



Geography of Environmental Justice in Barrancabermeja: A Constructionist Approach for the Analysis of Social Justice Through the Cases of Environmental Justice and Water Pollution

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Abstract

The aim of this article is to represent social justice as a social construction throughout the study of the role of environmental justice in the process of construction of social justice. Social justice is presented as a socio-spatial state or situation characterized by the fulfilment of all different derivative kinds of justice (economic justice, environmental justice, racial justice, etc.) rather than a separate outcome. This approach links to Martha Nussbaum's and Amartya Sen's works on social justice as far as it is presented as the result of maintained social practices. Environmental justice is used in this article as a case-study to analyse the relationship between the incidence of environmental injustice and the weakening of social justice. The data over which this discussion relies was gathered during fieldwork in Barrancabermeja (Colombia) in June 2016, and it is composed by environmental, ethnographic and economic data. The approach of this article meets Doreen Massey's and other human geographers claims on combining human and physical geography research to produce systemic territorial data and position geography as the conceptual link between social and physical sciences.

Keywords

Justice; environment; construction; water; rights

Introduction

In this article, I will discuss how environmental justice participates in social justice, exploring a “constructionist” approach for social justice research. It calls for the collaboration of different scientific methods and fields, like human and physical geography, sociology, environmental sciences, political sciences and regional studies; and promotes interdisciplinary research in the field of social justice. For this purpose, I will use an approach based on the principle of interdependence of variables, agents and processes at local scale. The research proposes local case-study research and will specifically study how environmental injustice represents a barrier to social justice. I will analyse differential relations between wealth and exposure to environmental degradation as indicators of environmental injustice. Ultimately, this data will be used to determine in which form environmental injustice participates in overall social injustice for the case-study.

This article relies on data collected during fieldwork performed in Barrancabermeja (Colombia) in June 2016. It is based on water samples, ethnographic work and degradation indexes, for which a full explanation is provided. The characteristics of Barrancabermeja’s social and environmental local structures make it the optimal site to observe how differential access to environmental resources derives in the debilitation of urban social justice, as it has been experiencing harmful environmental contamination since the beginning of oil-industry activity in the early 20th Century. Such local environmental damage and its social consequences were already illustrated and discussed in Rafael Jaramillo Arango’s 1934 novel *Barrancabermeja; novela de proxenetas, rufianes, obreros y petroleros* (translated as: Barrancabermeja, a novel of pimps, ruffians, workers and oil-workers) which showcases the environmental devastation and social rupture caused by the early industry. These matters are also discussed Laura Restrepo’s more recent novel, *La novia oscura* (translated as: The dark bride), written after arduous fieldwork and interviews to the last early inhabitants of Barrancabermeja and focusing on women pertaining to the local prostitute community, who lead the process of urbanisation during the decades of 1930’s and 1940’s.

Social justice and environmental justice

Justice is a subjective term that has been articulated, defined and categorized in a variety of ways within academia and philosophy. Justice connotes “righteousness”, and the characterization of something as just or unjust refers to the exercise of examining it in contrast to a given philosophical framework (Colquitt et al., 2001). This statement implies that the concept of justice is differently

understood depending on the societies' cultural and philosophical frameworks, following the spatial distribution of socio-cultural structures. The idea of justice has also changed temporally, supporting the conceptualisation of "justice" as a socially constructed set of beliefs and ideas (Colquitt et al., 2001). Aristotle was one of the first thinkers that identified different kinds of justice in conceptual terms in his *Nicomachean Ethics* (Boyles, Carusi and Attick, 2009), but the idea of social justice as commonly understood today is a product of modernity (Arendt, 1998). The first use of this term was by Luigi Taparelli in 1840 to express the unjust scenarios that occurred as a consequence of the predominance of private interests during the process of unification of Italy (Behr, 2003; Boyles, Carusi and Attick, 2009). The concept gained importance and evolved during the 20th century, facilitating further research in the field and the emergence of different forms of "justice". This could be understood as a specialisation process of research and production of knowledge within the field of social justice.

This article will use Martha Nussbaum's definition of social justice (2011) underpinning the *Capabilities Approach* (Sen, 2000; Nussbaum 2001;2003;2011; Nussbaum and Sen, 1993). Nussbaum's definition has been chosen due to its wide acknowledgment by institutions at international scale such as the United Nations (hereafter UN). Nussbaum (2011) states that social justice is a social construction where all individuals have equal, fundamental entitlements to fair access to services, opportunities, wealth and health. It is based on a freedom of choice approach, therefore coercion or limitation of individuals' decision-making processes prevents systems of social justice (Nussbaum, 2011). This definition of social justice integrates - in practical terms - other types of justice: equal, fundamental entitlements to fair access to services, opportunities, wealth and health implies that gender, racial, economic, spatial and environmental justice, for example and among other types of justice; need to be assured. Social justice cannot be experienced if some individuals and/or communities experience racial injustices, just as it cannot be experienced in a space where environmental injustices develop. Following this rationale, it can be said that social justice is a status in which all different "justices" are achieved, creating a scenario in which all individuals and communities effectively have the same access to services, opportunities, wealth and health; and freedom of choice is secured.

The framework of Capability Space developed by Frediani and Boano integrates the notion of production of space by Henri Lefebvre into the Capabilities Approach, critically positioning the concept of space in the social justice literature (Frediani and Boano, 2012). It explores a spatial approach to social justice that highlights that the processes of space management and its outcomes (process and products of design) can collide with social justice's realisation (Frediani and Boano, 2012). Resource and urban land management are elemental aspects of the production of space (Lefebvre, 1991; Purcell, 2002;2003) and neoliberal systems of oil-extraction and production highly control space uses in numerous global south regions (Sawyer, 2004; Valdivia, 2018; Vega Cantor et al., 2009). This situation

creates systems of social injustice that can be observed through the case of environmental injustice since land use liberalisation and poor application of environmental legislation derive in important environmental damage and health risks for adjacent communities (Sawyer, 2004; Valdivia, 2018). This article's proposed constructionist approach to social justice relates to these frameworks as far as it mobilises urban-spatial information to determine in which ways these processes can neglect social justice. This article, thus, participates on a critical effort to feature spatial variables and systems such as water pollution and hydrological networks in discussions on social justice, understanding that each space has different capabilities, opportunities and responsibilities towards the realisation of social justice.

