hayes-Conroy 2018). Affective work in stream basins could contribute to local residents not conceiving of streams as sewers or garbage dumps, but, by contrast, places of encounter where they can engage in social and ecological activities that benefit all. Similar to the framework of "social-ecological

education" affective change can be generated through experiential pedagogies that promote sensory interactions in the streams and riparian zones (Brown, & Cutter-Mackenzie, 2014). Youth groups in La Honda stream basin are already primed to take a leadership role in making such changes.

Conclusions:

This study has been developed from critical, participatory engagement with the environmental base groups that work for the ecological restoration of the "La Honda" stream in the Northwest of Medellín. This project seeks to make visible their work and experience that is often excluded from the environmental policies of the city of Medellin. Accordingly, this paper has recognized how community groups – particularly those led by youth – are already setting up the building blocks for alternative forms of environmental governance based on affective relationships to streams and stream basins. This affective work mirrors similar kinds of work seeing in other grassroots movements at the regional and national levels in Colombia.

A total sensorial immersion in the riparian zones of the "La Honda" stream (physically, emotionally, verbally) allowed researchers and participants in this project to develop an even more nuanced understanding of the social and ecological conditions around this area. We traveled by foot through urban and rural neighborhoods and districts, understanding the perceptions and cultural relations of communities with riparian zones. In this study, we identified deep contradictions between the current forms of environmental governance led by government actors and the demands and proposals of grassroots community groups.

In the end, I have proposed an alternative governance mechanism based on the establishment of eco-affective networks among community-based groups. Eco-affective networks start from recognizing that other forms of alternative governance are possible and necessary, mainly by changing hierarchical structures of governance for networked articulations allowing a form of equitable distribution of resources oriented to solve environmental problems. By building trust among grassroots community groups and including them in the distribution of resources to enhance their work, they can become cultural agents that promote the creation of an atmosphere of protection and care for the streams and riparian zones. Eco-affective network governance could guarantee an effective and *affective* long-term work towards the ecological restoration in the "La Honda" stream.

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# CHAPTER 3
# ARTICLE 2: DESIRABLE SCENARIOS, SENSE OF PLACE, AND RESTORATION SCENARIOS OF URBAN-RURAL RIPARIAN FOREST IN MEDELLIN-COLOMBIA.

Abstract:

Aim: Urban sprawl in Medellin, as in many other cities in the global south, occurs with limited consideration of the local hydrologic regime. The city of Medellin is affected by high levels of ecological degradation in rivers, streams, and riparian zones and a high vulnerability of communities living around these areas to extreme events. This research seeks to produce and spatially represent future land cover scenarios postulated by community actors and governmental actors for the restoration of riparian zones in La Honda Stream in the Northeast of Medellin. The first scenario is established from the regulations for land use planning approved by the local government in 2014 and national decrees for the protection of water sources. The second scenario was constructed from the narratives based on the sense of place of seven environmental community-based groups committed to the ecological restoration of this watershed.

Location: The research focuses on one stream called "La Honda" located in the North - East of Medellin - Colombia.

Methods: This study combines Public Participation Geographic Information Systems (PPGIS) activities including Stream Habitat Walks with Open- Source Remote Sensing for comparing desirable scenarios of ecological restoration. Using PPGIS, this study makes a spatial representation of the visions and narratives of environmental community-based groups for ecological restoration of riparian zones and compare them with the zones defined by the land zoning norms.

Results: I show that the main differences between the two scenarios and the current land use planning norms for ecological restoration of streams and its riparian zones are based on an arbitrary division between urban and rural areas, that constrains: 1) the possibility to include the sense of place of local communities in the production of scenarios, and 2) the prioritization of areas in the urban-rural gradient that can promote ecological connectivity. I also found that both scenarios translate into an increase in forest covers with a higher increase in forest cover under the land zoning scenario. These differences in the allocation of forest cover constitutes the main conflict between the two scenarios. While the land zoning vision translates into the conversion of urban areas towards the middle and lower part of the stream to forested land, the community- based scenario calls for their preservation as urban areas.

Main conclusions: Restoration scenarios using PPGIS open-source software could support the process of decision-making to identify suitable areas for intervention based on the sense of place and scenario narratives of local communities. The consideration of sense of place by local communities in urban riparian forest restoration planning, can promote social well-being and contribute to the protection and restoration of water-related ecosystems.

## Introduction:

Urban sprawl in Medellin, as in many other cities in the global south, occurs with limited consideration of the local hydrologic regime. The city of Medellin is affected by high levels of ecological degradation in rivers, streams, and riparian zones and a high vulnerability of communities living around these areas to extreme events. This research seeks to produce and spatially represent future land cover scenarios postulated by community actors and governmental actors for the restoration of riparian zones in "La Honda" Stream in the Northeast of Medellin. The goal of this research consists of producing an empirical analysis of territorial conditions for the ecological restoration of streams and riparian zones from a geographical perspective in its human and physical dimensions. For this purpose, this study combines Public Participation Geographic Information Systems (PPGIS) activities including Stream Habitat Walks with Open-Source Remote Sensing for comparing desirable scenarios of ecological restoration. The first scenario is established from the regulations for land use planning approved by the local government in 2014 and national decrees for the protection of water sources. The second scenario was constructed from the narratives based on the sense of place of seven environmental community-based groups committed to the ecological restoration of this watershed.

### *Sustainability Science and Scenarios*

Sustainability science has proposed the combination of different ways of knowing and learning for finding solutions to current environmental problems at multiple scales (Kates et al., 2001). The production of solutions, requires bringing together perspectives

from developed and developing societies and among theoretical and applied scientific disciplines, to bridge the gap between theory, practice, and policy (Bettencourt & Kaur 2011). For this reason, in recent decades, sustainable science is building research methods to move toward transdisciplinary approaches that bridge cooperation between sciences and other disciplines and non-academic stakeholders. Additionally, these new conceptualizations and methodologies must be integrated into the everyday life of societies to influence public policy, governance, and social behavior (Iwaniec et al., 2020).

The notion of "scenarios" can open public debates that facilitate societies to solve current socio-environmental problems. The implementation of scenarios requires the recognition of values, interests, contradictions, and power embedded in the collective agency. Different cultures and countries have different perceptions of sustainability. Also, different actors have different levels of political influence to achieve their vision. For this reason, scenarios are classified in different typologies according to their intentionality, rationality, and spatiotemporal range. Scenarios could be predictive, explorative, participatory, or normative. (Börjeson, Höjer, Dreborg, Ekvall, & Finnveden, 2006). For the purpose of this study, we will use a normative scenario approach, which is useful to understand the connection between the current situation and possible, desirable futures.

In recent decades, scenarios have had an increasing contribution to the field of ecological restoration coining the term "restoration scenarios." This term refers to the use of scenarios to support ecological restoration (Acosta et al. 2018). The use of scenarios in ecological restoration has contributed to aspects such as the evaluation of the cost-effectiveness of different projects (Metzger et al., 2017), and the balance of ecological

and social outcomes (Burnett, 2019). Some of these studies emphasize on physical and climatological scenarios, while others integrate the narratives of local communities in the modeling of desirable futures (Mallampalli, et al., 2016). In this study, the narratives of environmental community-based groups are relevant to understanding and analyzing the desirable scenarios of ecological restoration in streams and riparian areas. Thus, this paper seeks to answer the following question: What are the desirable scenarios of environmental community-based groups and governmental authorities for ecological restoration the "La Honda" stream and its riparian zones in Medellin Colombia?

*Restoration scenarios of streams and riparian zones*

Restoration scenarios are useful to explore alternatives for solving environmental problems such as the degradation of streams and riparian zones. In the global South, urban riparian zones represent a critical challenge to promote sustainable transitions, because these areas are often neglected, and used for precarious slum settlements or as dumping sites (Vollmer et al. 2015, Wantzen et al., 2018, Wantzen et al., 2019). Damage to riparian zones by urban residents disturbs the ecological functions of streams, increasing the vulnerability of local communities to floods and landslides.

To date, the use of scenarios in studies of ecological restoration of streams and riparian zones has largely been based on quantitative approaches, such as the study of the effects of riparian buffers in hydrologic components (Alvarenga, Mello, Colombo, & Cuartas, 2017), and its role in the biogeochemical cycles in watersheds (De Mello, Randhir, Valente, & Vettorazzi, 2017). However, some studies argue that successful restoration must include qualitative elements for the construction of scenarios. Riley (2016)

proposed that the benefit of ecological restoration of urban streams goes beyond economic instrumentality, and includes the re-creation of a "sense of community" and re-establishing a "sense of place" (2016, p.23). The re-creation process envelops the human interactions and experiences with the environment, which is a crucial driver to move forward in the implementation of sustainable transitions in socio-ecological systems (Masterson, 2017).

The construction of restoration scenarios is a socially engaging and inclusive process. Restoration of rivers, streams and their riparian zones must embrace and understand the interrelations between nature and culture, integrating societal and environmental objectives (Smith et al. 2016; Riley, 2016; Lave, 2010). Therefore, scenarios that integrate cultural and technical dimensions in the spatial representations of narratives can become more informative than those relying only on technical considerations. Scenario narratives can also be combined with remote sensing and GIS data and methods for the spatial representation of possible and desirable scenarios. (Larondelle, Frantzeskaki, & Haase, 2016). The narratives of community-based groups could be translated into quantitative assessments of land-use change (Mallampalli, 2016). In Latin America, in recent years, different studies have developed restoration scenarios using land-use cover technics to analyze processes of ecological restoration of streams and riparian zones in urban and rural areas. These studies include the prioritization of riparian sites for providing ecosystem services for local urban communities (Guida-Johnson & Zuleta, 2017).

Finally, the use of scenarios can generate new approaches to critical aspects of ecological restoration processes of riparian zones, such as the exploration of land-use scenarios (LUSs) to integrate the visions of different stakeholders fostering cooperative agreements (Vignola et al., 2017), and the evaluation of environmental norms for the preservation of ecological connectivity in riparian zones (Rother, 2018). This paper develops a spatial analysis contrasting two normative scenarios (Schneider & Rist, 2014), for the ecological restoration of riparian zones around "La Honda" Stream in the urban-rural gradient in the North-East of Medellin. The first scenario is based on the Land-Use Zoning Plan and national zoning norms for the protection of watersheds. The second scenario integrates the spatial perceptions and sense of place of environmental community-based groups for the ecological restoration of "La Honda" Stream.

Study Area

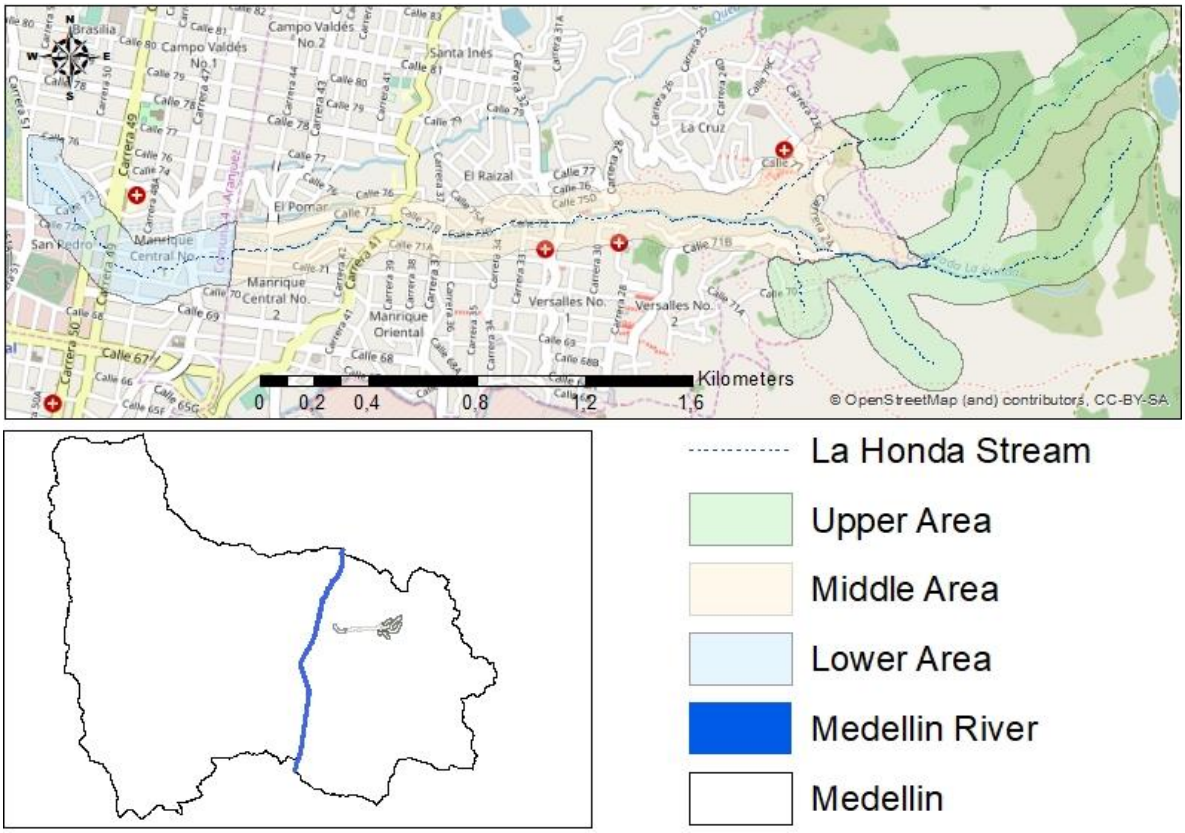


**Figure 13. Location of La Honda Stream (POT 2014). The study area includes a 100-meter buffer around the La Honda stream bed, which was established following the criteria of maximum protection areas.**

Urban sprawl in Medellin, as in many other cities in the world, is not well integrated into the local hydrologic regime. This socio-ecological disruption between the hydrological system and the urban fabric has produced a chronic urban stream syndrome, which according to Walsh et al. (2005), describes the “consistently observed ecological degradation of streams draining urban land." The majority of riparian zones of the streams that belong to the Medellin River basin have been degraded or damaged. In the case of La Honda Stream located in the north-east of Medellin, informal urbanization invaded the area of the riparian zones, destroying its ecological functions. However, the

upper part of the stream still conserves ecological functionalities, because it is located in the natural reserve of the Arví Park, right above the city of Medellín. This area is located within low mountainous rain forest (Sánchez-Botero, 2016), better known as the cloud forest.

