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Water as a hybrid: an analytical structure based on a hydrosocial approach

A água como híbrido: uma estrutura de análise a partir do enfoque hidrossocial

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ABSTRACT: The reductionism promoted by modernity enabled a common sense as to what water was to be molded in the discrete form of H2O. Questioning that unique conception reproduced in studies of water resources and their governance, to the detriment of their multiple ontologies, was the starting point of this article. An analytical structure is proposed based on the reflections made by Political Ecology and the concept of the hydrosocial cycle. Unlike the naturalization of the hydrological cycle, it contemplates the multiple socionatural relations that constitute water. The aim of the proposed structure is to enable the apprehension of the hydrosocial cycle in time and space, in other words, its application in case studies. The reflection on a hybrid nature of water, duly considering the interactions between human and non-human agencies, provokes a critical look at modern reductionism on water, paying attention to the need to include other practices and epistemes, thereby contemplating a plural perspective on the issue.

Keywords: water; hydrosocial cycle; political ecology; hybrids; water production.

RESUMO: A possibilidade de um senso comum sobre o que seria a água foi possível graças ao reducionismo promovido pela modernidade em uma forma discreta: H2O. Questionar essa concepção única da água, reproduzida nos estudos de recursos hídricos e sua governança, em detrimento das suas múltiplas ontologias, foi o ponto de partida deste artigo. A partir das reflexões realizadas pela Ecologia Política e o conceito de ciclo hidrossocial – que surge em contraposição à naturalização do ciclo hidrológico – acerca das múltiplas relações socionaturais que constituem a água, é proposta uma estrutura de análise que visa possibilitar a apreensão do ciclo hidrossocial no tempo e espaço, ou seja, a sua aplicação nos estudos de caso. A reflexão de uma natureza híbrida da água, que contemplam as interações entre agências humanas e não-humanas, provoca um olhar

crítico em relação ao reducionismo moderno sobre a água, atentando-nos à necessidade de incluir outras práticas e epistemes, que possibilite uma perspectiva plural sobre a questão.

Palavras-chave: água; ciclo hidrossocial; ecologia política; híbridos; produção da água.

1. Introduction

As a rule, studies on water resources and their governance consider water in its discrete form, H2O, based on a technicist and reductionist vision fostered by modernity (Hamlin, 2000). That view concentrates on water's materiality in its biophysical condition. Starting in the 20th century, economic development plans led to the encroachment of State control over water management and water began to be defined as a resource and a mobilizer of development processes. More recently, with the ascension of neoliberal practices, the use and distribution of water resources have become the objects of market investments based on privatizations and concessions of sanitation services, hydroelectricity production, commodities markets and others (Tsutsui & Empinotti, 2021).

However, there is also a less cited political component associated to water management and access to water. Within the scope of Political Ecology, this article questions the restricted vision of water as an input and a mere material object. By means of a relational-dialectical approach such as the hydrosocial cycle, that embraces water as a hybrid product in a socio-natural process (Linton & Budds, 2014), this study develops an analytical structure that enables the apprehension of water production in time and space, in its interactions, in its multiple, material, discursive, administrative and managerial dimensions and those of its associated practices; that is, it enables the application of the hydrosocial cycle concept to case studies. To that end the study conducted a bibliographic review of the hydrosocial cycle literature and that of theories concerning the production of socionature and hybrids.

The description of the proposed analytical structure and its components unfolds in the course of the article and includes the structuring questions that each case study may endeavor to address. Based on the critique of a single concept of water, the proposed structure is not rigid because it is fundamentally important to underscore the particularities of each of the waters in the case studies. Thus, towards the end, the article takes up, once more, its provocation regarding the restricted vision of water associated to modern objectivity to think in terms of a next step, a plural comprehension capable of encompassing other water-related epistemes and practices.

2. Water and its multiple dimensions: water as a hybrid

Towards the end of the 19th century, associated to scientific progress and based on mathematics and chemistry, a specific determination of what water was began to emerge (Gregory, 2001). In the 20th century, in the light of the extant reductionist and scientific comprehension, water also came to be understood as a natural resource and its administration and management to be the responsibility of the State. That conjuncture was what Linton (2010) referred to as 'modern water'.

In his critique of the 'modern', dualist vision, Latour (1993), declared that "we have never been modern" and sought to demonstrate how objects and things have failed to remain in the polarized categories of 'nature' and 'society', insofar as they are constantly crossing over, interacting and forming hybrid elements. Latour (2004) considers that, against a background of complex expansion of the relations between science and society, the environmental crisis is actually a crisis of objectivity as environmental issues can no longer be addressed or comprehended by isolating humans and nature from one another.

From the perspective of Political Ecology, an interdisciplinary research agenda that seeks to overcome the society-nature binarism, the present research begins by breaking away from that modern dualism and understanding that things are of a hybrid nature and are syntheses of the socio-natural metabolism, for, as Swyngedouw (1999) puts it:

> (...) the "world" is a process of perpetual metabolism in which social and natural processes combine in a historical-geographical production process of socio-nature, whose outcome (historical nature) embodies chemical, physical, social, economic, political, and cultural processes in highly contradictory but inseparable manners (Swyngedouw, 1999, p. 447).

That metabolic process in which the natural and the social combine, is known as hybridization and from it stems what Latour (1993) characterized as the 'quasi-object'. Figure 1 illustrates that process in which a series of components that constitute the multiple dialectical relations interact with one another and are always implicated in the constitution of the thing and never apart from its creation process. It is a process in which nothing is fixed or, if it is, the fixedness is only momentary and nothing can be captured in its totality as the flows are constantly destroying, creating, combining and separating themselves (Swyngedouw, 1999).