Therefore, this research considers social justice as a situation where all derivative types of justice are met in a particular space. This approach relates to Nussbaum's as far as it supports the conceptualisation of social justice as a socially constructed system, further supported by work of authors like Bogotch (2002). It conflates with Amartya Sen's (2009) approach since it presents social justice as an accumulative process of different justice-related realisations, parting away from other definitions that refer to it as an "exercise" (Goldfarb and Grinberg, 2001) or that focus on its distributive and cultural aspects (discussed by Fraser, 1998). This article's proposed approach to analyse the construction of social justice stands for a systemic and systematic study of territories at different scales, defining how different realms of justice interrelate and participate in building social justice.

To provide an insight into this phenomenon, I will explore how different variables indirectly related to environmental justice (differential buying power from the realm of economic injustice, and differential urban degradation/service supply from the realm of urban justice) reproduce and support environmental injustice.

Environmental justice is a relatively new term that started having a significant impact in academic discussions since the late 1980's (Schlosberg, 2013). Environmental justice can be defined as communities' and individuals' equal access to the environmental goods available in a territory (Walker, 2012) and equal institutional protection against environmental risks. Environmental justice is strongly threatened by different forms of environmental pollution that negatively affect social life. Natural-resource extraction is one of the most environmentally damaging economic activities, specially affecting water courses (Kemp, Bond, Franks and Cote, 2010). In this article I will focus on the oil industry for two main reasons: first, due to the damaging effects of extracting and processing activity for local hydrological structures; and second, due to the highly localized pattern of extraction, which develops influential economic pressures over resource-extracting territories from international markets.

The availability of oil is determined by a territory's physical structures and geological history at a regional/local scale. These scenarios create powerful

international market relations: since the areas with resource availability are limited and not evenly distributed, most of the territories at global scale depend on the international markets to acquire basic energetic resources, both for industrial and individual use (Kilian, 2006). Consequently, the exploitation of oil-rich regions is imperative for sustaining socio-economic activity at a global scale (Solnik et al., 1996; Kilian, 2006). It can be deduced, thus, that oil-rich areas are supporting current industrial practices at international scale while they concentrate the environmental damage derived from the extraction and processing of a resource that is used continuously worldwide. One of the direct consequences of this scenario is the development of global systems of environmental and social injustice where oil-rich spaces accumulate significant harmful secondary effects derived from the production and use of oil products while importing territories only have to deal with secondary harmful effects derived from oil-product use. This global system of socioenvironmental injustice is supported by capitalist and neoliberal dynamics through the international oil market. Territories at the receiving end of globalization (Massey, 1999) can hardly resist the strong pressures from international oil markets, tending to prioritise the economic efficiency of the resource-related activity over its socioenvironmental responsibilities. This scenario often derives in the relaxation of environmental criteria, pointing out a state failure in environmental management that produces sites of exclusion, illegitimacies and illegalities (Mehta, 2012). The repercussions of environmental contamination can also lead to a significant and immediate threat to human health and life quality when affecting basic environmental resources as water. Thus, differential exposure to contamination and differential access to safe environmental resources among social groups create a context of injustice that directly affects individuals' access to services, opportunities, health and wealth; thus debilitating local systems of social justice.

Nevertheless, social justice also needs a state of individual freedom that allows individuals to flourish at will (Nussbaum, 2011). In a context of globalization, glocalization and strong specialization; economic pressures derived from the fluctuations of international markets transform territories at the local scale and minimize individuals' agency over the characteristics of the space they inhabit. In order to explain this process, it is important to make reference to neoclassical trade theory, which states that "[...] resource-rich countries should specialise in the production of those resources in which they have a comparative advantage in world trade." (Gwynne, 2003:311). This statement implies that oil-rich regions like Barrancabermeja are pressured by neoliberal actors and forces towards their accommodation to the characteristics of oil demand in international markets (Gwynne, 2003). This process should be understood in a context of economic glocalization, a process through which international economic activity has increasingly focused in the local scale rather than the national scale, converting cities into nodes in an international system of industrial and economic activity (Robertson, 1995; Hampton, 2001). In glocalized systems, cities act as clusters for capital accumulation through urbanization (Harvey, 2008; 2009; Purcell, 2003)

attracting agents that transform them following private interests and damaging territorial democracy (Turner, 1995; Harvey, 2008; 2009; Purcell, 2002;2003; Brenner, 2009). Therefore, the shaping of resource-rich areas at the receiving end of globalization is highly controlled by the interests of international private actors (Massey, 1994; Gwynne, 2003). Moreover, strong specialization processes end up creating highly economically resource-dependent local economies and communities that cannot afford a decrease of the resource-related economic activity since it would have a significant impact in local economic and social life (Gwynne, 2003).

Water, oil-extraction and socioenvironmental justice in Barrancabermeja

To provide a better insight of the situation of Barrancabermeja, I will briefly discuss the main environmental consequences of oil-industries at the local scale. It is crucial to reference relevant academic work on the relation between environmental justice and oil productive activities. Sawyer's work in the Ecuadorian case (2004) is very relevant and relates to the Colombian case as far as they both share the Amazon and have similar issues regarding systems of environmental injustice involving the oil industry and rural or indigenous communities. Likewise, Valdivia concentrates on the Ecuadorian case, and concretely her 2018 published investigation in the city of Esmeraldas depicts a case very similar to Barranca's since she "examine[s] how urban residents of the refinery city of Esmeraldas "wager life" under conditions of social and chemical toxicity associated with oil capitalism." (Valdivia, 2018:549). She notes, though, that "how oil flows through urban nodes remains underdeveloped [...]" (Valdivia, 2018:551), subject to which Barrancabermeja's research can contribute. She discusses how the prevalence of oil-capitalism and the normalization of its derived injustices risk dignified life in petro-cities, providing an effective insight into social justice dynamics in urban, petrol-producing environments (Valdivia, 2018). Research in the case of Barrancabermeja aims to provide critical knowledge on how localised oil-industries can effectively neglect social justice through the degradation of natural and urban environments at local scale.