The upper part of the La Honda micro-basin is located the Santa Elena township division, one of five sub-divisions of the Medellin metro area, and directly adjacent to the city (*zona urbana*) of Medellín (Fig. 1). The upper part of the streams consists of hilly geoforms, with low to medium slopes and little incidence of mass movements. However, downstream between the 2400 and 2110 meter marks, the relief changes abruptly, represented by a V valley geoform, made up of highly incisive and sloping hillsides, which are very susceptible to mass movements. (CTA & Á. M. D. V. p19, 2018).

The middle and upper parts of the stream and its riparian zones in the city have been occupied in recent decades, areas by informal displaced settlers, largely as a consequence of the country's armed conflict. These communities find in these areas as the only possibility to build a house, causing urban sprawl in the edges of the city. In the case of the "La Honda" stream, the communities living in the upper part often take water directly from the spring, and they discharge their wastewater down the stream and riparian zones. The same problems with sewage discharge is present in the middle and lower parts. The degradation of these areas caused by informal settlers translates into a reduction of vegetation cover and hydraulic capacity as well as an increase in landslides (Álvarez-Escobar, 2019). Also, the stream has been channelized in the many parts of the middle and lower part for the mitigation of flooding.

In 2016, local environmental authorities, including the Metropolitan Area Authority and the Environmental Department of Medellin, started an initiative of ecological restoration for “La Honda” Stream. This initiative, called Plan Quebradas, seeks to establish cooperative agreements among public, private, and community actors to develop projects in three main components: sanitation, reforestation, and environmental education. Conceptually, this new plan proposes that changes in socio-cultural relationships with streams are the primary factor in ensuring sustainable restoration of the watersheds in the city. This paper thus analyzes the vision of environmental community based – groups for the ecological restoration in the upper, middle, and lower course of the “La Honda” stream, contrasting similarities and differences that exist between their vision and the zoning ordinances.

Methods:

The methods used in this study were divided into two major components; the first component is the delimitation of areas for the two scenarios. This component includes the analysis of 1) the zoning norms according to the land-use zoning plan and national decrees and PPGIS and 2) the visions of seven environmental community-based in the "La Honda" stream and its riparian zones. (Fig. 2)

The second component is the elaboration of a land-cover maps representing the narratives of both scenarios spatially using open-source geospatial technologies and then using those maps to identify areas of conflict or agreement between the two scenarios analyzed.

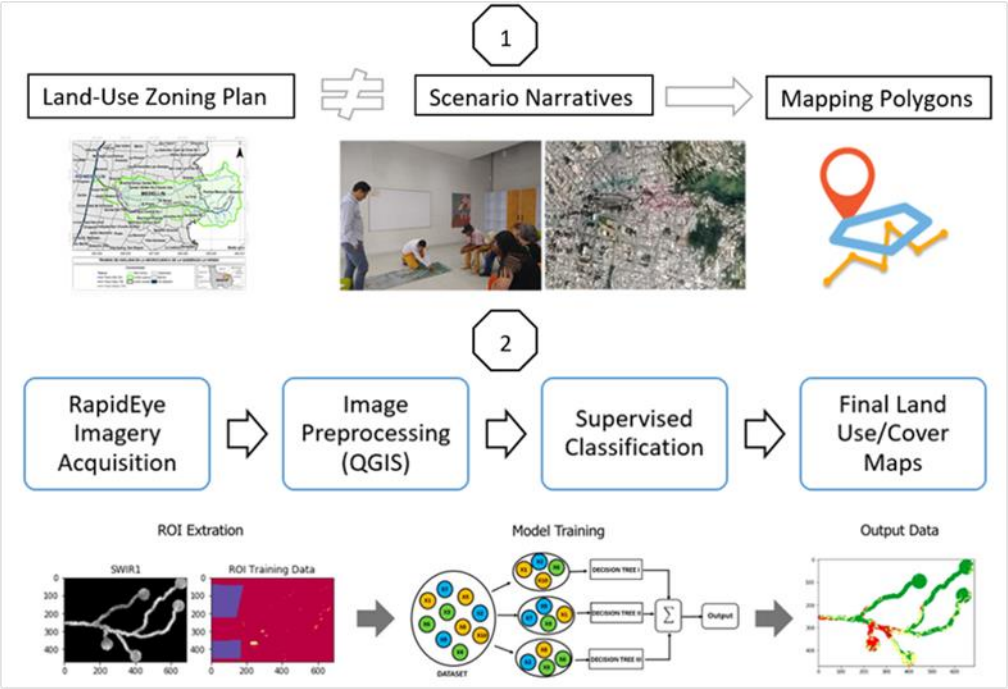


**Figure 14. Workflow for defining areas of spatial representation and land-cover classification.**

*Analysis of Zoning Norms According to the Land Use Zoning Plan and National Decrees:*

I analyzed the current land use zoning plan for Medellin and national laws for the protection of watersheds to determine the desirable buffers for the protection of "La Honda" watershed. These zoning laws establish the following criteria:

> The rural area is divided into two parts, around the spring following the Parameters in the decree 1449 of 1977 the first area is demarcated with a buffer of 100 meters around the five water springs that integrated the upper part of "La Honda" Stream basin (Fig. 4A). The rest of the rural corridor is defined based on the land use zoning plan that establishes a buffer of a minimum of 30 meters from the bank of the stream. Finally, in urban areas, the zoning plan determines a minimum of 10 meters for the conservation of riparian zones.

In 2014, Medellin adopted a new land-use zoning plan (POT, 2014) to organize the territory in the following 12 years. The main goal of this plan is the protection and restoration of the Ecological Structure (ES) of Medellin, which is defined in the following terms:

> "The Ecological Structure (ES) of Medellin is the interconnected system of areas with a high environmental value that sustain essential primary ecological processes and offer ecosystem services. These areas are integrated structurally and functionally with the regional ecological structure, with the purpose of supporting social, economic, and cultural development." (De Medellín, 2014, p.24)

Based on the land use zoning plan and national norms, local environmental authorities have defined some areas of environmental protection for riparian zones that must exclusively be used as natural reservoirs. However, the implementation of this plan requires radical changes in the use of land in the city with severe social consequences for low –income communities living along the streams.

*Public Participation GIS (PPGIS) for Mapping Scenario Narratives:*

The activities for the definition of desirable scenarios based on narratives of community-based groups were developed using PPGIS. This methodology was chosen because it provides access to geospatial technologies to groups that have been traditionally excluded (Sieber, 2006). PPGIS also enables the co-production of knowledge about specific places, allowing the understanding of the cultural relations of local communities with their ecosystems (Brown & Weber, 2011, p, 2).

The study organized in-depth group interviews centered on specific logistical and experiential elements related to streams and stream restoration with leaders of environmental community-based groups. The study developed a total of seven in-depth

small group interviews with the leaders of environmentally-active community groups adjacent to the stream. The interviews were linked to PPGIS activities through the provision of printed satellite images of the territory. Environmental group leaders marked points with geometric figures and keywords in response to a series of questions. The questions most relevant to this paper involved an exploration of the sense of place of the streams through the geographical narrative of the environmental leaders. The leaders of environmental community-based groups also physically drew on the printed satellite images to indicate scenarios of desirable futures for different riparian zones of the "La Honda." stream. All the narratives and descriptions were recorded through cell phones in audio files.

The information of all the activities was transcribed and later classified by extracting narratives with spatial information from different areas of the stream and its riparian zones. These narratives are the inputs for the generation of polygons representing the areas prioritized by the community to develop ecological restoration processes in different riparian zones. These polygons allowed the creation of vector mask layers in QGIS, which were later used in the analysis of specific areas of the raster classification matrix.

The polygons were socialized with community-based environmental group members for further refinement and confirmed in the field during stream habitat walks in different areas of the stream.

*Land-Cover Classification of Delimited Areas:*

The current land cover status was characterized through the application of a supervised land cover classification using a random forest algorithm (Breiman, 2001), implemented in the scikit-learn library in the python computing environment (Holden, 2019). This remote sensing analysis used a Rapideye satellite image with the following characteristics (planet, 2016):

Satellite Data: Rapideye Satellite Constellation

Acquisition date: 2017-12-20

| Band Name | Spectral Range (nm) |
|---|---|
| Blue | 440 – 510 |
| Green | 520 – 590 |
| Red | 630 – 685 |
| Red Edge | 690 – 730 |
| NIR | 760 – 850 |
| Ground Sampling Distance (nadir) | 6.5 m |
| Pixel size (orthorectified) | 5 m (p, 6) |

**Table 1. Satellite Data: Rapideye Satellite Constellation**

The land cover classification analysis was considered as a baseline to determine differences in the percentages of change of forest, herbaceous, and urban land covers. Then I used the narratives based on the land use zoning plan versus the one stated by the

environmental community-based groups to modify the current land cover map to representing explicitly the spatial configuration of each scenario.

The land cover analysis was performed following methodological steps:

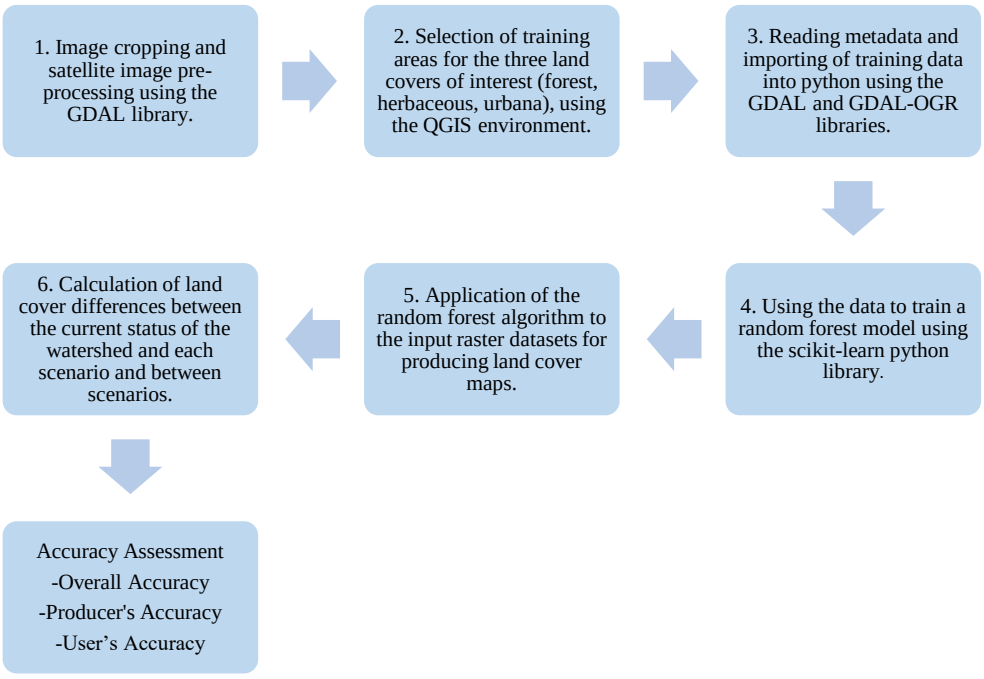


**Figure 15. Workflow for land-cover classification.**

For the accuracy assessment, the expected results were compared with the obtained results between the different land cover classes creating an error matrix and applying the following accuracy metrics *(Story & Congalton, 1986)*:

> Overall Accuracy for a particular classified image/map is then calculated by dividing the sum of the entries that form the major diagonal (i.e., the number of correct classifications) by the total number of samples taken.
>
> Producer's Accuracy, the number of correctly classified samples of category X is divided by the total number of reference samples of category X (column total).