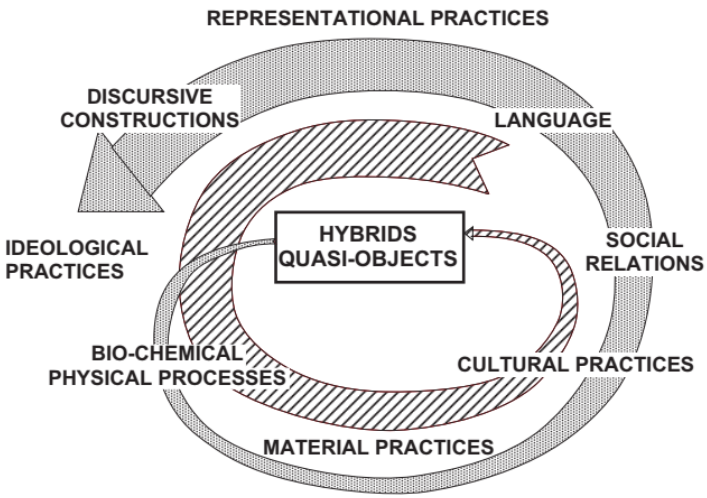

FIGURE 1 – Hybridization: the production of socionature.
SOURCE: SWYNGEDOUW, 1999.

Swyngedouw (1999) underscores the non-neutrality of socionatural relations and calls attention to the political aspect of the flows and processes. In that sense, PE is based on a fundamental presupposition, namely that the environment is not something given, it is the result of transformations based on relations that mold the different forms of interaction between the human being and nature and influence the access to, maintenance and control of common assets (Bryant, 1998).

Acknowledging the extant variety of approaches regarding water Bichsel (2016), set out to synthesize the different ways in which certain authors[1] address the relations among water, infrastructure and the political rules based on their theoretical perspectives and research agendas. In her view, what distinguishes the PE approach is that it enables an analysis of the interaction between those elements and the political inequalities that permeate the relations between society and water. From the PE perspective, the relations among the materiality of water, infrastructure and political rules are established by the hydrosocial approach.

Furthermore, Latin American political ecologists have been attentive to the importance of an epistemological and ontological approach to the question. Theirs is a critical view of the reproduction of a certain rationality when, for example, water is nominated as a 'natural resource' or a 'hydrological resource', because doing so "incarnates a profound anthropocentrism and is centered on the functionalist idea whereby nature is conceived as a resource at the disposal of capital" (Roca-Servat, 2020, p. 30). Latin American PE adds to that its own reflections based on its historical-geographic context of intense exploration and violent appropriation of nature ever since the colonial period right through to the present day (Alimonda, 2011). It brings to light the protagonist role of the experiences of insurgency based on the recognition of different ways of being in the world, of the multiple forms of relations with nature, of the resistance and re-existence struggles of the original peoples, traditional communities, and the minorities and marginalized populations.

Having recognized the plurality and multiplicity of understandings of water and to avoid reproducing readings of the single/universal type, we chose to deepen the discussion based on those concepts of hybrids and hydrosocial relations that can offer paths to be explored in the recognition of the multiple ways of understanding water.

Such an understanding of water's hybrid and multiple nature demands an approach that enables the comprehension of the power relations among the different agents involved in its cycle. Going beyond the usual 'water cycle', as they do, political ecologists adopt the concept of the hydrosocial cycle. That 'socio-natural' hybridism is the basis for the relational-dialectical approach when addressing the hydrosocial cycle. The concept emerged in response to the naturalization of the hydrological cycle, which according to Horton (1931 apud Linton & Budds, 2014), considers the water cycle to be a natural circulation entirely independent of human involvement.

[1] The authors refered to are those who published material in the journal Water Alternatives, v. 9, n. 2, in the year 2016. Bichsel (2016) makes comparisons of the different perspectives, specifically of those authors who participated in that edition.

The relational-dialectic approach seeks to transcend the dualistic categories of water and society and show that the two are in a socio-natural process of mutual transformation in time and space. Thus water is seen as a product undergoing a continuous process of reconfigurations between it and social relations. Being of a hybrid nature, water transforms and is transformed by its cycle (Linton & Budds, 2014).

Linton & Budds (2014) demonstrate the functioning of the hydrosocial cycle (Figure 2) in which water, at the center, is the product of those various interactions between the element water (H2O), technology / infrastructure and social power / structure.

The materiality of water represented by the element H2O, refers to water's role not only as a material in flow but also as an agent of social change and changes in the organizations. The hydrological environment's socio-physical constructions, historically produced in accordance with the social content in an association with the physical-environmental conditions, water governance and its water bureaucracies are all important agents in the hydrosocial cycle power structure. That is because those institutional arrangements determine the scale of actions and the administrative approach among other constituent aspects of water production. Apart from the water bureaucracies, other important agents involved in the social power/ structure in the hydrosocial cycle. Examples include the basin committees, civil society organizations, social movements, water users and other social actors and arrangements that participate and articulate within each cycle.

> The hydrosocial cycle offers a critical approach that prompts us to consider how water internalizes and reflects social and power relations that might otherwise remain invisible. This, in practice, implies that we need to think differently about water, attend to the social circumstances of water circulation, and ask questions about how water, social structures, power relations, and technologies are internally related (Linton & Budds, 2014, p. 178).