First, it is crucial to state that mineral extraction industries need great amounts of water on site to be able to develop the economic activity (Allen, 2008; Kemp, Bond, Franks and Cote, 2010), creating intricate and often clashing needs between the industry and local communities regarding the use, quality and access to water (Kemp, Bond, Franks and Cote, 2010). The location of the refinery in Barrancabermeja was based on the geostrategic features of the area, the existence of an abundant source of water being one decisive factor. The region does not only locate one of the most economically efficient oil reservoirs in Colombia – a consequence of close-to-surface reservoirs and oil quality-, but it has access to the biggest river in the country. Barrancabermeja is located on the riverside of the river Magdalena and within a complex hydrological network that interconnects swamps, *ciénagas* (environment similar to a marsh environment) and the river. The river

provides water for extraction and oil-processing activities, refrigeration, waste transport and disposal, machinery maintenance and human consumption between others (Allen, 2008; Kemp, Bond, Franks and Cote, 2010). Consequently, the river and adjacent hydrological networks are as relevant in Barrancabermeja's local oil industry as the oil itself, since they have historically provided fundamental services for the industry.

The long-standing, water-dependent extracting and processing activities have significantly damaged local hydrological networks. Extensive research on the field of medical sciences has proved that harmful concentrations of heavy metals are related to different kinds of cancer development, (Koller, 1980; Solomon and Janssen, 2010; González Gutiérrez, Fonseca Fonseca and Jiménez Jordán, 2006); therefore, communities in Barrancabermeja greatly exposed to heavy metals are at higher risks of developing cancer than those that are less exposed. In cases like Barrancabermeja, environmental injustice derives in great social divides since communities with higher investment capability can afford palliative technology and/or housing in healthier areas, therefore they are less exposed to contamination and more likely to enjoy healthier lives (Forero and Umaña, 2014). This scenario reveals that there is not equal institutional protection against environmental hazards, thus proves a scenario of environmental injustice in Barrancabermeja.

Conflicts arise in these contexts when there is uneven access to local environmental goods and wealth among local communities and between local communities and the oil industry (Kemp, Bond, Franks and Cote, 2010). The frictions have also evolved through time and along the complex Colombian conflict until present times, when we can pinpoint water quality and the employment of new oil-extraction methods (such as unconventional fracking methods) as the main contestation points between the inhabitants, the refinery and Colombian institutions.

The frictions between local communities and oil extraction industries have been acknowledged in academia (Idemudia and Ite, 2006; Tuodolo, 2009) and by international related institutions like the International Council of Mining and Metals (ICMM hereafter). Meanwhile the ICMM has recognized that water management, mining and the human rights of local communities are conceptually embedded (ICMM Sustainable Development Framework, 2015); the World Petroleum Council Guide in Water Management (WPCGWM hereafter) does not provide a further insight to this idea. The only reference to water management in the WPCGWM is when it acknowledges that “[...] the use of water -as an interdependent resource- in exploration and production operations should be considered holistically and taking into account other users.” (Gomez in WPCG, 2015:70). Nevertheless, the WPCGWM focuses on resource efficiency and treatment for the industrial activity and does not explore the tensions between industrial demand and local communities' demand, neither tries to encourage extracting industries to take them into account.

In Barrancabermeja's case, local institutions have failed to enforce current Colombian environmental law and have not developed effective palliative measures to combat the harmful effects of environmental degradation. Moreover, they have allowed the recent establishment of an illegal, not well provisioned landfill within the municipal area -obviating citizen discontent and open opposition-, in a nature reserve zone part of the International Jaguar Corridor and home to endangered manatees. The landfill is not structurally adequate, and the lixiviation of residues has contributed importantly to the contamination of one of the *ciénagas* that supplies most of the water that is piped to Barranca's urban centre (data from *Unión Temporal de Diagnóstico Ciénaga San Silvestre*, Temporary Union for the Diagnosis of Ciénaga San Silvestre monitoring project, 2014). In Barranca, contamination derived from industrial activity has been proven to spread out of the hydrological network and affect adjacent structures. Residual heavy metals in watercourses percolate into soils affecting agriculture and farming (Bustamante, Chaparro and Peláez, 2015), revealing a more complex picture of what access to clean water implies. Bustamante, Chaparro and Peláez (2015) found lead, cadmium, molybdenum and zinc on beef cattle's meat pasturing in the area of Barrancabermeja, determining that eating meat and viscera from animals bred in the region can constitute a severe risk for human health.

Issues of environmental injustice around water pollution in Barrancabermeja do not affect just water supply to humans: it affects all local water-dependent industries. Public institutions prioritise the economic efficiency of the oil-industry over traditional local farming and fishing industries (Vega Cantor et al, 2009b), creating scenarios of environmental and economic injustice not just between the oil-industry and the city inhabitants but also among all economic uses of the river. This scenario sets the basis for a long-term conceptualisation of the social use of water that adds up to daily water use, illustrating that water pollution is a problematic that evolves and affects local justice from different angles, at different speeds and that does not present a short-term recovery time.

Methodology: environmental and urban degradation indexes

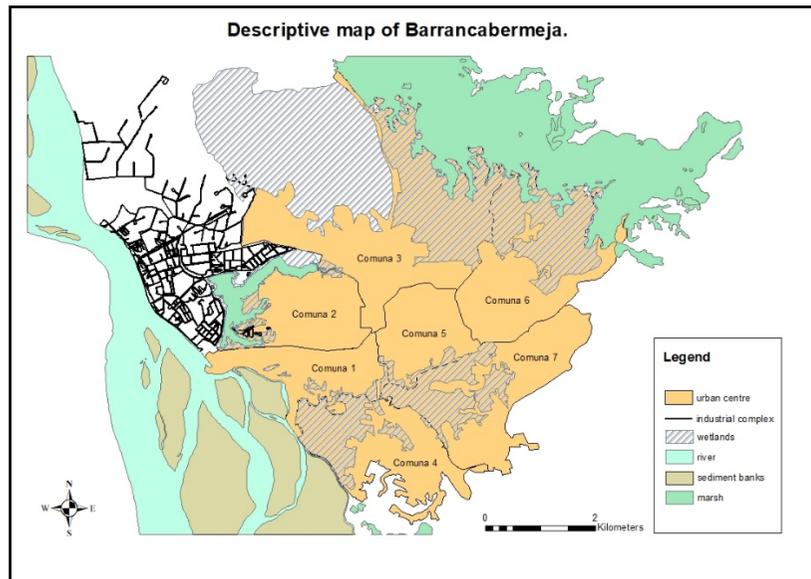
The proposed research questions aim to define how differential exposure to environmental degradation derives in social fragmentation and social injustices in highly industrialized, oil-rich cities in the global south. The questions are the following:

RQ1: What is the spatiality of the degradation of the natural and built environment in Barrancabermeja?