> User's Accuracy, when the number of correctly classified samples of category X are divided by the total number of samples that were classified in category X (row total). (p, 397-398)

Results:

*Current State of Riparian Zones around "La Honda" Stream.*

The majority of the upper area of the stream is conserved given its location in a natural reserve. However, there is an increasing extension of the urban settlements so close to the natural reservoir of the Arvi Park. In the middle part, there are three main areas to analyze; the first one is the riparian corridor located between the neighborhoods "El Pomar" and “Manrique Central,” this riparian zone conserves a high percentage of riparian forest vegetation around the channelized stream. Second, between the neighborhood "Manrique Oriental" and the neighborhood "El Raizal," the majority of riparian zones are occupied by urban settlements and the built environment. Third, from "El Raizal" until the neighborhoods “La Cruz” y “Versalles 2”, these neighborhoods are located in the urban limit of Medellin in the border with the district of Santa Elena. In this area, there is a riparian corridor that conserves vegetation and forest approximately 15 meters around the stream; the geomorphology determines the conservation of the riparian zones in this area, characterized by high slopes that constitute a physical barrier for new illegal settlements. In the lower part of the neighborhoods, “San Pedro” and “Manrique central 1,” the stream and riparian zones are almost cover-ups by the built environment, including essential streets that connect the central area of the city with the north-east.

*Official zoning areas of protection and restoration*

In the official zoning, established in the land use plan and national decrees, riparian protection areas are divided using a traditional urban-rural dichotomy without leaving room for transition zones. In this zoning, buffers of 100 meters around the source and 30 meters in the rest of the rural area are established, while in the urban area a minimum protection area of 10 meters is established. This zoning does not promote the protection of riparian forests in urban areas. Also, this division of restoration areas between rural and urban does not allow the definition of common agreements for ecological restoration in transition zones that are undergoing an accelerated process of informal urbanization (Fig. 4).

*Community zoning based on conservation zones and a sense of place*

Group dialogues with community environmental leaders revealed negotiated consensus about desirable scenarios in the upper, middle, and lower region, such as demonstrated below. More consensus is evident regarding the upper part than the middle and lower parts. For example, speaking of the upper part of the La Honda stream, environmental leaders wanted to prioritize reforestation:

> "From the spring to 30th street, including areas within the natural reservoir of Arví Park and the riparian corridor in the neighborhood La Honda, [this is] an area prioritized for ecological restoration by local environmental leaders". (Environmental Leader #2)

> "We need a process of reforestation in this area for restoring the stream". (Environmental Leader #6)

> "We need to be aware that the clean air for the city depends on the conservation of the forest in this area; for this reason, we need to stop the urban sprawl". (Environmental Leader #3)
>
> "I imagine a big forest with native trees and fruit trees; it could be a beautiful natural place for restoring the fauna and flora". (Environmental Leader #1)
>
> "One alternative is the restoration of the forest in the upper part. It makes these neighborhoods in the urban and rural gradient attractive to the practice of ecotourism activities such as hiking or camping". (Environmental Leader #4)

Meanwhile, speaking of the middle and lower parts, some leaders were skeptical of the possibility to make significant changes, while others thought that reforestation and protection of vegetation could still happen in the most upstream portions of this zone:

> "From the 30th street until 39th street, it is a highly urbanized area, and the majority of the stream is cover up with built infrastructure. There are some riparian areas located in private backyards". [uncertainty] (Environmental Leader #3)
>
> "From 45th street until the mouth of the stream near to botanical garden in the neighborhood "San Pedro," it is a highly urbanized area, and the majority is covered up by built infrastructure". [uncertainty] (Environmental Leader #2)
>
> "From the street 39th until street 45th is the area with more conservation of forest and vegetation around the stream, this area needs to be protected and reforestation should be attempted in some points". (Environmental Leader #7)

Most pointedly, the environmental leaders of adjacent community groups concede that it is necessary to promote the ecological restoration of the La Honda stream and its riparian zones through alternative forms of zoning that break with the ineffective urban-rural division. Certainly, they express that future scenarios should be generated following the cultural and geomorphological characteristics of specific places, especially in the upper zone, for their protection and ecological restoration. For example, although the areas of

protection are 10 meters in urban areas, these community groups, through communal actions have already protected areas of riparian forest that double the area of the norm, and these areas should be protected through other decrees. Community leaders also discussed the prioritization of a riparian forest corridor, which would strengthen ecological connectivity in the urban-rural transition area, as well as the conservation of a 100-meter buffer on the northern branch of the stream, since it provides water to several families in this sector (Fig.3).

Such differences between the community actors and plans of official institutions with respect to the zoning of riparian areas, makes governance and implementation of ecological restoration processes difficult.

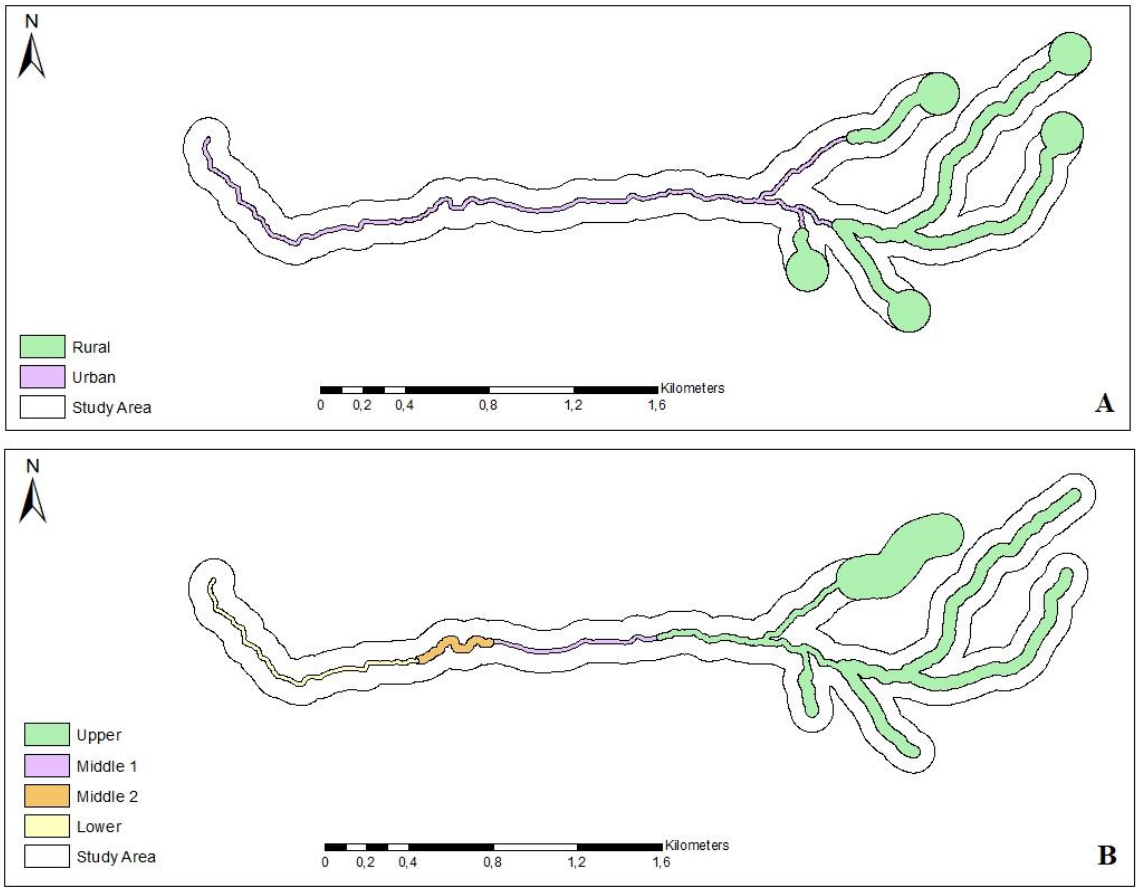


***Figure 16. Division of the watershed in zoning areas according to A. the land use zoning plan and B. the community vision.***

*The Strict Implementation of Land Zoning Norms*

After the first analysis of the current state, the next step was to visualize an ideal normative scenario based on the strict implementation of zoning laws that remove urban settlements from the riparian zones and the conservation of the herbaceous and forest covers. The ideal scenario would be the strict application of zoning regulations. However, environmental authorities would not have the resources to relocate all the families settled

in riparian zones as well as the urban infrastructure located in this area, such as some main roads in the Northwest of Medellin.

*Desirable scenario based on the sense of place of Environmental community-Based Groups*

The scenario proposed by environmental community-based groups divides the stream into two categories. The first category consists of highly urbanized areas where ecological restoration interventions are not feasible due to the potential economic and social impacts of these megaprojects. These areas include the riparian corridor between "El Raizal" and "Manrique Oriental," as well as the corridor from the Neighborhood "Manrique Central" to the mouth of the stream into the Medellin River in the neighborhood "Moravia."

The second category includes suitable areas for the ecological restoration of the Riparian forest due to their geomorphological conditions with few urban settlements. These areas include the riparian corridor from the spring in the district of Santa Elena until the neighborhood "El Raizal," and the riparian corridor between the neighborhoods "El Pomar" and "Manrique Central."

The normative scenario based on the narrative of environmental community-based groups seeks to develop the process of ecological restoration without the displacement of the low-income communities that are living what zoning norms consider to be the riparian zones. However, these communities must contribute to a strategy of ecological connectivity in a zone of transition between the urban and rural area, this zone of

transition could be supported by community projects of urban agriculture to prevent the future urban sprawl. (Hammelman & Saenz-Montoya, 2020)

Another aim of this scenario is the connection between rural and urban areas in the upper of the stream; this proposal implies a difference with the current normative that divided riparian areas with different zoning norms, instead this narrative scenario proposed the prioritization of the areas of restoration based on similarity in geomorphological conditions and the fostering of ecological connectivity. For example a specific action proposed by environmental leaders is the ecological restoration of the riparian forest between the neighborhood "El Raizal" and the northern branch of the stream. This area could be delimited in the same zoning norm connecting ecologically rural and urban areas in a riparian corridor of 2 kilometers of longitude with a buffer 30 meters.

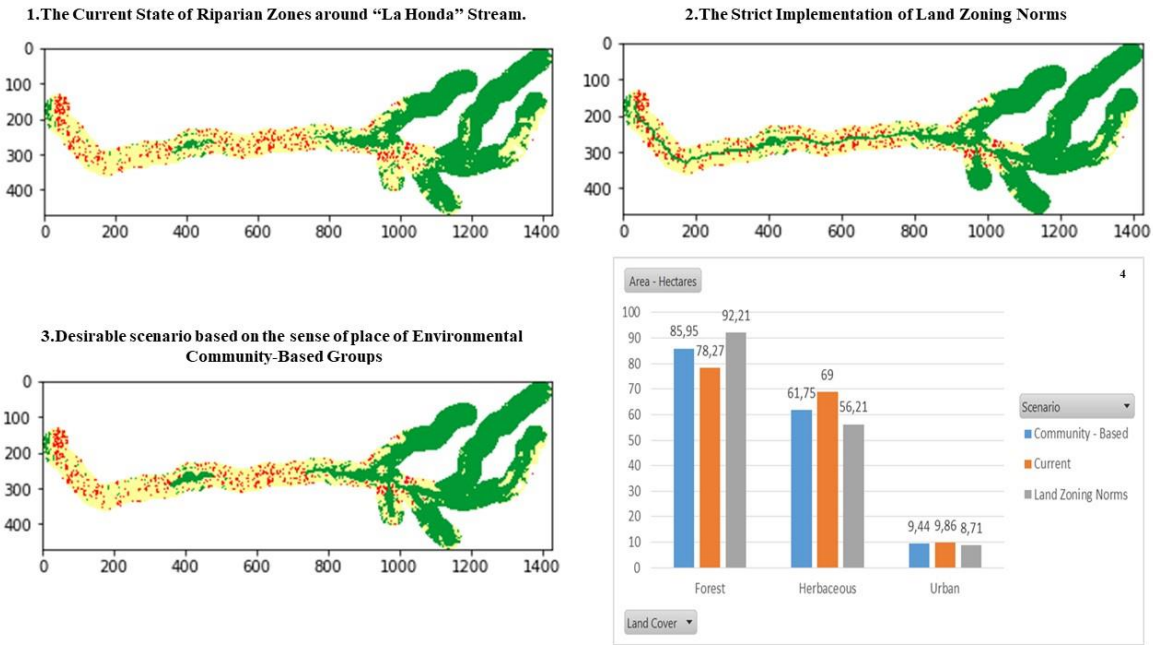


**Figure 17. Land Cover Scenarios: 1. Current land cover classification of riparian zones around the "La Honda" stream. 2. Ideal land cover classification of riparian zones based on the strict implementation of land-zoning norms.3. Prioritized Areas According to the Sense of Place of Environmental Community Based Groups.4. Comparing the results of land cover classifications of the current, land zoning norms and community-based scenarios.**

*Accuracy Assessment*

The results obtained in the current scenario of land covers were evaluated in a validation process to determine its accuracy using overall accuracy, producer's accuracy and user's accuracy (Story, & Congalton, 1986).

| | Forest | Herbaceous | Urban | Clouds | Total |
|---|---|---|---|---|---|
| Forest | 6461 | 0 | 0 | 0 | 6461 |
| Herbaceous | 0 | 158 | 0 | 0 | 158 |
| Urban | 0 | 0 | 833 | 0 | 833 |
| Clouds | 0 | 0 | 0 | 543 | 543 |
| Total | 6461 | 158 | 833 | 543 | 7995 |

| | | | | |
|---|---|---|---|---|
| Overall Accuracy | 100% | | | |
| | | | | |
| Producer's Accuracy | | | User's Accuracy | |
| Forest | 100% | | Forest | 100% |
| Herbaceous | 100% | | Herbaceous | 100% |
| Urban | 100% | | Urban | 100% |
| Clouds | 100% | | Clouds | 100% |

**Table 2. Accuracy Metrics.**

Scenarios and Social-Ecological Trade-Offs:

*Current Scenario to Land Zoning Norms Scenario.*

This scenario proposes a radical change in the organization of the territory, prioritizing the protection and restoration of riparian zones. Its implementation would imply the displacement of hundreds of households and the modification of the urban infrastructure of important streets in the northwest of Medellin. The implementation of

this scenario would benefit many families living in high-risk areas, which could be relocated to safer places, however, it would generate a tremendous social and cultural impact on the everyday life of these communities. In ecological terms, the implementation of this scenario would recover all the protected areas, allowing the restoration of the riparian forest in the entire basin and improving the ecological connectivity between the urban and rural areas.