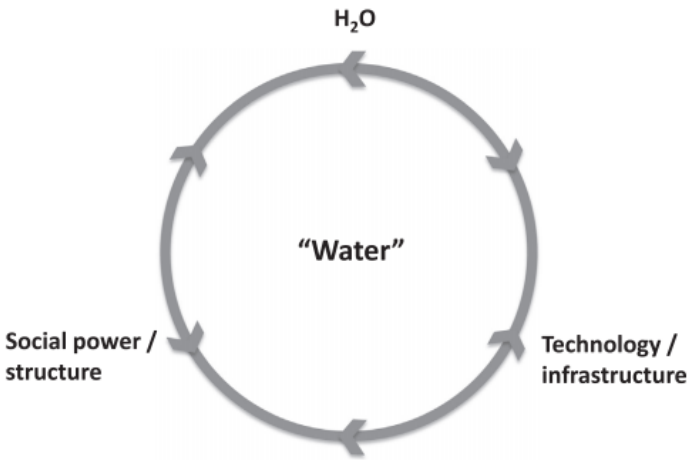

FIGURE 2 – The hydrosocial cycle.
SOURCE: Linton & Budds, 2014.

As water production depends on the social relations in each context, so that water, at the center of the hydrosocial cycle, is just an instant, modifying itself according to the alterations in relations in the cycle. Instead of addressing it as if it were something homogeneous, the hydrosocial cycle orientates the "analysis towards the hybrid nature of different waters by attending to water's different states, forms and qualities, which make it act and give it meaning in distinct ways" (Linton & Budds, 2014, p. 177).

As it is a very recent concept the studies with a hydrosocial approach are still being constructed (Moreno, 2017) and lack methodological bases that would enable them to capture the hydrosocial cycles (Imbelloni & Felippe, 2017). Moreno (2017) indicates the possibility of adopting a hydrosocial approach in studies related to the great impacts of infrastructure such as hydroelectric plants and the occupations of mining industries. According to that author, a hydrosocial approach can unveil the socioenvironmental conflicts and power relations involved in access to and maintenance of the natural resource especially when those processes are subjected to more profound multi-scale analyses.

In a review of the hydrosocial cycle literature, Schmidt (2014) identified the central critique of the discussions as being the modern dualism between society and nature and showed how that concept had affected the understanding of what water is and how it fits into society. The author cites two issues that need to be brought into the discussion of the hydrosocial approach, namely, the critical recognition of how the water agencies have been influenced by the North American tradition of water resource management and, once the arguments on which the claims of the hydrosocial cycle are based have been evaluated, then the historically neglected notions of non-human agency must be addressed.

In that sense this article seeks to further the discussion by means of a hydrosocial cycle-based analytical structure that can be used in case studies. The proposed structure is based on a fundamental observation that the totality of socionatural relations is not give by the sum of nature and society. In search of a broader understanding that would make it possible to include the hybrid elements, neither totally natural nor totally social, that author proposes a collective notion founded on two categories, namely, the human and the non-human.

3. A hydrosocial cycle analytical structure: between the human and the non-human

Every day there are new warnings of a catastrophic ecological crisis. Latour (2004) considers that the said crisis has its origins in another crisis, that of objectivity. According to him, modern objectivity supported itself on the disassociation of human being/culture from nature and, historically, society has dealt with nature in an objective manner in order to overcome it and intending to be independent of it. Thus "that ontology of the human as a special being (that is, modern in the official version of the word) produced a human separate from the world (that is, from nature in its disenchanted version)" (Marras, 2018, p. 255).

Given the discussions that have emerged from that crisis condition, different approaches have endeavored to obtain a possible interpretation of the issue. This article has opted for an in between appro-

ach, that is, one that prioritizes the in between over the being. It is an associative approach that makes it feasible to establish bridges between disciplines and knowledges; one in which the frontiers are actually spaces for dialogue but also for contradiction, forming, in the diversity, coalitions to face the extant crisis of modern objectivity.

Latour (2004) holds that the crisis lies in the insertion of disorderly objects, that is hybrid objects, into the set of 'risk-free objects' or 'clean objects' with which we have been habituated up till now. Nowadays those objects have already revealed themselves to be subjects and too intrusive for us to carry on treating them as mere resources. Thus, taking them into consideration means generalizing the notion of exchange with a view to giving other practices a chance. It is a question of "paying attention to the vital and participative continuum of that reality which, indeed, can only be conceived as a hybrid if we presuppose that those ontologies are distinguishable from one another" (Marras, 2018, p. 261).

In a bid to grasp the hybrid elements, Latour (2004) calls on the collective to participate in the associative categories of the humans and the non-humans. In that author's view, the non-human is not characterized by the function of a passive object for it too is a performer, an agent and one that also acts and interferes in reality; neither is it characterized by the anthropocentric notion of 'subject'. Breaking off from the dichotomy between subject and object makes it possible to aggregate the other without demanding its disappearance of the other and do so in the light of an associative understanding that seeks to get beyond such binaries for "while objects and subjects can never associate, humans and non-humans can" (Latour, 2004, p. 143).

That associative comprehension suggests that it is not possible to 'purify' the alliances between human and non-human; in other words, there is no intermittent condition between what is essentially human (subjective) and on the other hand what is essentially non-human (objective) as they are indissociable.

Thinking in terms of associative, not necessarily oppositive models means thinking in the gaps among things, the in between space, transit spaces, and not merely among human spirits but also between those and all the other spirits of the world, encompassing plants, animals, land, water and all sorts of non-humans (Marras, 2018).

Basing ourselves on the understanding that the human and the non-human can, and do associate makes it possible to grasp the hybrid things in the analysis. In the hydrosocial cycle, water figures as a hybrid element, an instant in the process of metabolizing and producing socio-nature (Swyngedouw, 1999. Water is characterized by the relations and associations among various human and non-human elements among which are H2O, social power/structure and technology/infrastructure (Linton & Budds, 2014).