RQ2: Which is the relation between wealth and exposure to environmental risks?

RQ3: In what terms environmental contamination and injustice derive in social injustice in the case of Barrancabermeja?

For this purpose, this research acquired environmental and urban-related data systematically in different locations within the municipality of Barrancabermeja. To define spatialities of environmental and urban degradation, the research will use Barrancabermeja's municipal demarcations of "comunas", what could be compared to municipal districts, as different territorial units within the city. The data collected will be ascribed to each comuna in order to analyse spatial variations in urban and environmental degradation.



Map 1: "Descriptive map of Barrancabermeja.", self-produced. Data: fieldwork and territorial data sets facilitated by research collaborators.

The methodology to determine degradation levels is an original production of this research. Scales to determine environmental and urban degradation have been conceptualised, and comunas will be categorised following this criterion. The environmental degradation scale has been developed following water quality standards published by the World Health Organisation (hereafter, WHO) in "Guidelines for drinking-water quality", 4th edition (2011). Although this guide makes reference just to drinking water and for this research samples of natural water basins were as well taken, it is still applicable since the water samples were taken on the surface of socially used water basins. This implies that individuals, food and/or farming product (cattle or vegetables) were directly exposed to levels of heavy metal contamination of those basins. WHO's criteria have been used since it is widely the most recognised by the international medical community.

The urban degradation scale is based on ideas and research on basic urban services and justice like Swyngedouw and Heynen's (2003), Lowman, McDonald, Wing and Muhammad's (2013); or Sze's (2006). This body of literature explores the relation between access to basic urban services and social and environmental justice, and this scale aims to systemically describe how lack of access to urban

basic services produces and derives in different forms and degrees of urban degradation. From this standpoint, urban degradation is presented as a state of deterioration or non-functionality of the urban network that affects social justice. In this respect, this work directly relates to Frediani and Boano’s (2012) work on space and social justice since it discusses how the outcome of urban design processes collide with social justice.

The presence and concentration of heavy metals were determined through the use of heavy metal test strips (iron, copper, cobalt, zinc, cadmium, nickel, lead and mercury) on water samples taken from municipally supplied water (tap water) and present watercourses/water basins within the comuna. The method does not provide concrete levels of concentrations of heavy metals in water but provides the results in ranges (<10 µg/L -20 µg/L; 20 µg/L -50 µg/L; 50 µg/L- 100 µg/L; 100 µg/L - 200 µg/L; 200 µg/L – 400 µg/L; 400 µg/L -1000 µg/L; <1000 µg/L) which

<p>ENVIRONMENTAL DEGRADATION SCALE: 0= no presence/minimum concentrations of heavy metals (0-10 µg/L) 1= low concentration heavy metals (<10 µg/L) 2= moderate concentration heavy metals (>50 µg/L) 3= significant concentration heavy metals (>100 µg/L) 4= high concentration of heavy metals (>400 µg/L) 5= very high concentration of heavy metals (>1000 µg/L)</p>
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<p>URBAN DEGRADATION SCALE: 0= the comuna provides access to all basic urban and social services (electricity, sewage, water, health and education) and there is no sign of structural deterioration in any neighbourhood. 1= the comuna provides access to all basic urban services (electricity, sewage, water, health and education) but there are moderate signs of structural deterioration. 2= the comuna provides access to basic urban services (electricity, sewage and water) but fails to provide access to one or more social services (health and education). There are moderate signs of structural deterioration. 3= the comuna provides access to basic urban services (electricity, sewage or water), but fails to provide access to social services (health and education) and there are significant signs of structural deterioration. 4= The comuna does not provide access to either electricity, sewage or water; fails to provide social services (health and education) and there are severe signs of structural deterioration. 5= The comuna does not provide access to neither electricity, sewage nor water, fails to provide social services, there is an absence of basic infrastructures (asphalted roads) and there are severe signs of structural deterioration on the existing infrastructures.</p>

Table 1: “Scales of degradation”, original criteria and methodology for the quantification of environmental and urban degradation at local scale.

will be used to create a 0 to 5 scale indicating the degree of water pollution for each comuna. The degree of water contamination will be used as an indicator of environmental degradation in this article. This data

will be finally used to produce maps using ArcGIS software, define the spatiality of

degradation in Barrancabermeja and identify the most exposed areas and communities.

In parallel, the research will rely on ethnographic data collected throughout 7-day fieldwork by participant and non-participant observation in different meetings, workshops and talks. The most relevant ethnographic data were derived from observation in a workshop on geological structures, oil availability and fracking organised by Dr. Julio Fierro and the Labour Trade Union, hereafter USO. Relevant ethnographic data was also acquired from the attendance to a public meeting on a highway project and from the visit the community of Patio Bonito, highly affected by the environmental effects of the landfill previously mentioned. Additionally, systematic acquisition of visual material and informal, non-structured interviews completed the ethnographic material.

A buying power map was also produced using average housing prices as income indicator for each comuna, aiming to locate the wealthier and the most deprived communities and to be compared with the spatiality of degradation in Barrancabermeja.

There is an aspect of the scales that needs further explanation before presenting the findings. Each comuna will receive the higher degradation level for both environmental and urban degradation indexes to illustrate that there are communities within that comuna that are exposed to those levels of degradation. If a comuna receives a level 5 of urban degradation implies that there is at least one area within that comuna that presents those characteristics.