*Current Scenario to Community-Based Scenario.*

This scenario proposes the prioritization of the restoration and protection of the riparian forest in the middle and upper part of the "La Honda" stream, whose main objective is to recover the ecological connectivity of the riparian forest between the urban and rural zones. This scenario would imply the relocation of dozens of households located in the "Versailles 2" neighborhood.

In sum, in analyzing contrasts between scenarios, we can argue that in social and economic terms in the current situation of the city, the scenario proposed by community-based groups is more viable to implement than the scenario based on land zoning norms. The community-based scenario focuses on the restoration of the riparian forest in the middle and upper parts of the stream to consolidate a transition zone for ecological connectivity integrating urban and rural areas.

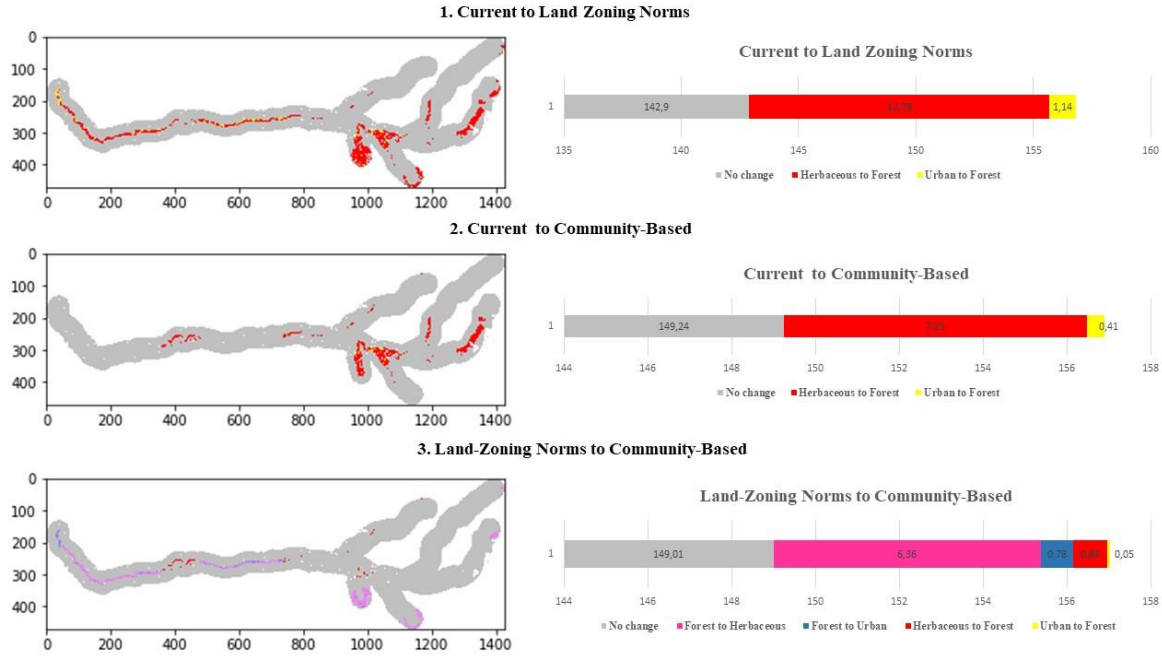


***Figure 18. Maps of land cover changes per scenario. 1. Current Scenario to Land-Zoning Norms Scenario. 2. Current Scenario to Community-based Scenario. 3. Land-Zoning Norms Scenario to Community-Based Scenario.***

Discussion:

The implementation of the land zoning norms scenario is almost impossible according to environmental authorities due to the economic cost, and the social implications because this process involves the total relocation of the urban built environment in a buffer of 10 meters around the basin. In the recent history of Medellin, there is just one experience of the relocation at the neighborhood level of communities living in riparian zones without moving them to other areas of the city. The intervention took place some years ago in the stream "*Juan Bobo*" located in the northeast of Medellin, and it was part of the program of integrated management of neighborhoods (Echeverri & Orsini 2011). This intervention prioritized a social goal based on the improvement of housing conditions and the channelization of the stream for reducing the risk of landslides.

*Areas of Conflict*

The attempt to develop ecological restoration in all the riparian zones of the stream "La Honda," is almost impossible due to the high level of urbanization in this area and the limitations of resources by the local government to relocate some neighborhoods and important streets in the Northeast of Medellin. However, in a sector of the middle zone, actions are being taken to protect the urban riparian forest by environmental community-based groups, but this community effort requires the support of environmental authorities for the protection of this area. In the upper zone, a reforestation project can be developed in the riparian corridor, integrating the rural and urban areas and strengthening ecological connectivity. These actions would imply a change in land use norms that prioritizes ecological objectives by restricting new urban settlements.

Further research:

Further research in normative scenarios based on the narrative of local communities could include two theoretical perspectives. First, the analysis and evaluation of the implementation of sustainable development goal # 6 "Ensure access to water and sanitation for all" at the stream basin level, specifically the target 6.6 “protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes.” (UNGA, 2015, p.18) The second perspective is the analysis of the urban ecological infrastructure (Li et Al., 2016) to develop sustainable transitions in urban streams and riparian zones. For analyzing the integrated network of grey land, including streets, channels, bridges, and the sanitation system and waste management. The green

land, including the riparian forest, riparian vegetation, and it is eco-integration into the ecological functionalities of streams.

Limitations:

I recognize one key limitation to this study, that the upper part of the stream is covered continuously by clouds because this area is located in a cloud forest, and their presence could interfere in the accurate percentages of forest and herbaceous land use in this area.

Conclusions

Riparian zones around streams in Medellin have been affected by accelerated ecological degradation caused by illegal urbanization in these areas. In recent years, environmental authorities and grassroots community groups have been thinking about desirable scenarios that would facilitate the reforestation of riparian zones. Differences between scenarios constitute a conflict about how to develop ecological restoration without displacing low-income communities.

The central issue of this study was the contrast of views between the ecological restoration scenarios of Medellin's local government and the environmental community-based groups that are seeking to overcome the urban-rural dichotomy. In this sense, one of the relevant points found in this study is that ecological restoration of streams such as "La Honda" and its riparian zones requires breaking the urban-rural dichotomy in the urban-rural gradient. The proposal in this perspective is to constitute an exclusive zone of ecological protection on the edges and slopes of the city that favors ecological connectivity. In the case of "La Honda," stream this protection zone is urgent because of

the growing number of illegal urban settlements that are spreading in the upper riparian area**.**

The zoning for protection and restoration of streams and riparian areas stipulated in the land use plan, and other national decrees are not in agreement with the reality of urban development and ecological pressure on the edges and slopes in Medellin. The construction of informal housing is rapidly expanding into areas of ecological protection, which are the ecological connectivity corridors of the riparian forest around the "La Honda" stream. This study shows that there are significant differences between government actors and community actors in the definition of areas for ecological protection and restoration. One of the major differences is about what the protection areas for riparian forest corridors in the urban-rural transition zone should be. Ecological restoration of riparian corridors is not only a technical matter but must involve the cultural perceptions and values that local communities establish with their ecosystems. This study suggests generating spaces for the co-production of knowledge about the ecological restoration of streams and their riparian corridors to generate interventions that include the communities' sense of place.

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# CHAPTER 3
# ARTICLE 3: THE *ELATLAS* PROJECT, WEB-MAPPING ECO-AFFECTIVE NETWORKING FOR THE POSITIVE SOCIO-ENVIRONMENTAL TRANSFORMATION IN COLOMBIA.

Introduction:

From the ages of seventeen to thirty-three, sixteen years, I worked as a community organizer, pursuing the building of peace in my home country of Colombia, which has been affected by more than six decades of violence. Working for peace in different regions of Colombia, I saw how community-based groups resisted the impacts of violence, protected ecosystems, and more generally, built, in everyday life, effective mechanisms of positive social-environmental change. Moreover, I saw that these community-based groups often integrated into networks in ways that gave them power and real political influence at the regional and national levels. Today, in any Colombian city (or rural area) there are hundreds of community-based groups working, both separately and collectively, to sustain life for local youth and families. They develop cultural activities to resist violence, create task forces to protect rivers and forests, and organize meetings for sharing knowledge and feelings. To me, this also means that these groups and networks are producing geographic knowledge about places and spaces.

I have spent the last six years studying the discipline of geography. The bulk of this work was in a different language and a different country than my own. This opportunity was serendipitous, although coming from a working-class background, none of it was easy. Through this academic work I have come to see spaces, places, networks, and landscapes in new ways. Yet, my interest in the work described in this paper, and in my career more broadly, comes full circle back to my home and to the communities in which I grew as a

young person and as a youth activist. My interest is to continue to support community-based groups and their networks through collaborative, active scholarship; this is not scholarship that makes artificial claims about being helpful, but instead, scholarship that seeks to understand, move with, and dynamically support the changing needs and desires of community-based groups as they work towards environmental and social transformation. Through the work described in this paper, I provide several examples, and a flexible model perhaps, of how geography can help community groups work towards such change.

The work described in this paper coincides with the span of my graduate work in geography, through which I found new ways to support and provide resources for the labor of community-based groups (Derickson and Routledge 2015). I began working with my doctoral advisor even prior to my acceptance into my doctoral program on a matter of mutual interest: how affection and other feelings/affects come to matter in community organizing in Colombia. In 2015, with the support of community-based groups in Medellin Colombia, we initiated a community-based mapping project called *ElAtlas* to connect with and visualize the work of community-based groups (partially described in Hammelman et al., 2019). The shifting goals, lessons, failures, and successes of that project are the focus of this paper. Specifically, through the example of *ElAtlas*, we demonstrate the possibilities and limitations of uniting human geographic methods, GIS, and tools of geovisualization with the methods and expertise of community organizers for the purpose of addressing complex socio-environmental problems. Moreover, our work in *ElAtlas* has always prioritized the affective dimensions of activism and community organizing (c.f. Hayes-Conroy and Martin 2010, Clough 2012, Hayes-Conroy 2018).

Thus, the methods we discuss may be particularly valuable for scholar-activists interested in merging various tools of participatory GIS (e.g., Public Participatory Mapping, (PPGIS) Volunteer Geography Information (VGI)) with critical understanding of affect/feeling in order to understand and support the ways in which activists and community-based groups use feeling to build networks and to drive their work.

The structure of this paper is set up as follows: In the next section, I review some of the geographic methods that became central to *ElAtlas*. I then describe the different stages of development, at each point describing the community needs, limitations, and negotiations that drove our evolution as a project. The stages lead, consecutively, to my dissertation project, which is the final example described. Finally, I discuss the lessons learned: our process of collective reflexivity as a team about the risks, failures, and challenges associated with the work. In the coming pages I use "we" when I want to indicate the collective nature of the work, which was produced with many community actors, including a youth board, as well as my advisor (Dr. Allison Hayes-Conroy).

Geographic Information Systems and Affective Networking:

To be clear, *ElAtlas*, as a community-driven academic project has been many things. One sticking point that has defined us throughout the last five years has been that *ElAtlas* seeks the co-production of geographic knowledge, produced between academics and community actors, in ways that benefit both geography as a discipline of engagement, and society in the form of targeted community outcomes. In our perspective, geographic knowledge is more than the product of geographic thinking and reasoning (Eliot 2000). Instead, this form of knowledge involves feelings, sensations, and emotions about

particular places. Therefore, *ElAtlas* has used a convergence of reasoning and feeling to co-produce relevant geographic knowledge to support local processes of positive socio-environmental change. Put differently, our vision has been to "make geography useful" to community-based leaders who are trying to enact change, and from my own years as an organizer, I know this to be a process of, at once, feeling and thinking.

There is a wide literature on scholar activism and community-driven research within geography. We situate *ElAtlas* within this literature, and have been inspired particularly by recent debates about how to "resource" scholar-activism in ways that directly and concretely advance the needs of community collaborators (e.g., Derickson and Routledge 2015, Croog et al 2018). Also, fittingly, we have been particularly attentive to how the events and research spaces produced by academic projects have emotional or affective dimensions that must be carefully attended to (e.g., Bondi 2005, Askins 2009, Young and Gilmore 2012, Kwan 2007, Mason 2015). And, finally, we have been inspired by methods in critical geography that open new possibilities for understanding affect and for merging feeling and thinking in research on activism and/or community engagement (e.g., Shurr and Abdo 2016, Hayes-Conroy 2010, Clough 2012, Wright 2010).