Thus we use 'human' and 'non-human' as relational categories of the elements involved in the coproduction of water. The construction of the diagram below (Figure 3) was based on the conjuncture of the associative approach to the collective and the reflections on the hydrosocial cycle.

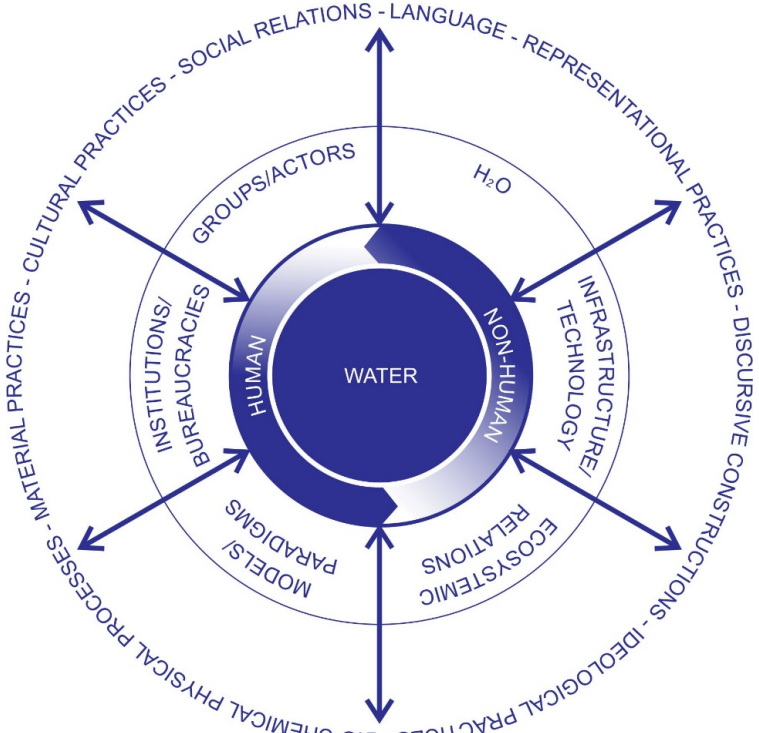

FIGURE 3 – A hydrosocial cycle analytical structure.
SOURCE: Elaborated by the authors.

The above scheme represents water in its aspect as the agent and product of human and non-human relations which will characterize it in the hydrosocial cycle. Based on those human elements (models/paradigms, institutions/bureaucracies, and groups/actors) and non-human elements (H2O, technology/infrastructure and ecosystemic relations) the system endeavors to direct the focus of analysis to the capturing, characterization and differentiation of the hydrosocial cycles in the course of the interactions among and constitution of those elements.

In addition, in the outermost part of the diagram, the processes and practices that permeate the relations and the constitution of the agencies in the cycle are represented, namely, the discursive constructions, representational practices, language, social practices, cultural practices, material practices, physical biochemical processes and ideological practices. Those components originate from the proposal concerning the production of socionature put forward by Swyngedouw (1999) and represent the multiple dialectical relations involved in the constitution of the hybrids.

On comparing the proposed scheme with the hydrosocial cycle that Linton & Budds (2014) elaborated, it can be seen that some elements have been repeated just the way those authors presented them (H2O; technology/ infrastructure), and some

have been derived from their 'social power/structure' component (planning models and hydraulic paradigms; institutional apparats and bureaucracies, groups and social actors) and one element not foreseen in the hydrosocial cycle has been added (ecosystemic relations).

The breaking down of the 'social power/structure' component into three agencies (planning models and hydraulic paradigms; institutional apparats and hydraulic bureaucracies; social actors and groups) was based on the ascertainments of Molle *et al.* (2009) and Schmidt (2014) of how hydraulic mission paradigms had disseminated worldwide in the course of the 20th century, especially starting from the case of the Tennessee Vally Authority (TVA), and influencing the water administration plans of various countries, regional development and the creation of various institutional apparats. Thus, the proposal to analyze the agencies that represent the paradigms and the hydraulic bureaucracies is an endeavor to underscore the role of the State in the performance of water production based on its planning, implantation and administration of hydrological models. Similarly, proposing the element 'groups and social actors' was designed to bring to light the various heterogenous groups that represent multiple interests which perform and/or demand their participation in the course of the cycle's transformations.

The hydrosocial cycle, as Linton & Budds (2014) proposed it, did not consider ecosystemic relations. The support for proposing that category was based on the reflections of Schmidt (2004) regarding the need for greater investigation of the non-human agencies and also on the provocation that Zimmerer & Bassett (2003) made when they alleged that many researchers were simply treating the biophysical environment as if it were a stage or arena in which the struggles for access to and control over common assets took place.

We will now describe in detail the different agencies that must be analyzed in the case study. That will include what they are, their relations with the hydrosocial cycle and the paths that can be followed during the research. The objective of totalizing analyses and interactions of those agencies being to capture the hydrosocial cycles in time and space.

3.1. Planning models and hydrological paradigms

The advance of modernity since the 19th century brought with it the need to think of new development models based on technological apparats and human beings' domination of nature. In that context, the 'hydraulic mission' emerged as an exaltation of modernity seeking to increase the productivity of food and energy by means of mechanization, intensification and economies of scale (Molle *et al.*, 2009).

Furthermore, the hydraulic mission has played a fundamental role in its aspect as a geopolitical action, influencing States with its icons and paradigms during the Cold War and diffusing itself around the world in the course of the 20th century (Molle *et al.*, 2009).