Research in Barrancabermeja: findings

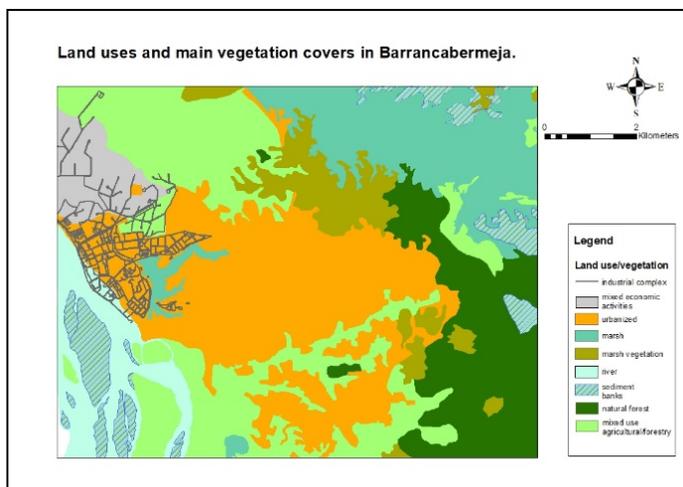
The central findings of the research in relation to the subjects covered by the research questions are: (1) in Barranca there is a differential geographic distribution of degradation, (2) there is an inverse relation between wealth and exposure to environmental risks and (3) environmental justice issues affect social justice by means of differential exposure to risk and differential access to services between urban communities. When performing fieldwork, it was observed that the vast majority of the urban dwellers in Barrancabermeja do not directly drink piped supplied water due to its high level of contamination. It is common that dwellers invest in water filtering and treatment technologies in order to make the resource suitable for human intake, while others depend on the activity of private water suppliers that deliver treated water in tanks. Overall, the quality and quantity of the water an inhabitant intakes in Barrancabermeja varies significantly depending on the individual's buying power. This fact unveils a relevant economic aspect in the process of accessing good quality services and resources in the municipality of Barrancabermeja.

Taking into account Walker's definition of environmental justice, which focuses on equal access to environmental resources, as well as Nussbaum's definition of social justice, which stresses the importance of equal access to

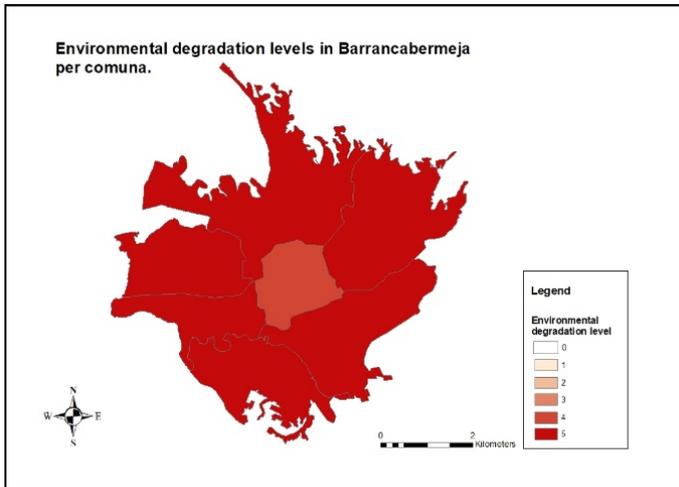
services; we can observe how environmental justice prevents social justice in this scenario regarding access to safe water. The urban population does not have equal access to safe water since access is highly conditioned by investment capability. Investment is determined by buying power, therefore individuals with higher levels of buying power are more likely to be able to obtain safe water and minimize their exposure to environmental risks than those with lower buying power. Considering the definitions of social and environmental justice used in this analysis and the scenario described above, it can be argued that a context of environmental injustice (unequal access to environmental resources) promotes a marketized system of provision of basic services to which individuals do not have the equal access, affecting local social justice.

The communities that have less income have less choice when investing in housing, education, palliative technology or infrastructures, a fact that exposes them more to socioenvironmental risks thereby putting them on a vulnerable position. This finding engages with the “Capabilities approach” and with Harvey’s *Justice, Nature and the Geography of Difference*, showing that economic classes are exposed to environmental risks in relation with their capability of investment, determining their options of choice (Harvey, 1996; Nussbaum, 2011).

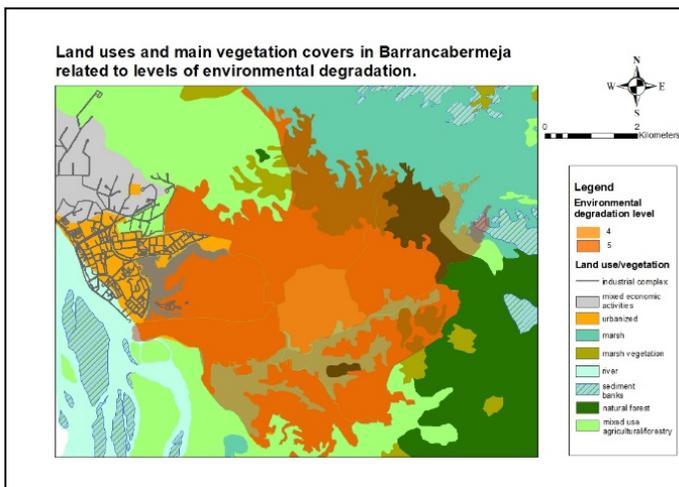
The maps below illustrate the data collected and support this investigation’s findings. Throughout maps analysis, the research questions will be answered in further detail. To begin, maps representing the spatiality of urban and environmental degradation will be studied to define RQ 1’s answer.



Map 2: “Land uses and main vegetation covers in Barrancabermeja.”, self-produced. Data: fieldwork and territorial data sets facilitated by research collaborators.



Map 3: “Environmental degradation levels in Barrancabermeja per comuna.”, self-produced. Data: fieldwork and territorial data sets facilitated by research collaborators.



Map 4: “Land uses and main vegetation covers in Barrancabermeja related to levels of environmental degradation.”, self-produced. Data: fieldwork and territorial data sets facilitated by research collaborators.