Yet, one of the most animating aspects of geography to me as a long-time community organizer, has been what I broadly understand as "participatory mapping" or "participatory GIS." Originally, geographic information systems were developed in the sixties in a positivist framework for storage and processing of spatial analysis. However, in the 1990s, literature criticizing uses and practices of GIS technology emerged, raising questions of ethics, equity, technological biases, access, and privacy (Schuurman, 2006). This constructive debate opened space for new approaches such as qualitative GIS, which

brought new ontological and epistemological approaches in GIS practice and research. Harris & Weiner (1998) explained the paradigmatic shift of GIS in the nineties, which produced a new configuration to GIS practices in society, exploring alternatives to just pure positivist conceptions about the space and including non-Euclidean representation of places. Similarly, Sui et al. (2013) have claimed that "multiple new technological advances during the past the past two decades have indeed unleashed the potential of a geographer within everybody" (p.9).

Some of these alternative configurations of participatory mapping include Public Participatory GIS (PPGIS), Volunteered geographic information (VGI), and Web Mapping. Elwood (2001) defined PPGIS as the processes of acquisition and application of hardware, software, and spatial data for GIS analysis, but also the social and political contexts in which GIS is being employed, which influences its use and impacts. (p.1). Along the same lines, Sieber (2006) argued that PPGIS is characterized by four themes, which are termed place and people, technology and data, process, and outcome and evaluation. PPGIS has been used by many scholars to analyze different conceptualization of the space working directly with communities affected by socio-environmental problems or with community-based organizations addressing these issues. This methodology has provided an integrative vision between scholars and communities. However, the possibilities of its implementation depend on different factors such as the motivation of each community based - organization to recognize the value of this activity linked to its institutional mission. (Elwood, 2001). Additionally, some scholars have emphasized their capacity to build affective relations into the communities. (Young & Gilmore, 2012). I will describe momentarily how *ElAtlas* has used PPGIS to co-produce

maps about different socio-environmental problems and to geo-visualize the networking of activists and community-based groups. First, the below sub-sections offer some particular methodological details that became central to the work of *ElAtlas*.

*The Information Age and the Geoweb*

In the mid-nineties, Manuel Castells (1996) predicted that "the internet [will become] the dominant frame of reference for symbolic processing from all sources and messages." (Castells.1996, p.693). This assumption became a reality at the beginning of the new millennium with the development of the web 2.0, in which collaboration and user-generated content are the main principles (Han, 2011). These principles transformed traditional conceptual and methodological methods to produce geographic information, in the previous decades, the GIS manipulation and analysis was reduced to spatial labs in universities and governmental institutions in the hands of professional cartographers and geographers.

This situation of GIS exclusive use by experts changed radically. Peterson (2008) reported that in the last decades, the Internet has become the dominant medium for the diffusion of spatial information. Similarly, Leszczynski (2012) and Young & Gilmore (2014). Asserted that the geoweb is changing all the previous regimes of production dissemination of geographic information. McConchie (2015) defined this new age as "neogeography," which is "constellation of new mapping practices and populations on the geospatial web" (p.874). The neogeographic age has opened new possibilities for alternative democratic forms to use and disseminate geographic information such as open-source GIS, web mapping, and volunteered geographic information.

*Open Source GIS*

Coleman 2013 defined that "free and open-source software (F/OSS) refers to nonproprietary but licensed software, much of which is produced by technologists located around the globe who coordinate development through Internet-based projects." (p.1) Open-source technologies have supported the implementation of Open source GIS, which promotes geospatial programming strategies independent of any specific GIS software. (Free and Open Source Software for Geospatial Applications FOSS4G). With open source, it is possible to design and execute spatial data management and spatial analysis projects using automated geoprocessing functions available in the built-in scripting languages such as Python or JavaScript. This current trend in GIS is fostering an open culture (Rey, 2014; Sui, 2014), oriented by the principles of open data, open modeling, open software, open collaboration, and open publication. Open source GIS technologies offer the possibility for low-income communities to access data and geovisualization. In this sense, local governments in Colombia are generating open data repositories that communities can use in their projects. Through open software GIS, new skills can be gained for the production of maps, and these can be published massively with the broad spectrum given by the Internet.

*Web Mapping*

Web Mapping is a collection of techniques for publishing, visualizing, and accessing maps and data on the Internet using markup languages. In Geoweb applications and open-source approaches, the production of geographic knowledge is open to anyone with the technical skills to make interactive maps. In this way, software developers

become mapmaking subjects producing geographic knowledge (Dalton, 2015). In other words, open-source and web mapping technologies are altering the sociopolitical construction of spatial data (Elwood, 2010). Therefore, it is a transition from cartography produced by the state to the hands of market regimes (Leszczynski, 2012). In the last decades, online communities of GIS practitioners are continuously interacting, interchanging, and producing new methodologies to store and analyze geographic data. Scripting languages like JavaScript, Python, or R are part of the essential toolkit of GIS practitioners; these programming scales are necessary to interact with API and get access to multiple repositories of geographic data.

*Volunteered Geographic Information*

Volunteered geographic information (VGI), is a term coined by Michael Goodchild in 2007 when he referred to the massive production of geographic information using geoweb tools by those who have no formal training in geospatial data collection and analysis (Goodchild 2007). In other words, geography and cartography have entered an era of civic engagement (Brovelli et al., 2015). Elwood et al. (2012) argued that VGI is a collection of tools for spatial analysis and representation in digital environments open to the general public. However, according to Blatt (2015), this massive public participatory engagement in geography represents new challenges on several legal and ethical issues surround this public exchange of geospatial information. Similarly, Scassa (2013) analyzed potential legal issues from the perspective of the operator of a VGI site or application, the contributor of VGI, and the user of the product, service, or application that is created using VGI. The collective feelings stimulated by a VGI platform influence

the quantity and quality of information that volunteers are willing to share. A platform can be oriented from feelings such as solidarity or mutual aid in emergencies, or it can also be a platform for denouncing environmental injustice, it can also stimulate in a fun way the generation of information about citizen activities in urban areas. In the case of the *ElAtlas*, it seeks to make visible the creative work of grassroots community groups in Colombia.

*ElAtlas* has sought to make geography and open-source geospatial technologies relevant to community processes working positive socio-environmental transformation in their territories. In this pursuit, *ElAtlas* has had different stages co-produced through the interests and motivations of community-based groups and their networks in Colombia.

Stages of *Elatlas*: Negotiating Community Needs and Technological Limitations

The work of *ElAtlas* has been divided into three stages, plus a pilot stage, each mapping in different ways the affective networking of community-based groups:

In 2015 a **pilot stage** set up a youth board and piloted data gathering techniques

(1) In 2016 the **first stage** focused on the development of a geo-platform for the visualization and articulation of community-based groups in Medellin, Colombia.

(2) In 2017 the **second stage** mapped affective networks for peacebuilding at the national and local levels.

(3) In 2018-2019, the **third stage** of *ElAtlas* focused on the geovisualization of affective networks in processes of environmental governance.

In the following pages, I will look back at the project stages, paying attention to key details about the work itself, as well as highlighting key products. In the subsequent section I describe key lessons from this work.

*Pilot Stage: El Atlas del Afecto*

The original idea of the *ElAtlas* project was to create an online atlas of maps visualizing the work, and collective power, of youth-based and community-based groups in the city of Medellin, Colombia. The project was an arm of a larger funded project that studied the role of bodily feeling and affect in a large peacebuilding network called the *Legión del Afecto* (LA)[2]. The LA is a youth-led, non-violence movement originating in Medellin, Colombia (Hayes-Conroy 2018). LA leaders have worked with dozens of community groups, youth groups, and local collectives in the city, offering a perfect methodological starting place to recruit participants. Fittingly, at that time we referred to the *ElAtlas* project, as *El Atlas del Afecto* [Atlas of Affection], and our work drew upon our knowledge of the role of bodily feeling in peacebuilding from our work with the LA, in order to hypothesize connections between other youth and community groups as a dynamic affective network across the city. Planning to work with a youth board, we had tentative plans to use existing online web mapping software to collect qualitative and geolocational data among 50+ different groups across the city, regarding their activities in the city.

[2] This work was based on a larger project supported by the National Science Foundation (NSF) under Grant #1452541. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the NSF.

As expected, our original plans were reformed by the board of youth collaborators we set up to realize the project. The collaborators were all youth leaders, residents, and community actors in working class neighborhoods across the city. Working with these collaborators as paid co-investigators, we held initial meetings in summer of 2015 to negotiate the intent and purpose of the project, to strategize data collection, and to troubleshoot. The youth board was enthusiastic about the potential of the project, but were concerned about making it "big enough" to appeal to the prospective community groups they targeted for engagement. Thus, the original proposal to use PPGIS and VGI tools to visualize the power of the groups, was adapted to enable input from local groups on what kinds of online capabilities and products would be most appealing. That first summer we held two events that brought leaders from several community groups together to pilot data gathering techniques. Interestingly, participants seemed most enthusiastic about the non-technical activity that we developed using a large map of the city printed on wipeable canvas that enabled them to collectively map out collaborations between groups across the metropolitan region, much like a flight map. Perhaps due to financial limitations on the number of devices we had available, or perhaps due to the lag time associated with new technology use, there was generally less enthusiasm about online activities. The youth board met monthly during the rest of the year to discuss what kinds of data we wanted to collect and how to motivate perspective participants (i.e. groups) about the process through events designed to engage both feeling and thinking.

*Stage 1: Red ElAtlas – Community-Based Network or Spatial Database*

By the next summer, 2016, the youth board had shifted, losing some participants to other commitments, and gaining new youth expertise in networking and community engagement. The board used the lessons from the previous summer's fieldwork to move away from existing platforms for web mapping, and create its own online platform. The purpose of the platform would still be to target lesser-known grassroots groups, collectives, or alliances that are often invisible outside their local neighborhoods. The project we now referred to as *Red ElAtlas* (Atlas Network). *Red ElAtlas* sought to provide these groups with a platform to share group actions and activities and to be visible (through locational and keyword searches) to other groups and people seeking grassroots collaboration. Recognizing that offline networking is likely to be more important than online, we also sought to mirror our online presence by participating in and/or co-sponsoring activities and events that brought together various youth and community groups from across the city. The youth board targeted 100 community-based groups across the city that first summer, spanning from informal groups youth had set up to train breakdance or sport, to artist, clown, or hip-hop collectives, and activist networks, as well as long-standing cultural houses or community organizations that have existed for decades. By the end of the summer collectively the board had made almost 60 community visits, and had collected about 80 groups as participants to the platform.
In the *ElAtlas* geoweb platform, each group created a profile providing basic information to be shared online to facilitate connections and collaborations between different grassroots groups of the world. (The inclusion of "the world" rather than simply the Medellin metro area was part of the strategy of the youth board to insist that the platform

was “big enough” to be interesting). Groups could provide open ended descriptions of themselves, as well as select their type of work with any (or all) of the following categories: Arts & Culture, Food & Agriculture, Environmental Activism, Animal Protection, Sports and Recreation, Human Rights, Community Development, Education, Housing & Habitat, Health, Media & Communication. The youth board defined the following benefits from such an online platform, and socialized these ideas with dozens of groups at local events:

- The ability to highlight activities of one’s own group and to participate in a more appropriate collective social networking webspace for community organizing (more appropriate than individual-focused corporate options)
- The ability to visualize the power and connectivity of these groups.
- The ability to search for collaborators and to be seen by potential collaborators, including not only other groups but also scholars/academics looking to build new alliances.
- Enhanced potential for online sharing of ideas, information, skills, inspiration (affects), and financial resources.