Duly acknowledging the strong influence that the North American tradition has had on water administration, especially the Tennessee Valley Authority (TVA) model, the case study analysis must seek an understanding as to how the technical/scientific exchange and the influences of it and/or

other hydraulic paradigms in the course of time materialized or failed to materialize from the water agencies and bureaucracies that the State created.

In addition to the influence of hydraulic techniques of the private sector and of institutional interests, Molle *et al.* (2009) point out that the orientation of the hydraulic mission is established under the strong influence of government policy and those influences associate the hydraulic mission with the structural role of reproducing the extant political system. It is therefor important to analyze the political-economic context in which those hydraulic paradigms are adopted.

In Brazil, for example, at first regional planning adhered to the ideas stemming from the hydraulic mission, above all, the TVA model. In the course of time, with the absorption of new references, different institutional apparats emerged from the hydraulic bureaucracies. In that regard the hydraulic paradigms play a fundamental role in understanding the transformations of the hydrosocial cycle as the respective models have influenced water projects in Brazil and even the emergence of new bureaucracies that constitute the institutional structures of State power in making the plans viable.

3.2. Institutional apparats and hydraulic bureaucracies

Ever since Wittfogel (1957) proposed his theses relating large-scale irrigation in countries like China, Japan, India and Egypt to the emergence of hydraulic bureaucracies associated to centralizing and authoritarian states, there have many debates and critiques endeavoring to comprehend and question that correlation between control over water and control over human beings.

Molle *et al.* (2009) consider that the hydraulic bureaucracies emerged to address issues such as floods, hydroelectricity generation and public large-scale irrigation which, according to those authors consist of appropriating every drop of water for human benefit.

The hydraulic bureaucracies have developed alongside technological progress in the course of modernity and from the 1930s on, based on the example of the TVA, they have aligned themselves with the economic development model. That took place in a double movement that integrated multiple intents, sustained by economic development and water management on a river basin scale (Molle *et al.*, 2009).

In the first half of the 20th century most of the peripheral countries had recently become independent and in that context, the hydraulic bureaucracies, supported by the developmentalist discourse had an important influence on National States' local elites and the legitimization of their power over the territories (Molle *et al.*, 2009). With the advent of the Fordist crisis and the intensification of neoliberalism in the 1980s, state funding for hydraulic bureaucracies became increasingly restricted, leading to series of reforms in the latter. Furthermore, in the Brazilian context, decentralization of water administration also affected the scale of those bureaucracies' performance. While up until the end of the 1970s they were nationally integrated, from 1980s on, the local scale became decisive in decision making.

Water governance and its bureaucracies are important agents in the power structure of the hy-

drosocial cycle as their institutional arrangements are what determine whether the scale of activities will be local, regional, national or global. They also determine whether the approach in water management will be integrated or sector-based, among other essential aspects that characterize water production.

When determining which hydraulic bureaucracies to analyze in a given case study, it is necessary to understand the three temporal intervals involved in the process, namely those of planning, execution and administration. Those moments are not necessarily in the hands of the same bureaucratic agents. Once bureaucracies that are relevant for the analysis in hand have been defined then it is necessary to understand their multi-scalar interactions, in addition to analyzing the political-economic context, as that conjuncture is fundamentally important in enabling an understanding of the intentions and discourses and in identifying which interest groups are favored by certain decisions.

3.3. Groups and social actors

In the economic development model, the hydraulic bureaucracies have played a fundamental role in the way State actions affect people's daily lives (Swyngedouw, 2007). Thus, with the advance of the regulatory process, of industrialization and of urbanization different groups have been affected by the implantation of water infrastructure apart from the regulation of access to water and its use.

This paper understands the production of water to include, simultaneously, the material, the discourse and the symbolic aspects (Swyngedouw, 2004). Water is therefore subject to multiple interests and significations associated to each individual or social group. These last are heterogenous and have the most varied objectives, making it necessary to identify which groups are participant and which are marginalized and to understand their material and/or symbolic divergences in the water production process.

A research effort that proposes to analyze hydrosocial cycles in time and space must locate the participant or marginalized groups in the territory and involved in the course of the hydrosocial cycle. Then, based on their strategies for access to water or decision making, examine whether or not there was any articulation and which discourses were predominant in legitimizing those strategies. In addition, if the research involves fieldwork[2], it will need to understand the symbolic meanings of water in the different visions in order to identify water's multiple ontologies.

3.4. Infrastructure/ technology

Ever since the work of Wittfogel (1957), it has been understood that the implantation of infrastructure reconfigures not only the space but also social and political relations. Political Ecology and especially Urban Political Ecology has addressed the issue based on the infrastructure provision policies in contraposition to a merely technical approach in which infrastructure is interpreted as a mere backdrop and either neutral or unquestionable (Loftus *et al.*, 2016).

[2] Research efforts whose objective is to go into greater depth with this part of the analysis can find theoretical and methodological pathways in the discussion on the ethnography of environmental conflicts that Little (2006) carried out.

EP conceives infrastructure as being not merely a technical product, a material/physical element in itself, but as one that is socially produced in a given time/space and established in a context that combines technical artifacts, regulatory aspects, cultural norms, environmental flows, funding mechanisms, and forms of government, among other factors (Obertreis et al, 2016).

By means of the water bureaucracies and in its aspect as a socio-technical-natural product, water materializes from a set of cultural, political and economic relations (Gandy, 2002) under the strong influence of the performances of the State and other groups with power of decision. Infrastructure, in its aspect as a non-human performer molds and is molded by the hydrosocial relations introducing new characterizations and relations in the territory. Thus, the case analysis must identify which infrastructure has been implanted (including secondary infrastructure stemming from it) and must examine how those elements have (re)configured the territorial dynamics and the local and regional morphology in addition to the ecosystemic relations.