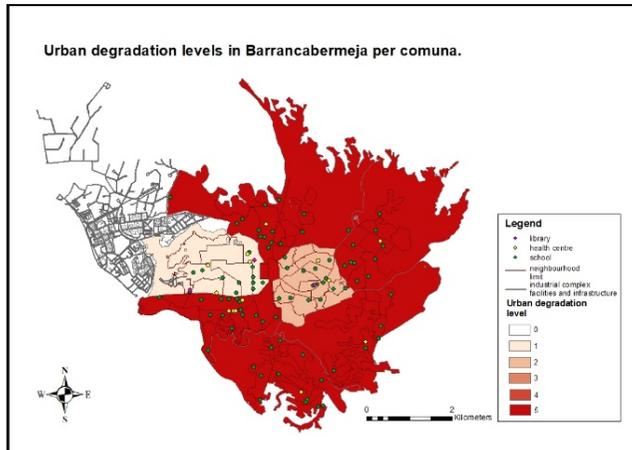
The combination of these three maps provide an effective image of the local environmental structure and the different levels of environmental contamination. Map 2 represents main land uses and vegetation covers for the local area of Barrancabermeja. The main purpose of this map is to show the area’s geographical characteristics to provide context to the environmental degradation levels showed in Map 3. As it can be observed, the most extensive land uses are those dedicated to urbanization and agricultural/forestry developments, the latter characterized by pasture and shrub vegetation. The main agricultural activity is farming (beef and buffalo cattle); nonetheless, the agricultural/forestry use of the area placed in both

comunas 4 and 7 is significantly less intensive than those areas placed around the limits of the urbanized centre, allowing the preservation of a small area of natural forest.

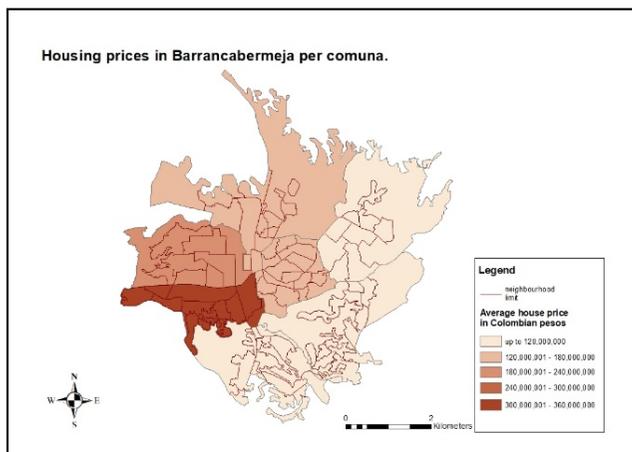
Commenting now the vegetation covers, there is a considerable area between Ciénaga San Silvestre and the urbanized centre characterized by marsh vegetation and swamp-like environments. They form an environmental corridor for water runoff between the marshes and the river Magdalena. The vegetation covers and the characteristics of the local hydrological network facilitate the transport of contaminating agents by carriage throughout the local area. It explains why on Map 3 levels of environmental degradation are 5 (high concentrations of heavy metals in water implying a severe risk to human health) in all comunas but comuna 5. In comuna 5 the level of environmental degradation is lower because there is no water basin at surface level, therefore the recorded concentrations of heavy metals rely just on piped water, which normally presents lower concentrations of contaminating agents than open water basins. It is also significant the fact that, within the administrative limits of the municipality of Barrancabermeja, there is a relevant area covered by marsh vegetation and swamp-like environment. They are characterized by the existence of small stagnant water basins that contribute to higher concentrations of contaminating agents at those points.

The main conclusion of this series of maps is that the entire municipality of Barrancabermeja is within a very contaminated environment that, in all locations, showed very high concentrations of heavy metals in water (piped and hydrological structure); which are potentially harmful for human health and contaminate agricultural products. The information represented in the maps and the conclusions drawn from it provide answer RQ1 on whether there is a spatiality of environmental degradation in Barrancabermeja.

Hereafter the article will concentrate on analysing the data that provide the answer to RQ2. The data acquired for this purpose is based on a wealth indicator (housing price in Barrancabermeja per comuna) together with the environmental degradation map already presented and an urban degradation map. First, I will show the overall urban degradation map together with the housing prices map.



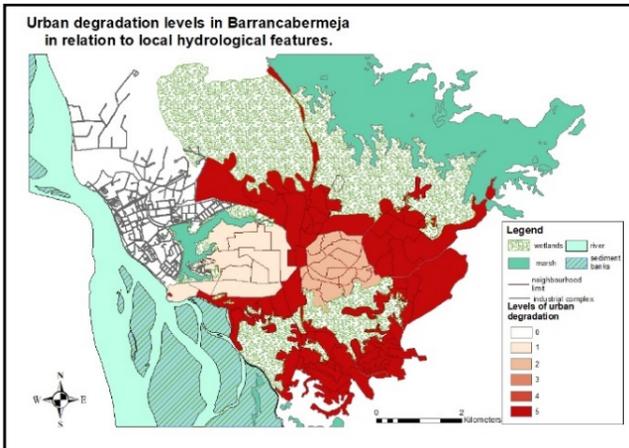
Map 5: “Urban degradation levels in Barrancabermeja per comuna.”, self-produced. Data: fieldwork and territorial data sets facilitated by research collaborators.



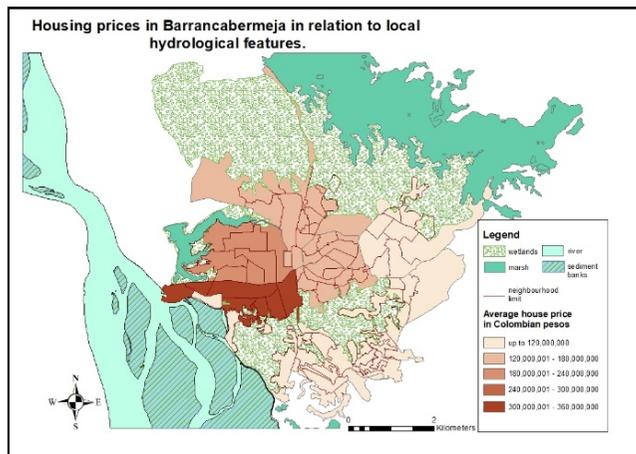
Map 6: “Housing prices in Barrancabermeja per comuna.”, self-produced. Data: fieldwork, territorial data sets facilitated by research collaborators and online advertised on sell properties per neighbourhood.