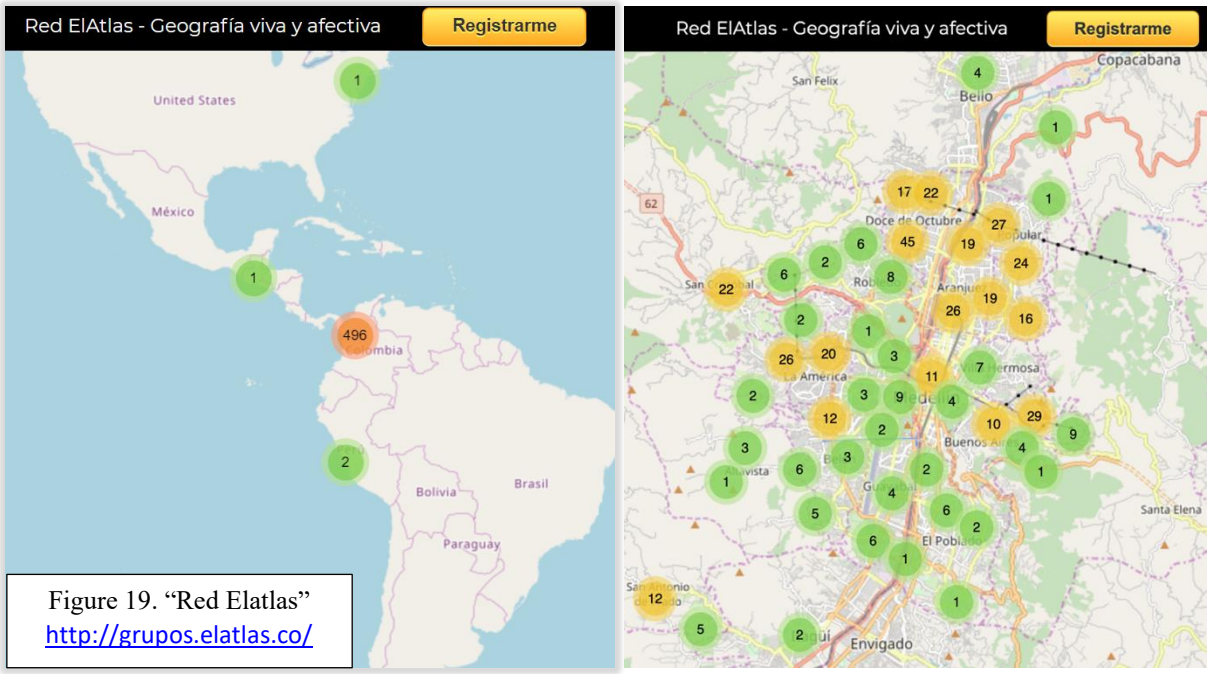


Figure 19. "Red Elatlas" http://grupos.elatlas.co/

By the time we "perfected" the platform we had over one hundred users (groups with self-made profiles). We also had a problem: most of those with profiles were not going to use it. We came to this realization partially because of another oddly similar story: A year and a half after socializing the *ElAtlas* platform to communities, we discovered that the municipal government was also constructing a geographic platform for social engagement between community groups. Specifically, they planned an online platform with the goal of joining different youth groups that were participating in their government program "Clubes Juveniles." They asked groups to create a profile online and then to search groups in the same area in order to develop a proposal together, which they could submit to obtain resources of the local government. The government also proposed that groups could use platform to look up study and job opportunities, as their platform was linked to a system of information on large companies and education institutions. Obviously, the municipal platform had many more resources than we did. Yet, they too

failed: On the official website of this platform, within a month of it opening, only 23 groups had joined this initiative.[3] This situation forced them to change their strategy to organize the "Clubes Juveniles" program in a more offline participatory way that was supported more intimately by community-based organizations.

Online platforms have various obstacles to joining groups and maintaining online participation, such as the lack of internet connection in some communities, lack of perceived utility, and competition with other social media platforms. Our youth board recognized that the offline *ElAtlas* was doomed to fail because we lacked the resources to keep up with offline networking at the pace necessary to maintain excitement about the online platform. After our failure and after witnessing the similar failure of the local government platform, we reinforced our commitment to the creation of mutual trust through affective networking offline. Reflecting upon the community organizing expertise of the youth board, we saw that any offline network needed to be developed through in-person experiences that activated senses and emotions along with intellectual and practical interests. Additionally, saw the need to more carefully tailor our work in geography and open-source geospatial technologies to the existing needs and motivations of individual community-based groups.

Yet the board still agreed that the platform could be valuable as a database. Technologically oriented participants were still excited about this web mapping architecture based on the foundation of VGI that opens the possibility to democratize the production and distribution of geographic knowledge. *ElAtlas*, is still a repository for quantitative, geolocational, and qualitative information about "base" community groups,

[3] By the end of 2016, we found yet other examples of governments and NGOs with similar ideas, including the “Civics” Map, which also failed to inspire long-term participation https://civics.cc/en/acerca

which are rarely known outside of their local neighborhoods but which form a crucial foundation for the mobilization of broader initiatives and movements. Such VGI can tell us "about local activities in various geographic locations that go unnoticed by the world's media." (Elwood, Goodchild, & Sui, 2012). Thus, through an agreement with the Secretary of Youth of Medellín, the *ElAtlas* technical team obtained data from 411 other youth groups that were joined to the platform later that year, as a way of reinforcing our commitment to making visible the creative work of young people in different neighborhoods of Medellín. Our platform now has information on 511 groups, and serves as a database through which relevant qualitative, quantitative, and locational data on grassroots groups are stored and shared.

*Stage 2: Affective Networks of Peacebuilding*

By the fall of 2016, the youth board (which had shifted again) regrouped to strategize with respect to our original vision, which was to “make geography useful” to community leaders and the myriad needs of those seeking to creatively engage their communities in peaceful social and environmental transformation. Since we had begun with the interests of mapping the affective connections (and the power of affection) among community groups, we also went back to that starting point. Several local leaders of the nation-wide peacebuilding initiative *Legión of Afecto* (LA), mentioned above, indicated their interest in varied means of demonstrating the power and importance of the LA network across the country. The LA had previously received government funding, but now leaders were continuing their peacebuilding and networking labor unpaid. Thus, I

led the *ElAtlas* team in devising a plan to map the affective networks that the LA had generated for peacebuilding since its start in 2003.

The first task was to recover all of the archives that were scattered throughout the Colombian territory. This was especially challenging for locating data on activities and events between 2003-2010, since, compared to later years, these years were the least systematized by leaders in the initiative. Over a period of six months, a team of three *ElAtlas* researchers travelled from Medellin to different cities of Colombia, recovering and carrying out PPGIS activities to recover the legacy and the places where the Legion articulated community-based groups for peacebuilding. The activities of PPGIS took place in different municipalities of Colombia, inviting all those who participated in the activities in different years directly or indirectly. Each research event "dialogue" revolved around a map of a given region in which the participants described where and how the Legion's activities were developed. The description of the activities by the participants followed three primary questions: What happened during this activity or event? How many people participated in each activity? And, why this activity was important for this specific neighborhood, district, or region?


**Figure 20. Screenshot of online map of "La Legion Del Afecto" digital archive map of the peacebuilding activities of the social in Colombia 2003-2018**

These PPGIS research events did not have a pre-established time limit. Thus, in most cases, these events became hours-long opportunities to share anecdotes and memories of the activities described by the participants. The descriptions were recorded and transcribed to contribute to the archive, that was then transferred to a spatial database. Also, by email, many persons shared pictures, videos, and narrative files about the LA's activities. The information collected allowed us to generate two maps. The first one (Figure 3) represents a digital archive of the peacebuilding activities of the social initiative "Legion del Afecto." In this map, geolocational, qualitative, and quantitative information is accessible, detailing the work of the LA as a peacebuilding initiative. Using this online interactive map, it is possible to visualize the number of municipalities, the number of activities, and the number of people mobilized by the Legion.

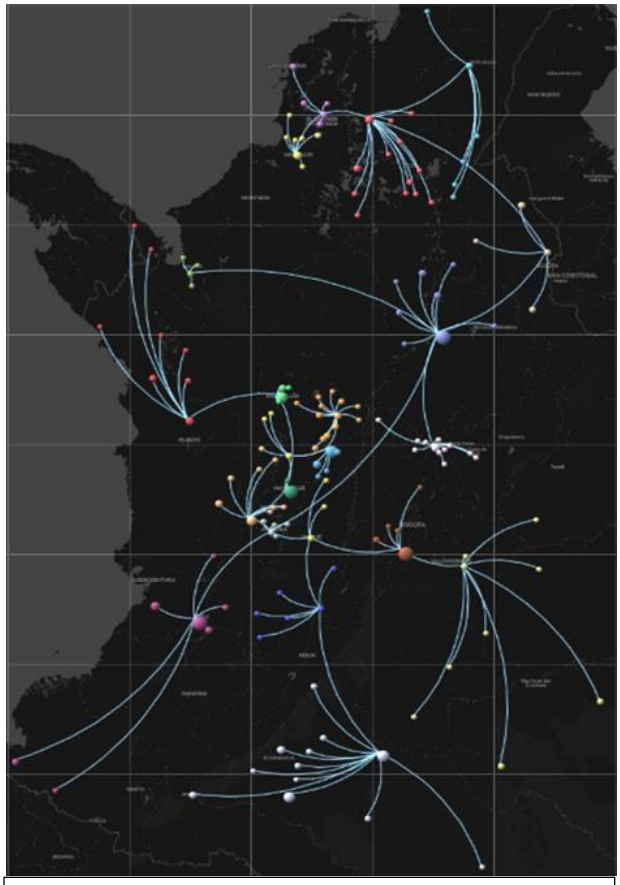

**Figure 21. Screenshot of online map of "La Legion Del Afecto" Activity nodes of Peacebuilding in Colombia 2003-2018. Dot size represents relative number of activities per municipality**

From this first map, a second map was built (Figure 4), visualizing the different territorial nodes of the "La Legion." This map shows the territorial networks created between municipalities in different regions of the country. Only text-type information was included; thousands of photos and hundreds of videos are still to be classified. It was just

the first step (however important) to visualize the peacebuilding labor of hundreds of grassroots community groups in the most remote regions of Colombia.

The methodology of first exercise with "Legion del Afecto," has been replicated by the *ElAtlas* team on a handful of smaller projects in different neighborhoods of Medellin. These smaller projects came to us through our previous interactions with youth-based organizations in Stage 1, and again included collaborative online and offline data gathering related to the creation of affective networks between organizations. While these projects were much smaller scale, they again served to demonstrate the latent powers of affective networks through visualizing their potential for maintaining connection and enabling collaboration between distant groups.

For example, in a smaller project undertaken with a local community organization, we generated a PPGIS activity to foster public participation and enhance networking among multiple youth-based organizations in *Comuna 5*, Castilla, Medellin. The *ElAtlas* team both supported and conducted in-person workshops to recognize the positive influence of youth-based organizations in this territory. In these workshops geovisualization work on the power of connection was considered to be especially important because this is an area affected by “invisible barriers” to spatial connection and social collaboration across neighborhoods that are imposed by illegal armed groups. Through a PPGIS activity involving group dialogue coupled

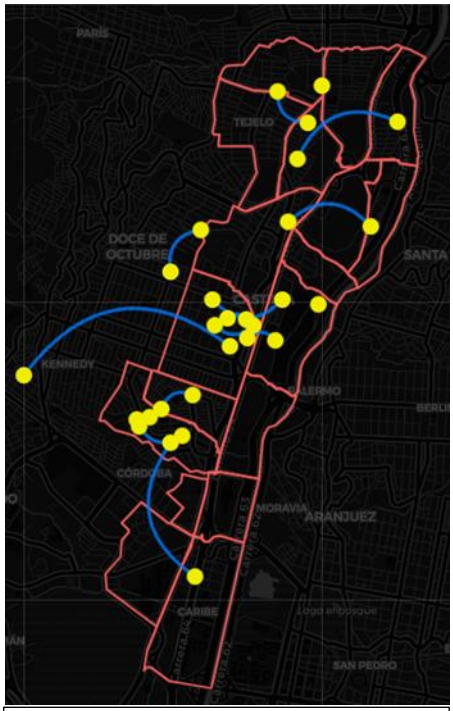


**Figure 22. Youth-based groups in Comuna 5 of Medellin, and existing collaborations between groups**

eighth the drawing flight line connectors on a canvas map, we linked the support networks that were created among 29 community-based groups in different neighborhoods in the comuna. Each group described their work and established lines of relationships the groups with whom they work the closest. This information was transferred to an *ElAtlas* spatial database and mapped online using the JavaScript Leaflet library, and ultimately shared with the groups. This and other interactive maps are published on the elatlas.co website. (See screenshot in Figure 5).

*Stage 3: Affective networks of Place-Based Environmental Governance.*

By the summer of 2018, the *ElAtlas* team had worked on various projects of affective networking, both online and offline (as described in Stage 2). This budding expertise and collective interest in affective networking became a centering point for the team. Members of our youth board began to use local connections to think about how to make this expertise useful to a wider variety of community projects. In particular, having focused the work of *ElAtlas* on social and political activism, in topics such as peacebuilding and cultural resistance, we brainstormed how to integrate our work more clearly into environmental and social-ecological issues. This work was particularly important for members of our group not only because many of them see environmental and social issues as interconnected, but also because environmental activists have been targets of violence across the country in the last decade (Ball et al; 2018). Within this discussion, I brought the notion of 'visceral methods' more central to our planning. Visceral methods are those that pay attention to bodily feelings/emotions/affects, and although affect had always been a key feature in what *ElAtlas* does, the team was

enthusiastic to search for new ways in which "visceral methods can attend to broader biological and ecological realities, as they are central to both bodily experience and political situatedness." (Hayes-Conroy, 2017, p.2). Out of this discussion, we drew our attention to the possibilities of mapping eco-affective networks; that is, networks of action/activism and solidarity that are built on the feelings associated with affective bonds among people and between people and their natural environments. To date, *ElAtlas* has worked on two major projects on eco-affective networks, each detailed below.

(1) Solidarity Network for Grassroots Ecotourism in the municipality of San Luis.