3.5. Ecosystemic relations

In its aspect as a field of analysis of the relations between nature and society, that also and a field that seeks to overcome that dichotomy, EP positions itself with an in between approach, that is one that recognizes the articulations between the beings and the medium. Thinking in terms of those interactions does not mean situating ourselves in the medium that surrounds us but, instead, in a medium that traverses and constitutes us and vice versa. Thus, interpreting ecosystemic relations means understanding the symbiosis between the human and the non-human whereby the human acts and modifies the dynamics and, in the same way, so do the various non-human actors.

> (...) that is what biologist Lynn Margulis's symbiotic evolution theory makes it possible to extrapolate in the 'Gaia hypothesis'. Margulis showed the continuity, interdependence or coevolution among the terrestrial biota, the atmospheric composition, the Earth's surface and the oceans. That is, any one of those terms, as we know them today, cannot be explained other than by exchanges, among the most distinct scales that have always constituted them. In other words, no atmosphere out there, from its formation to its maintenance and its ways of varying, without considering the geo-physiological symbiotic force between minerals and bacteria. No life without the non life, no organic without the inorganic. From micro to macro and vice versa, no sky that is not understood in co-respondence with microbes (Marras, 2018, p. 260).

Biophysical forces have their own dynamics which constantly interfere in ecological relations (Little, 2006). Those non-human agencies represent a multiplicity of performers and interactions. In its general aspect, Political Ecology research

> must map the main biophysical forces such as the geological conformation of a region, the biological evolution of the fauna and flora, together with the main human activities such as agricultural systems, industrial effluents discharged into the environment, transport and communication infrastructure installed in the region. In addition to paying attention to both sides of that causality, the researcher must seek to identify the socioenvironmental realities that emerge from the interactions between the biophysical and the social worlds which only an exclusively ecological approach is prepared to discern (Little, 2006, p. 90).

To map the biophysical forces in action in a case study it is necessary, first, to evaluate the question of scale. In Political Ecology, thinking about scale means considering two kinds: the socially produced scale and the ecologically produced one (Zimmerer & Basset, 2003). While, on the one hand, human agencies define a given scale of action (local, regional, national or global), on the other, the non-human agencies in the ecosystemic relations articulate on more distinct scales that take into consideration organism, population, habitat, biome, continent, etc., (Little, 2006).

Zimmerer & Bassett (2003) point out that the challenge facing the political ecologists is to integrate the socially produced scales with those produced by means of ecological and biophysical processes, in which the complexity of the 'trans--level' relations, between humans and non humans, can interrelate without concealing the irregularities (Little, 2006).

Thus identifying the biophysical forces and their agencies that affect and/or are affected by water production in the hydrosocial cycle is important work and represents a great challenge given that ecologists and biologists hardly understand the ecological scales (Zimmerer & Bassett, 2003). Obtaining a more profound understanding of ecosystemic relations in the hydrosocial cycle requires an understanding of the biophysical that goes beyond an anthropocentric vision in which the medium is the stage for social relations; it requires an intensification of the exchanges of knowledge with the disciplines of ecology, biology and other natural sciences.

In the case of the hydrosocial cycle, it is fundamental to understand what the main environmental changes have been in the course of time, how those changes interact with the non-human agencies identified in the ecosystemic relations, and the impacts on the water flow and the water's material conditions.

3.6. Materiality of water (H2O)

In the hydrosocial cycle, H_2O, represents the "idea of the agential role of water in the hydrosocial relations" (Linton & Budds, 2014, p. 176), that is, the materiality of water. In that regard

> water's materiality (H2O) intervenes in the process, perchance stabilizing, perchance disrupting society (social power/structure), which gives rise to forces that intervene in the process by altering or manipulating the quantity/quality of flows in the hydrologic cycle (infrastructure/technology), and which in turn intervenes in the process by affecting the materiality of water (H2O), and so on (Linton & Budds, 2014, p. 176).

The materiality of water (H_2O) imposes on the other elements certain qualitative and quantitative configurations on the other elements, namely, source (underground water, glacier melting, etc.), quality (somewhat salty, rich in organic sediments, polluted, etc.) generating responses and actions on the part of those involved in the hydrosocial cycle. In the same way, the actors affected by the conditions established by the water (H_2O) mobilize and act on its materiality, reconfiguring its flow through technology and infrastructure designed to achieve a certain objective, for example.

Thus the case study analysis must focus on identifying the changes in water use and water materiality over time and how water (H_2O) conditioned and was conditioned by the interactions with all the other elements of the hydrosocial cycle.

3.7. Structuring questions

If we start from the need to focus on the processes in order to understand the meanings and the forms of water production then it must be admitted that the proposed structure has its limitations. It is in fact an orientation and being aligned with an in between approach, it needs to be clearly stated that each process is unique and presents elements and associations that are intrinsic to the particular historical and geographic condition so that it is up to each case study to identify the groups in action and their relations. In that sense of orientation, we have set out in the table below (Table 1) some of the questions that each research study might choose to respond to according to its peculiarities.

TABLE 1 – Structuring questions for each analysis component.