If these two maps were to be analysed on their own, it could be said that comunas that offer more of services (education and health) tend to be the ones that present higher housing prices. Nonetheless, these maps do not seem to display a correlation between housing prices and levels of urban and environmental degradation (please see Map 3). For this reason, comuna 1 was studied in more depth in order to provide an explanation of this phenomenon, since it is the comuna with higher housing prices and widest price fluctuation while showing a level 5 of both environmental and urban degradation. The comuna has been separated into two distinct areas for this analysis: the northern region composed by the neighbourhoods adjacent to comuna 2; and a southern region composed by three

neighbourhoods highly exposed to the wetlands and marsh-like environmental. In this case, different degradation levels were applied to the different sections, as well as housing prices for southern neighbourhoods were detailed. In order to bring the environmental aspect into this in-depth analysis, the information compelled above will be related to the main local hydrological features.



Map 7: “Urban degradation levels in Barrancabermeja in relation to local hydrological features.”, self-produced. Data: fieldwork and territorial data sets facilitated by research collaborators.



Map 8: “Housing prices in Barrancabermeja in relation to local hydrological features.”, self-produced. Data: fieldwork, territorial data sets facilitated by research collaborators and online advertised on sell properties per neighbourhood.

By combining the information displayed on Map 7 and Map 8, it can be observed that the three northern neighbourhoods of comuna 1 received a level of urban degradation 1 if applied the scale displayed in section “Research in Barrancabermeja: research questions and methods” while locating the highest housing prices. On the contrary, the southern neighbourhoods presented a level 5 of urban degradation, and the average prices dropped to the lowest rank. The very

significant observation from the comuna 1 case is that the neighbourhoods that are less exposed to wetlands and the river received lower urban degradation levels and presented the highest housing prices of the city meanwhile the neighbourhoods more exposed wetlands and the river received worst urban degradation levels and presented much lower housing prices. Following this appreciation, it can be observed that, generally, comunas with higher exposure to wetlands have lower housing prices, implying that dwellings spatially separated from wetlands, marshes and swamp-like environments are more valued in the local property market.

Taking the latter observation into account, can be said that there is an inverse relation between wealth and exposure to environmental contamination in terms of access to less exposed dwellings. This inverse relation has been as well observed on the households' investment capability in water treatment technology and/or methods.

Lastly, this article will articulate the previous arguments to provide the answer to RQ3. Data analysis and fieldwork observations lead to the conclusion that environmental contamination has an important effect on social justice at local scale. The absence of effective public protection against environmental contamination drives local communities to rely on private means to palliate exposure and access basic environmental resources. Markets are the structure through which Barrancabermeja's actors have organized themselves to access safe water: palliative technology, filters and water delivery are the main local markets related to water access. The marketisation of access to safe environmental goods implies that individual buying power defines access and choice, as in every market. Considering that safe water is one basic need to preserve human life and health, the inefficiency of public water supply and the emerging marketisation of safe water produces a context in which buying power determines individual immediate life preservation and health. In a capitalist society, markets and buying power strongly define individuals' freedom of choice and access to services, opportunities, health and wealth (Nussbaum, 2011); providing an insight on how markets can actually minimize individual freedom of choice and options for groups with a low buying power. But in Barrancabermeja's case, markets control the most basic resource for the preservations of human life and health, creating a situation in which physical integrity and health are highly controlled by private actors.

After this statement, I need to address that in the vast majority of Western/developed/Global North countries, access to safe, supplied water is also marketized, as far as it is not a free access resource; and a raising number of private agents are participating in the construction, financing and management of the water supply (Bakker, 2003; Larner and Laurie, 2010). Therefore, water marketisation is not exclusive for areas like Barrancabermeja; the difference resides in that, commonly, the referred countries are able to supply safe resource at an affordable price in relation to average income levels. The piped water supplied in Barrancabermeja is priced, but residents must rely in extra means to treat the resource to make it suitable for human intake; or must acquire it from a third party.

Thus, it can be observed that, in areas like Barrancabermeja, access to safe water is defined by two different markets: the piped supply market (affecting water for hygiene, cleaning and sanitation/sewage) and the water potabilization/palliative technology market. Therefore, it can be observed that environmental goods' marketisation is more extreme in areas where there is limited access to safe resources.

This scenario evolves into social injustice in Barrancabermeja as far as differential exposure to environmental hazards is determined by economic and social factors. Therefore, equal individual safety and integrity is not assured. At this stage it can be appreciated how environmental injustice participates in overall social injustice. Environmental injustices in the case of Barrancabermeja derive in a situation where citizens do not have equal, fundamental entitlements to fair access to services, opportunities, wealth and health; neither experience equal institutional protection against environmental risks. With these arguments and observations, this article has provided answer to RQ3.

Discussion

The purposes of this discussion are to define the research's position within the related academic work and to debate its potential impact. I will analyse Barrancabermeja's research findings together with Patrick Bond's (University of KwaZulu-Natal School of Developmental Studies and Centre for Civil Society, South Africa) book chapter *The Right to the City and the Eco-Social Commoning of Water: Discursive and Political lessons from South Africa* (2012) in "The right to water: politics, governance and social struggle." (Sultana and Loftus, 2012). This case was selected due to its focus on water safety and access, supply and social justice in a global South city (South Africa). The selection of this article was also motivated since it applies a rights-based approach for social justice and introduces ideas from the production of space by Lefebvre that apply to the framework of the Capability Space previously addressed. Thus, both researches concentrate on the same topics, although utilising different approaches to analyse how issues of environmental resource availability affect social justice. This exercise is very useful to see the potential complementarity of rights-based and geographical-environmental approaches for social justice research.

Bond's investigation is based on the case *Mazibuko & Others v City of Johannesburg & Others* (2009). The case verses on the amount of water each citizen daily needs and the payment methods: local communities requested 50 litres per person, but public institutions estimated that 25 were enough and designed a dual system of payments depending income (credit for those with higher income and prepayment for those with lower income) (Bond, 2012). Bond discusses differential water access depending on individual income from a rights-based approach. The concept of rights is invoked through South Africa's Constitutional clause: "everyone has the right to an environment that is not harmful on their health and well-being [...] everyone has the right to have access to [...] sufficient water"

(Arts. 24 and 27, Republic of South Africa, 1996: 1251-1255). The *Mazibuko* case defended that the limitation of litres per person by the City and the application of different water supply services depending on income contravene the Constitution. This relates to the Colombian case as far as the Colombian Constitution states that: “everyone has the right to enjoy a healthy environment. The law will guarantee community participation in decision making process that may affect it.” (Art. 79, Republic of Colombia, 1991:32) and “the resources of General Participation System [...] will be destined to the services under its responsibility, giving priority to the health system, education services [...] and public services for drinking water supply and basic sanitation, guaranteeing its provision and a widest coverage making an emphasis on the poor population” (Art. 356, Republic of Colombia, 1991: 131-133). In both cases, national law collects the right to a healthy environment; the difference resides on the right to water, which is not directly addresses in the Colombian constitution. Nonetheless, the Colombian constitution “guarantee[s] the community participation” in environmental management (Art. 79, Republic of Colombia, 1991:32). This statement can be directly linked to the rights-based approach for urban and resource management used by Bond. At this point I will provide a brief presentation of the rights-based approach to urban planning used by Bond (the right to the city) to discuss Bond’s standpoint at theoretical level.