**Figure 23.** ***Places of Eco-Affective Value In the municipality of San Luis, Antioquia***

The first project the *ElAtlas* team undertook with our new focus on eco-affective networks, was supporting a group of environmental leaders in the municipality of San Luis. San Luis is a rural municipality 3 hours southeast of Medellin. The municipality of San Luis was one of the municipalities most affected by the armed conflict more than 20 years ago. In the last decade, San Luis has been recovering from the effects of the conflict by seeking to generate economic alternatives for the communities through eco-tourism. Environmental leaders saw the possibility of ecotourism as a grassroots means of generating alternative economic revenue for local

residents struggling to meet basic needs. They asked us to generate a map of the tourist attractions with ecological value, and particularly those around riparian areas (streams being key to cultural leisure habits in the country[4]). Ultimately, their idea was that the geovisualization of these places would be used to seek the establishment of ecotourism policies that contribute to the protection of ecosystems and the empowerment of local communities in mechanisms of affective networks of place-based environmental governance. Residents have considered the riparian areas of the rivers and streams of the municipality of San Luis as ecological and cultural heritage. These areas are places for social gathering, sports, and recreation. The municipality extends over a vast region between the East of Antioquia and the Middle Magdalena in the Central region of Colombia to cover this territory; we again formed a working group of three people to collect information on rivers, streams, and riparian zones.

The activities of PPGIS were aimed at collecting three key aspects per site visited. First, georeferenced data on longitude, latitude, and altitude. Second narrative and descriptions of the site and third photographs for illustration. In each site, a community leader had been previously contacted through the community-based group "Colonia de San Luis." The team traveled by foot, visiting different districts in the municipality and taking notes of the narrative of each site through the voice of the community leader. Many narratives were loaded with stories of pain produced by the war. Others told us of happy memories and stories of rituals of indigenous tribes, of witches, of flying snakes, and of the thousand colored birds that inhabit these riparian areas. Among the stories of pain and magic that envelop the emotional atmosphere of this territory, the residents seek that this

[4] Streams and rivers have particular cultural importance in Colombia as a family gathering place to cook and swim during holidays and weekends.

map co-produced with them may contribute to make San Luis an ecological tourism destination that banishes the ghosts of war forever. A screenshot is pictured in Figure 6. And is also available online at the following site: http://www.elatlas.co/en/maps/map-touristic-san-luis/

(2)Eco-Affective Networks for the Ecological Restoration of "La Honda" Stream.

The most recent project that the *ElAtlas* team has finished (at the time of writing) is a project that we begin in 2018. The *ElAtlas* team collaborated with seven environmental community-based groups, focusing on the basin surrounding La Honda stream in the Northeast of Medellin (Figure 7). This stream has been prioritized in a government program for improving the ecological functionalities of urban streams and fostering a culture of protection around their riparian zones. However, the visions of many environmental community based have excluded of this process. The project focused on mapping environmental groups' perceptions of and desires for the stream and its surrounding basin as well as their influence (and potential for influence) in environmental governance related to the stream.

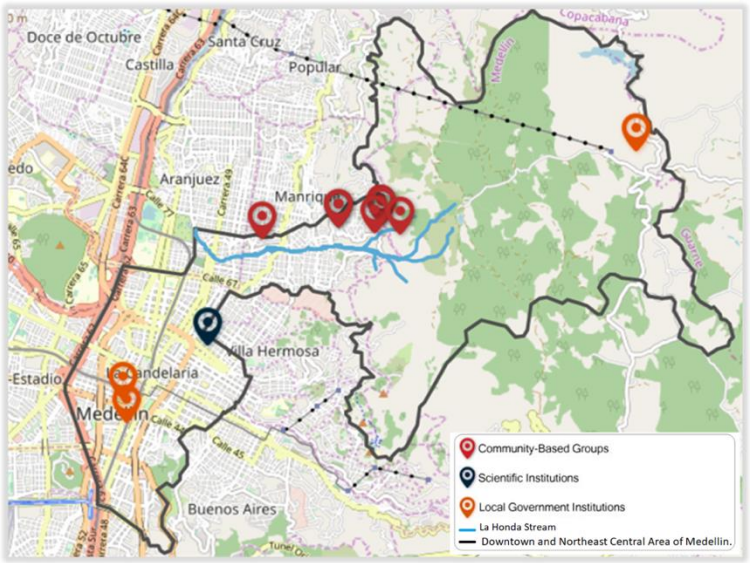


**Figure 24. Screenshot of online map of environmental actors**

This stream had recently been prioritized in an ecological restoration plan led by the environmental authority of the metropolitan area. However, within the conception of the plan, I discovered through interaction with local environmental leaders, the perceptions and visions of environmental community-based groups that developed actions around the Honda stream every day were not taken into account. Because the *ElAtlas* team had already collaborated with a few of these community groups during earlier stages, the *ElAtlas* team to was aware of their frustrations. Out of our interactions with these leaders, I developed the premise of my dissertation work that used La Honda stream as a case study to examine the political potential of eco-affective networks around streams in need of riparian restoration. I developed a participatory methodology in the following manner. The study organized in-depth group interviews centered on specific logistical and experiential elements related to streams and stream restoration with leaders of environmental community-based groups. The study developed a total of 7 in-depth group interviews (representing the seven groups working in the study area), each of which involved between 2-3 people (the leaders of each group), and took about 3 hours. The interviews were linked to PPGIS activities through the provision of printed satellite images of the territory. Environmental group leaders marked points with geometric figures and keywords in response to a series of questions that were divided into three phases. In the first phase, questions centered on the collective feelings about the streams and their emotions in the daily work of ecological restoration. In the second phase, they identified points around the streams where their activities take place. In this phase, we explored the sense of place of the streams through the geographical narrative of the environmental leaders. Finally, in the third phase, the leaders of environmental

community-based groups physically drew on the printed satellite images to indicate scenarios of desirable future futures for different riparian zones of the "La Honda." stream. At the same time, all the narratives and descriptions were recorded through cell phones in audio files.

Following these initial events, I conducted three stream habitat walks, inviting members of all of the groups. Stream habitat walks according to the EPA (2012) "is an easy-to-use approach for identifying and assessing the elements of a stream's habitat, which consists primarily of visual observation of stream habitat characteristics, wildlife present, and gross physical attributes." Environmental groups in the study area had a prior interest in habitat walks, and the project worked with these groups in undertaking these events (i.e., sponsored these events for the groups). Thus, stream habitat walks also became a way to participate and observe the environmental groups in action.

The three walks had average participation of 15 to 20 people. In the first walk, we went through the lower part of the stream, which is the most urbanized area. In this area, we mapped the points that are covered up with built infrastructure and those that are open, at the end of this walk, we had the feeling that due to the high degree of urbanization ecological restoration of

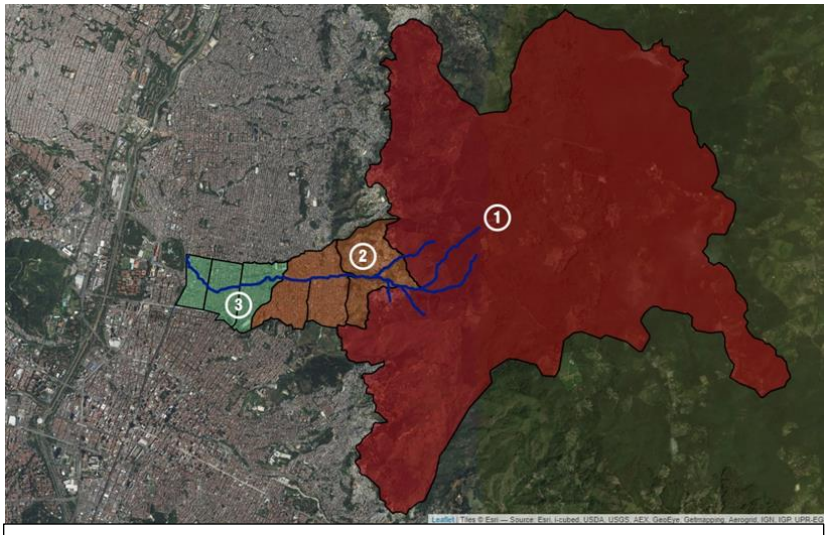


**Figure 25. Stream habitat walks around the "La Honda" stream. 1. Upper area, 2. Middle area 3. Lower area.**

this area is almost impossible. On the second walk, we explored two riparian corridors in the middle area of the stream. The first one is located between the neighborhoods of El Pomar and Manrique Central and the second one between the neighborhoods of El Raizal and La Honda. These areas are of significant ecological value for the city; they are the only places in the watershed where the urban riparian forest is preserved. The third walk began in the La Honda neighborhood and ended in the district of Piedras Blancas. In this rural area, there is a great variety of fauna and flora in the middle of a foggy forest, which is part of the natural reserve of Arvi Park. The stream habitat walks through the territory allowed us to see different contrasts in the same basin, both social and ecological. These reflections allowed us to conclude with the participants that the co-production of geographical knowledge is a living and emotional exercise that makes the territory more relevant, walking together. Finally, I held a networking meeting with representatives of the seven community-based groups in order to socialize and validate the results.

This empirical data collected from all of the above is also the focus of two other papers (Paper 1 and 2). Here I focus on the community-participatory meanings of my research that were set up to understand the following aspects of the work of community actors:

- Perceptions and feelings of participants in different community-based groups with respect to *specific locations* within the "La Honda" Stream and its riparian areas.
- The *spatial influence* of different community-based groups in the different areas of the stream, and their existing connections with other community-based groups and environmental authorities in the city.

- The *places* with the highest potential to initiate restoration processes and propose alternative scenarios to those established in the current land use zoning plan.

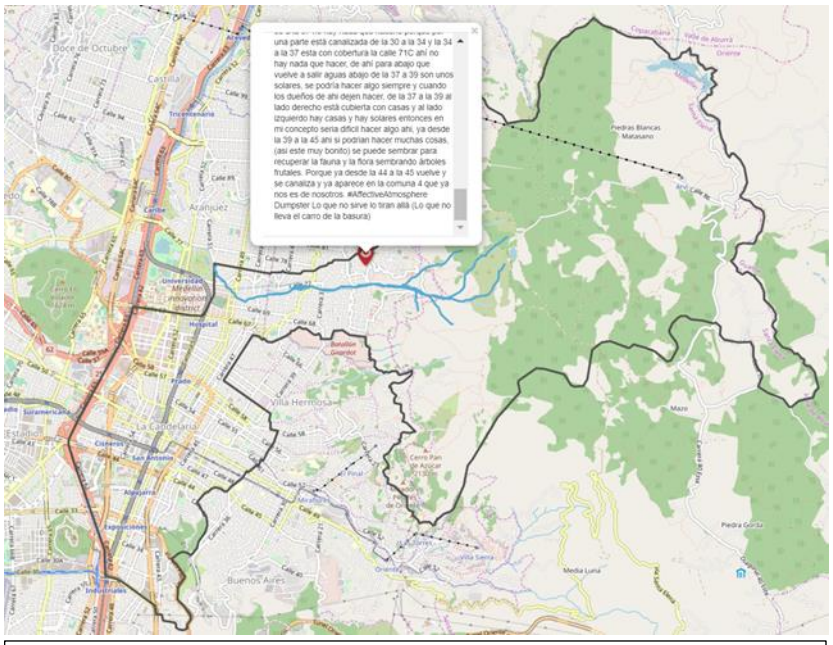


**Figure 26. Screenshot of online map of perceptions around "La Honda" stream.**

From the perspective of the *ElAtlas* mission this latest eco-affective networking project, building from the perceptions and visions of community-based groups, has helped us to collectively propose an alternative scenario of governance for La Honda Stream. In this alternative scenario, a network of cooperation would be established among the different community groups, ultimately seeking the empowerment of local communities in the long-term process of ecological restoration. The *ElAtlas* events described above intentionally modeled such networking, with the approval and support of participant groups. The *ElAtlas* team is now working with these groups to create a policy document to share with government actors and science professionals who are currently engaged in urban stream restoration in Medellin. Most broadly, this recent work with the community groups of La Honda steam has reinforced the ongoing dedication of the *ElAtlas* team to documenting, visualizing, and supporting affective and eco-affective networks of community actors. We see such work

as central to solving the multiple critical issues that are currently affecting the lives and livelihoods of Colombian society.

Discussion: Lessons Learned:

As described in the above stages, *ElAtlas* has evolved quite drastically since we first initiated activities in 2015. This evolution was a collective response to the challenges and lessons we learned about participatory methods in geography and GIS. Throughout all of this work, the *ElAtlas* team maintained a praxis of reflexivity about participatory research and community engagement: What does it mean to "engage" others in research? What level of involvement “counts” as co-production of geographic knowledge? To what extent can engagement be fluid and partial, yet still meaningful? The *ElAtlas* team often reflected on these issues, not only because our team itself was “fluid” (losing and gaining members over the five years documented here), but also because we sought to engage others – many others – in order to make our work useful, viable, and “real.” In one of the earliest conversations, we talked about the importance of recognizing the emotional involvement and the emotional labor of participants on the youth board. Motivating and mobilizing is what many of them do, already, as youth leaders. This is their expertise. And, yet, the challenges of motivating participation in a project with academic roots sometimes feels different, despite the somewhat open and negotiable agenda. The youth board was committed to the intellectual work of *ElAtlas* both because of and in spite of their activism; in other words, they found merit and excitement in the intellectual features of the project, as well as merit in the desire to “make geography useful” yet the group had to negotiate collectively how this could happen. Below we describe three key challenges

and lessons that we learned during this journey, which are relevant to current debates in community engagement and GIScience: (1) the risks of geolocation, (2) motivating VGI participation, and (3) merging the agendas of research and social transformation.