Analysis elements	**Structuring questions**
Planning models and hydraulic paradigms	• Which paradigms influenced the hydraulic bureaucracies? • How did those paradigms influence the adopted technology/infrastructure? • Was there any kind of technical/scientific exchange? • In what political-economic context were those hydraulic paradigms adopted?
Institutional apparats and hydraulic bureaucracies	• Which bureaucracies have been/are active in the region? • What were the determinant plans and projects? • What were the objectives and scales of action of those plans? • How were the water plans and projects elaborated and executed? • How did the interactions among the different hydraulic bureaucracies take place on the local, regional, national, global or other scales?
Groups and social actors	• How did the relations between the workers responsible for the construction of the infrastructure and the territory occur? • Which groups were involved or affected? • What are their agendas? • What are the strategies for access to water and/or decision making? • What were the predominant discourses sustaining those strategies? • Was there any articulation? • Where are they located? • What does water symbolize to those groups/actors?
Infrastructure	• What infrastructure has been implanted? • Which were the predominant discourses justifying the implantation? • How did that infrastructure impact territorial dynamics and the local/regional morphology?
Ecosystemic relations	• What have the main environmental impacts and changes in the course of time been? • Which groups of non-humans can be identified as affected by the territorial alterations? • How did the identified agents interact in the course of hydrosocial process?
H_2O	• Which conditioners did water determine in the territory? • What have the materialities of the water and its uses been in the course of time? • Was their any relation between the changes in water use and the access or non access to water?

SOURCE: Elaborated by the authors.

Based on the questions chart and the elements of analysis this paper has sought to construct the parameters of guidelines for the application of the hydrosocial cycle to case studies. The main objective of the elements being addressed here, in regard to the analysis, is that, as a set, they should be capable of identifying the (human and non-human) performing agents and demonstrate how their interactions were determinant for the production of water at a given time in a given space.

4. Final considerations

The objective of proposing an analytical structure that seeks to capture something that encompasses both elements and phenomena is not to exhaust the questions in a pretentious attempt to grasp the totality. The in between approach seeks to focus on the flows and processes. After all, there is no reason to attempt to exhaust the question given that we are constantly identifying and creating tools capable of capturing those highly interconnected relations of coproduction among the beings.

The analytical structure was developed based on the theories of Latour (1993, 2004) and the reflections on the hydrosocial cycle, were based mainly on Swyngedouw (1999), and Linton & Budds (2014). Despite the poststructuralist epistemological references in the construction of the hydrosocial approach, the Political Ecology of water continues to be strongly influenced by Marxist theories focused on conflicts (Rattu & Verón, 2016). While acknowledging the importance of Marxist theories in the reflections of Political Ecology, due attention is given to the importance of more in-depth use of the post-structuralist method in the studies on water as contemplated in the proposition put forward by Swyngedouw (1999), which foresees: comprehending the influence of discursive constructions, representational practices and language in the production of water, and their significances.

It is worth underscoring the contributions to knowledge production stemming from the global south and the need to increasingly radicalize the north-south exchanges. In the case of water-related research, Latin American political ecologists have been developing various fronts that have enabled progress with the methods based on a hydrosocial approach. One example of that is the application of the hydrosocial territories concept in the analyses of various South American contexts (Empinotti *et al.*, 2021b).

In regard to the interdisciplinary exchanges, analyzing the hydrosocial cycle in association with a territorial approach in a case study makes it possible to establish proficuous dialogues among the different fields of knowledge insofar as it ensures an enhanced understanding of water and of how its relations materialize in the territory and influence its dynamics. To the same extent, bringing the hydrosocial cycle into territory studies makes it possible to show water's importance as a protagonist and not merely as an input for economic development.

When it challenges the modern concept of a single ontology for water (H2O) (Schmidt, 2014), this paper does not intend to generate any kind of scientific relativism on the question. We understand however that it is necessary to question single discourses in a bid to foster pluralism in the sciences. Reevaluating water, in both chemical and social conditions, thus departing from a unique modern ontology (H2O), does not mean negating that ontology, far less relativizing it. Water is (H2O), as well.

In proposing the hydrosocial cycle as an analytical structure, this article has sought to represent water as a process and acknowledge its multiple ontologies. The ecological crisis that Latour (2003) qualified as a crisis of objectivity stems from a perception of modernity that superimposes on affects and imposes a single knowledge perspective. Recognizing the multiple ontologies that constitute water situates it closer to its broader meaning for "the more affects we allow to speak about one thing, the more eyes, different eyes we can use to observe one thing, the more complete will our 'concept' of this thing, our 'objectivity' be" (Nietzsche, 1998, p. 109).

References

Alimonda, H. La colonialidad de la naturaleza: una aproximación a la ecología política latinoamericana. In: Alimonda, H. (Coord.). *La naturaleza colonizada*: ecología política y minería en América Latina. Buenos Aires: CLACSO, p. 21-60, 2011.

Bichsel, C. Water and the (infra-)structure of political rule: a synthesis. *Water Alternatives*, 9(2), 356-372, 2016. Disponível em: https://www.water-alternatives.org/index.php/alldoc/articles/vol9/v9issue2/320-a9-2-10/file

Bryant, R. Power, knowledge and political ecology in the third world: a review. *Progress in Physical Geography*, 22(1), 79-94, 1998. doi: 10.1177/030913339802200104

Cunha, L. Da "tragédia dos comuns" à ecologia política: perspectivas analíticas para o manejo comunitário dos recursos naturais. *Raízes: Revista de Ciências Sociais e Econômicas*, 23(1-2), 10-26, 2004. doi: 10.37370/raizes.2004.v23.229

Empinotti, V. L.; Iamamoto, S. A. S.; Lamas, I.; Milanez, F. Entre crises e insurgências: a ecologia política em defesa da vida em comum. *Ambiente e Sociedade*, 24, 1-18, 2021a. doi: 10.1590/1809-4422asoc20210160vu2021L5ID

Empinotti, V. L.; Tadeu, N. D.; Fragkou, M. C.; Sinisgalli, P. A. de A. Desafios de governança da água: conceito de territórios hidrossociais e arranjos institucionais. *Estudos Avançados*, 35 (102), 2021b. doi: 10.1590/s0103-4014.2021.35102.011

Gandy, M. *Concrete and clay*: reworking nature in New York City. Cambridge, Massachusetts and London: MIT Press, 2002.