The right to the city was conceptualised by Henri Lefebvre in 1968 and displayed as a set of rights imbedded in urban life and the feature of the city, based on the right to inhabitation and in the principle of interdependence of rights (Sánchez Rodríguez, 2016). The right to inhabitation refers to a series of social, economic and political entitlements ascribed to an individual with respect to the urban space he/she inhabits, parting away from traditional forms of rights ascription based on nationality and citizenship (Purcell, 2002;2003; Mitchel, 2003). It is a right to occupy and manage urban space, to participate in urban life and to be integrated into the local social, political and economic structures under the basis of inhabitation (Purcell, 2002; 2003; Harvey, 2008). The right to the city acknowledges that public urban space appropriation and direct political participation in urban planning can be used as engines to allow local communities to claim rights and contribute to the adequacy of the urban space to the needs of the cohabiting urban communities, strengthening local social justice by integrating and giving a voice to all social groups within the city (Lefebvre, 1991; Mitchel, 2003; Harvey, 2008). Bond understands that failure in urban resource management and supply derives in individuals’ rights unfulfillment, proposing a barrier to the construction of social justice (Bond, 2012).

Bond argues that: “If the objective of those promoting the right to the city includes making water primarily an eco-social rather than a commercial good [...] [they] need to encompass ecosystemic issues in rights discourses [...]” (Bond, 2012:198). He considers that: “making hydro-socio-ecological connections will be one of the crucial challenges for those invoking water rights.” (2012:197), implying

that there is a need for empirical research involving those three elements to prove and define hydro-socio-ecological connections. From Bond's standpoint, defining these connections is critical to support the recognitions of a right to water and the suitability of a rights-based approach to urban and resource management. This article has a significant impact in this context. Such hydro-socio-ecological connections are proven to exist: water pollution as a consequence of oil-industrial activities and the lack of efficient public supply system derives in differential safe water access, affecting environmental and social justice. It derives in the contamination of adjacent ecosystems and the deterioration of natural structures and the relying socio-economic activity. The case of Barrancabermeja displays how socio-economic activity relies and affects hydrological networks, and the harmful effects for both social and natural structures.

Bond resolves his article stating that: "While having the potential to shift policy from market-based approaches to a narrative more conducive to "social justice", even in the face of powerful commercial interests and imperatives, the limits of a rights discourse are increasingly evident, as South Africa's 2008-09 courtroom dramas indicate" (Bond, 2012:198-199). The *Mazibuko & Others v City of Johannesburg & Others* case estimated that neither limited nor differential access to water in Johannesburg constitute a breach of the Constitutional right to water.

Barrancabermeja can benefit from a conceptualisation of water as an eco-social instead of a commercial good to strengthen local social justice, illustrating individuals' immediate, daily need of water for life and health preservation. It would benefit from a rights-based, participative approach to urban and resource management to promote the construction of environmental and social justice. The relevance of the Colombian case in this respect is that such right to participate in environmental management is already acknowledged in the Colombian Constitution as noted previously. But has not been effectively put in practice.

This aspect of the right to the city, individual agency over urban space management, can effectively participate to the construction of social justice by widening the freedom of choice of inhabitants with regards to the city. Inhabitants' freedom of choice with regards to urban space management is compromised in highly specialized and industrialized resource-rich areas by processes of glocalisation, predominantly dominated by private agents and promoting the de-democratization of the production of urban space, debilitating local social justice by limiting freedom of choice. Therefore, the right to the city can contribute to the strengthening of social justice by providing a system in which inhabitants' direct political participation in urban management enhances individual choice capability.

The research produced in Barrancabermeja contributes to the field of environmental and social justice and to the water justice movement literature (Francis, 2005; Zwarteveen and Boelens, 2014) as far as Barranca's research focuses on forms of access to water and its participation in the construction of

environmental and social justice. It also complements and provides further empirical evidence to the body of literature focused on water marketisation in the Global South (Bakker, 2007; Harris, Goldin and Sneddon, 2015). (Mehta, 2012)The significance of this research is that it proves the interdependency of economic activity, environmental health and socio-cultural uses of land in the construction of social justice.

Conclusions

The research conducted in Barrancabermeja has provided relevant evidence on the interdependency of social and natural variables in processes of construction of social justice. This evidence is key to support the development of environmental and rights-based approaches to social justice at local scale, as it demonstrates the systemic functioning of natural and social structures at local scale. Therefore, the construction of social justice is tied to spatial resources and dynamics (natural and social), which have been proven to interact and condition each other.

The relevance of this approach to social justice is that it concentrates on the interrelations that derive in social injustice. During fieldwork, it was observed that the contamination of the local hydrological network by the oil-industry has deeply affected local traditional economic uses of land. What starts as environmental injustice -one agent contaminates the environment and another agent consequently suffers its secondary harmful effects- derives in economic injustices -the contamination of the river by the activity of one agent derives in lower production rates for other sectors- without stopping being an environmental injustice in the first place. Therefore, the understanding and production of social justice needs of an interdisciplinary approach in which not just different social sciences, but also physical sciences create integrated knowledge to understand how processes from different realms affect each other and produce a whole. The systemic consequences of environmental injustice explored in Barrancabermeja provide empirical evidence of the interdependence of natural and social dynamics for the construction of social justice, and demands further research to define the interactions among justices, aiming to promote well-informed, specific, effective and multidisciplinary strategies towards the realisation of social justice.

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