*Attending to the Risks and Perceived Risks of Geolocation*

ElAtlas as a methodological process has encountered ethical challenges in terms of protecting personal privacy, a critical issue that remains highly contested in the exchange of geographic data across the geoweb (Elwood & Leszczynski, 2011; Shanley et al., 2013). In the development of the *ElAtlas* research project, perhaps the most critical issue has been to protect the confidentiality of social leaders that support our research, because, as I mentioned above, social and environmental leaders are in danger of violence in the Colombian context[5]. In particular, for many leaders, the geolocation of their activities can be perceived as a threat. Responding to this context, we implemented various measures for the protection of their confidentiality. First, throughout all of the research stages, our decision to focus on groups rather than individuals was a result of our desire to protect individual leaders. Our strategy sought not to politicize the information that was shared to make us vulnerable to armed groups. In the summer of 2017, we then decided to disable the option of sharing geo-referenced personal information on activities, because, in some neighborhoods, cultural, and artistic groups were declared military targets by armed groups for their cultural work rescuing young people from the armed

[5] According to Human Rights institutions, more than three hundred social leaders have killed in Colombia in the last three years. Ball, P., Rodríguez, C., & Rozo, V. (2018). Asesinatos de líderes sociales en Colombia en 2016–2017: una estimación del universo. *Bogota (1 Ed). Editorial Dejusticia*, *8*(2), 184-204.

conflict. In a country like Colombia with endemic violence, cultural and artistic acts can be seen a threat to the enemies of Peace. Unfortunately, the information gathered in VGI Platforms may unwittingly help these armed groups to obtain information to attempt against the life of members of community-based groups. Thus, the *ElAtlas* team calls for care, but not total silencing, of geographic information on community-based groups in order to reduce the risks of what is shared on the web.

*Appreciating Motivation in VGI participation*

Related to the first point above, the team started out with the admittedly hopeful assumption that for community-based groups to be geolocated in an online map may be perceived as an opportunity. Initial discussions about *ElAtlas* compared us to other online tools for social networking, but particularly built for community-based groups to build social change. Yet, one of our major lessons as we moved along was a recognition that sharing such information online (mapped or not) was not a real motivation. According to Goodchild (2007), the core element of VGI is motivating individuals to act voluntarily and share information. However, motivating people is not an easy task, despite having multiple members on our youth team whose expertise is community engagement.
After our failure and the failure of the local government platform as described above, it was necessary to understand that building mutual trust with specific groups and affective networking between groups, needs to be developed in activities that involve shared experience and that facilitate contact with members of other groups. Through our experimentation with socializing the *ElAtlas* platform offline, we recognized that through large-group events, participants appreciated being able to network with members of other

community-based groups with whom they may not have ample opportunity to communicate and collaborate. Additionally, as should be obvious by now in the paper, the *ElAtlas* team recognized that the relevance of geography and open-source geospatial technologies needs to be tailored to the current needs and motivations of community-based groups. Maps must be co-produced with the aim that geographic knowledge could support real, local transformations, even if those transformations seem small or trivial. *ElAtlas* has failed to project a global VGI platform of community-based groups. However, *ElAtlas* have found that the main motivator for active community engagement lies in the co-production of local knowledge (Budhathoki & Haythornthwaite, 2013)

*Merging (desires for) Transformation with (the co-production of) Geographic Knowledge*

ElAtlas, in a similar way to other projects focused on VGI and PPGIS (Bittner, 2017), has prioritized the reduction of social inequalities for the co-production of geographical knowledge by providing tools that allow active and democratic participation of community-based groups. Clearly, participation is not simply a mapping workshop or marking geolocation with information online, with the pretense that scholars will use these maps to identify social or environmental problems. Still, at the of the end of the day, despite whatever interest in technological engagement from community groups, such maps often go to the trashcan or becomes a useless link online. The researcher comes back to their academic duties, and the engaged participants continue struggling through the same problems. Therefore, one of the collective lessons we have learned, and have tried to remain reflexive about as a team, is how to produce a long-term process of social-ecological-technical engagement. In some ways, the *ElAtlas* team has become an

enduring experiment with "resourcing scholar activism" (Routledge and Derickson 2015). We evolved from a funded youth-board, organized around the broad desires and expectations of a funded research project to a team of young community leaders (who are also up-and-coming professionals) who now organize their work around the collective needs for transformation that they have witnessed in their own communities (and they still work together with other professionals and academics to find resources for their work). Being a part of a research project provided us a start – funding and on some level legitimacy, but it also guided us in particular directions that were only sustainable for a short time. Beyond that project, and in order to be sustainable as a scholar-activist collective for long-term. We have had to remain flexible to the needs of the groups with whom we sought collaboration and solidarity. Part of this flexibility has meant that we now understand significant social change as a networked process of small actions that progressively are (or can be) interconnected.

We still are convinced that geography as a discipline, and open-source geospatial technologies in particular can and should support that complex networking process. For example, through the first stage of *ElAtlas* work, we recognized the utility of both having a big online database, and the small-scale lively and affective ways in which we connected to, and networked among, community-based groups. Yet, these two types of "spatial labor" are valuable for vastly different reasons – one scholarly and logistical, and the other organizational and affective. Perhaps this lesson also seems obvious in retrospect, but trying to merge these two types of labor (offline and on-the-ground), and making them serve the same purpose, may not provide the transformational results scholar-activists expect. Thus, while we moved on from the database, we kept our VGI

Platform as a complementary tool to connect with groups, and as a product for increased scholarly interest in and access to data on youth groups in Medellin. However, the *ElAtlas* team now considers the core of our work to be the co-production of geographic knowledge in the context of local initiatives trying to engage local communities in making positive socio-environmental transformation.

*ElAtlas* is an innovative scholar-activist project that speaks directly to the goals of community geography practice. *ElAtlas* can be seen as a flexible model that supports community-based groups to empower them in the co-production of geographic knowledge. *ElAtlas* has three pillars or branches in our flexible model; the first one is *experiential*. In this pillar or component we include all the participatory activities that we develop with community-based groups such as networking activities. The second component is *social education*; we think that our labor is a means of non-hierarchical social education making geography accessible to groups of people outside the academic spectrum. We developed workshops and tutorials on different geography topics. At the same time, we implemented an interchange of knowledge between academics and communities. The final component is the *co-production of knowledge* in the research process; we foster horizontal and non-hierarchical methods between academics and communities to the production of geographic knowledge all results of these processes of co-production are visualized in our gallery.

Conclusions:

As a scholar-activist project, *ElAtlas* sought to make geography and open-source space technologies relevant to grassroots community groups in Colombia. This paper has documented some of our participatory-technical methodological challenges. I also have documented my own desire to merge my new scholarly and technical knowledge with the participatory community practices that I had been involved in since a child, became a slow, iterative process of trying, refining, and understanding. Yet, the reflections and lessons on methodological and technical challenges are not my own. Together, working with a youth board that shifted over the last five years to become the current *ElAtlas* team, we have been inspired and humbled by our daily work with community groups in different regions of the country. We have made many mistakes, both small mistakes, and big mistakes that have caused us rethink our mission on many occasions. However, we are convinced that the co-production of geographical knowledge is a valuable and maybe even necessary means through which we can together contribute a lot to the construction of territorial peace and ecological healing in urban and rural areas of Colombia. Today, *ElAtlas* continues to serve and support the work of various community-based groups in Medellin, and I continue to learn and grow as a geographer and as a community activist through this work.

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## CONCLUSIONS TO THE DISSERTATION

The papers compiled in this project should not be taken as separate parts, but as different elements of the same process that actually began in 2015 with the implementation of the *ElAtlas* initiative supported by community-based groups in different regions of Colombia. Throughout most of my doctoral work, I have led the *ElAtlas* initiative (Hammelman et al., 2019). The broad mission of *ElAtlas* of making geography, GIS, and open source geospatial technologies relevant to community groups was a negotiated objective – one that I negotiated with dozens of actors from varied social and environmental groups all over Medellin, Colombia, and one that I negotiated with myself as both a scholar/student of geography and a long-active social organizer in the city. Paper three detailed my positionality in this respect.

I see the co-production of geographic knowledge as embedded in the aspiration of modern liberal arts yet necessitating a transdisciplinary approach to solve real world problems. My intent in studying geography has not been to isolate myself from the challenges of communities, nor do I wish to engage, primarily in debates with other academics. I believe geography can be un-jargoned, practical, and political in the original sense of contributing to the working of "polis" and the social and ecological lives of residents and citizens. In this regard, I consider important the distinct three Aristotelian approaches to knowledge. First "Episteme" that refers to "know why," Second "Techne" that denotes technical "know how" and "Phronesis" that affirmed practical knowledge and practical ethics (Atwill, 2009). In other words, theoretical and technical expertise in geography could be applied to generate positive socio-environmental change in local communities inspiring an original conception and praxis of geography in the current era.

One central and practical goal of my dissertation research was to generate an inclusive vision of ecological restoration through examination of local processes of stream restoration in the Medellin river watershed. In undertaking this work, and in leading the *ElAtlas* initiative more broadly, I prioritized social engagement. I see social engagement, including attention to affect/feeling, and affective connections between people, as central to processes of ecological restoration and social transformation. It is for this reason that I undertook my doctoral work, my work on *ElAtlas* and my work in my dissertation. (It is also for this reason that I found overlapping research interests with my advisor.) While I do not claim to "know" (in all three of the above manners) the best methods to do so, through all of this work I have sought to build and/or to enhance networks among different groups involved in social transformation and ecological restoration, including community groups, environmental authorities, and academic researchers. The task of building and enhancing networks is both practical and *affective* – it not only creates new possibilities of collaboration and support for groups working on their projects for socio-ecological restoration, but it also can create positive feelings between those groups, which can lead to lasting collaboration and affective network governance.

As a geographer, I have sought to make key theoretical, empirical, and methodological contributions, as well as policy recommendations, through this dissertation. In paper one I used the case of La Honda stream to develop and analyze the potential practical and political utility of Ben Anderson's concept of "affective atmospheres" (Anderson, 2009; 2014). I worked to understand and analyze how affective atmospheres can be shaped for specific ends like stream restoration. I argued that rather than just *being affective,* ecological atmospheres like La Honda stream and its basin, have an affective dimension

that could be put to use strategically to inspire community-driven care and socio-ecological transformation of the zone. In this paper I also developed the concept of eco-affective network governance in order to give name to a kind of organizing or mobilization strategy that I have witnessed for many years in my role as an organizer. Finally, I also argued that affect and feeling should be considered as potential drivers of socio-ecological change within Plan Quebradas, and that the local government should more democratically includes the work of community actors in stream restoration.

Papers one and two also made key contributions to understanding how environmental and social actors surrounding La Honda stream are or could contribute to a scenario of the stream basin's ecological care. I documented how local environmental actors think and feel about La Honda stream, and analyzed what drives their local environmental actions. I also uncovered some key differences held between young and old actors regarding relationships with governmental authorities and professionals. Importantly, I extended these community-based findings by explore two future scenarios, one based on official plans and the other based on community visions, finding important contrasts in these two visions of ecological restoration, which would result in differing spatial configuration of different land covers and uses, and ultimately differing environmental and social outcomes. Papers one and two together offer a clear argument for the engagement of local communities in ecological restoration initiatives.

Finally, in paper three I detailed my work on the *ElAtlas* initiative. There I documented the rich historical process we went through to build *ElAtlas*. I described how the initiative involved the convergence of different participatory approaches in GIS, such as Public Participatory GIS (PPGIS), and Volunteered Geographic Information (VGI), and richly

detailed the three different stages of the initiative. In describing the third and current stage of *ElAtlas,* I specifically described the participatory methodology that I used in this dissertation, and how this dissertation research came to be a project as part of the broader *ElAtlas* initiative. I ended that paper by reflexively considering the risks, failures, and challenges we encountered as a team, as well as the positive outcomes we had in collaborative research to understand social and environmental issues in the Colombia. There are a few future outcomes that I would like to see come of my work and the kind of work that I have learned to do through my study of geography, which is documented in this dissertation. These future outcomes include the following:

1. The last pages of this dissertation were written from the confinement in my home in Medellín, Colombia, produced by the COVID-19 pandemic and quarentine. As a result of this crisis, many of the community groups and leaders who participated in this dissertation research now find themselves in extremely precarious situations. In this emotional climate of uncertainty and despair, I can only attest, through my writing, that my intent is that once the crisis is over, I will continue to support community groups in their work towards social and ecological transformation. And, specifically in the spirit of "resourcing scholar activism" I will continue to try to 'make geography relevant' via the *ElAtlas* initiative (Derickson and Routledge 2015). Through this conclusion, I want to reaffirm my commitment as a scholar-activist to co-produce geographic knowledge with many community-based groups supporting this labor for peacebuilding and socio-environmental justice in Colombia.

2. One of the areas of study that I would like to continue to develop is the role of affect in environmental governance and to understand how, from this perspective, we can generate new visions about socio-ecological restoration. This research on affect will be linked to new academic research on network governance (Sørensen & Torfing, 2016) for the democratic articulation of community-based groups.

3. With respect to the convergence of GIScience and critical methods for community-engaged socio-environmental research, I also want to continue to contribute to the protection and restoration of riparian zones in the world (Wantzen, 2018), especially in the global south, which are in particular need of protection and restoration.

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