Gregory, D. (Post) colonialism and the production of nature. *In*: Castree, N.; Braun, B. (Orgs.). *Social nature*: theory, practice and politics. Malden, MA: Blackwell, p. 84-111, 2001.

Hamlin, C. 'Waters' or 'water'? Master narratives in water history and their implications for contemporary water policy. *Water Policy*, 2(4-5), 313-325, 2000. doi: 10.1016/S1366-7017(00)00012-X

Imbelloni, A.; Felippe, M. Compreendendo o ciclo hidrossocial em comunidades quilombolas: possibilidades metodológicas para o estudo. *In*: *Anais do Simpósio Internacional de Geografia Agrária e IX Simpósio Nacional de Geografia Agrária*. Curitiba, 5 de nov., 2017.

Latour, B. *We never been modern*. London: Harvester Wheatsheaf, 1993.

Latour, B. *Políticas da natureza*: como fazer ciência na democracia. Bauru: EDUSC, 2004.

Linton, J. *What is water?* The history of a modern abstraction. Vancouver, BC, Canadá: University of British Columbia Press, 2010.

Linton, J.; Budds, J. The hydrosocial cycle: defining and mobilizing a relational-dialectical approach to water. *Geoforum*, 57, 170-180, 2014. doi: 10.1016/j.geoforum.2013.10.008

Little, P. Ecologia política como etnografia: um guia teórico e metodológico. *Horizontes Antropológicos*, 12(25), 85-103, 2006. doi: 10.1590/S0104-71832006000100005

Loftus, A.; March, H.; Nash, F. Water infrastructure and the making of financial subjects in the South East of England. *Water Alternatives*, 9(2), 319-335, 2016. Disponível em: https://www.water-alternatives.org/index.php/alldoc/articles/vol9/v9issue2/318-a9-2-8/file

Marras, S. Por uma antropologia do entre: reflexões sobre um novo e urgente descentramento do humano. *Revista do Instituto de Estudos Brasileiros*, 69, 250-266, 2018. doi: 10.11606/issn.2316-901X.v0i69p250-266

Molle, F.; Mollinga, P.; Wester, P. Hydraulic bureaucracies and the hydraulic mission: Flows of water, flows of power. *Water Alternatives*, 2(3), 328-349, 2009. Disponível em: https://www.water-alternatives.org/index.php/allabs/65-a2-3-3/file

Moreno, A. S. Exploración de las contribuciones del enfoque "hidro-social" a los estudos estudios de caso sobre água. *Waterlat-Gobacit Network WorkingPapers*, 4(3), 15-26, 2017. doi: 10.5072/zenodo.167124

Nietzsche, F. *Genealogia da moral*: uma polêmica. São Paulo: Companhia das Letras, 1998.

Obertreis, J.; Moss, T.; Mollinga, P.; Bichsel, C. Water, infrastructure and political rule: introduction to the special issue. *Water Alternatives*, 9(2), 168-181, 2016. Disponível em: https://www.water-alternatives.org/index.php/alldoc/articles/vol9/v9issue2/311-a9-2-1/file

Rattu, P.; Verón, R. Towards a foucauldian urban political ecology of water: rethinking the hydro-social cy-cle and scholars' critical engagement. *Foucault Studies*, 21, 138-158, 2016. doi: 10.22439/fs.v0i0.5021

Roca-Servat, D. Los comunes desde las ecologia(s) política(s) del Sur/Abya-Yala: visibilizando alternativas al desarrollo extractivista em la región. *In*: Roca-Servat, D.; Perdomo-Sánchez, J. (Orgs.). *La lucha por los comunes y las alternativas al desarrollo frente al extractivismo*: miradas desde las ecologia(s) política(s) latino-americanas. Buenos Aires: CLACSO, p. 27-37, 2020.

Schmidt, J. Historicising the hydrosocial cycle. *Water Alternatives*, 7(1), 220-234, 2014. Disponível em: https://www.water-alternatives.org/index.php/volume7/v7issue1/242-a7-1-13/file

Swyngedouw, E. Modernity and hibridity: nature, regeneracionismo, and the production of the Spanish waterscape, 1890-1930. *In*: *Annals of the Association of American Geographers*, 89(3), 443-465, 1999.

Swyngedouw, E. *Social power and the urbanization of water*. Oxford: Oxford University Press, 2004.

Swyngedouw, E. Technonatural revolutions: the scalar politics of franco's hydro-social dream for Spain, 1939-1975. *Transactions of the Institute of British Geographers*, 32(1), 9-28, 2007. doi: 10.1111/j.1475-5661.2007.00233.x

Tsutsui, H. K.; Empinotti, V. L. O papel da água na atuação e reflexão do planejamento regional brasileiro: uma perspectiva histórica. *Revista Política e Planejamento Regional*, 8(1), 121-139, 2021. Disponível em: http://www.revistappr.com.br/artigos/publicados/O-papel-da-%C3%A1gua-na-atua%C3%A7%C3%A3o-e-reflex%C3%A3o-do-planejamento-regional-brasileiro-uma-perspectiva-hist%C3%B3rica.pdf

Wittfogel, K. A. *Oriental despotism*: a comparative study of total power. New Haven, CT: Yale University Press, 1957.

Zimmerer, K.; Bassett, T. *Political ecology*: an integrative approach to geography and environment-development studies. New York: Guilford, 2003.