

Article

Social Innovations as A Response to Dispossession: Community Water Management in View of Socio-Metabolic Rift in Chile

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Abstract: Chile has gone through more than four decades of neoliberalism, inaugurated by the civil–military dictatorship (1973–1990). One of the central aspects of the current model is the neoliberal exploitation of natural commons such as land, water and minerals. In some territories, such as the central-north province of Petorca, the accelerated extractivism of this period has disrupted the reproduction of life cycles, leading to disruptive influences in the form of "socio-metabolic fractures". In this article we highlight aspects of this process as it relates to rural community water management. Based on literature and media analysis we first describe the case of Petorca from a political, ecological point of view. We then use the concept of institutional bricolage (ad hoc construction) to analyze qualitative interviews, allowing us to establish a more in-depth insight into the organizational structures of Petorca. Although we point to the weakening of community organization, we highlight in this article how, in a scenario of profound dispossession, as is taking place in the province of Petorca, ongoing experiences of community organization continue to emerge and challenge the impacts of the socio-metabolic rift. Thereby we shed light upon the often less visible structures of power and the processes of meaning and legitimacy within these social innovations.

Keywords: community water management; socio-metabolic rift; neoliberalism; Chile; social innovations; institutional bricolage

1. Introduction

Chile has experienced more than four decades of neoliberalism, inaugurated by the civil–military dictatorship (1973–1990). Diverse areas of social life (education, health, social welfare, etc.) went through radical processes of privatization, commercialization and/or commodification [1]. A central aspect of the current model is the neoliberalization of natural common goods, such as land, water and minerals. In this case, neoliberalization refers to a particular form of regulatory reorganization of "state-economy relations, to impose, extend or consolidate marketized, commodified forms of social life" [2] (p. 330).

Regarding water management, the political constitution of 1980, which is still in effect, defines private property rights over water in article 19 N° 24.e. This law opens the way for the commodification process of the common good, as it gives individuals the power to sell, buy or lease their water rights without major restrictions. In 1981, a water code was created, which defines the procedures that protect the dominant form of water appropriation [3]. Furthermore, this code regulates the operation of water user organizations managing the different water sources of a basin. According

to this regulation, the management and distribution of water in the basins is the responsibility of organizations formed only by water right owners.

Other important types of water organization, not regulated by this code, are the rural drinking water (RDW) committees and/or cooperatives that are in charge of domestic water provision in the rural area (regulated by the Sanitary Services Law of 1988).

In addition to this legislation on water, an accelerated increase of mining, forestry, agriculture and aquaculture extractive projects began in the 1980s. As of the present, these extractive industries continue to enhance the economic growth of Chile through raw materials exportation [4]. These elements reinforce the current situation where water problems such as scarcity and unequal access and distribution are central to the current territorial conflicts throughout the country [5]. In the view of climate change, a study of the World Resources Institute states that Chile will be facing extremely high (more than 89 %) water stress by 2040 due to rising temperatures and shifting precipitation patterns [6].

On the one hand, Chile's water and sanitation policy has been praised for significantly improving the water and sanitation supply [7–10]. On the other hand, some researchers claim that the current challenges caused by climate change impacts and the resulting increase in water conflicts are either caused or exacerbated by the dysfunctions of the institutional system [3,11,12]. In 2005, a water code reform was made with the aim of enhancing the regulatory function of the state, and to assure higher environmental standards. However, these changes did not profoundly alter the core elements of water regulation, nor did they overcome divergent power structures. Humberto Peña, ex-director of the General Water Directorate (Dirección General de Aguas, DGA) between 1994–2006, first defended the introduction of the reform in 2005 by stating that it would bring about an equilibrium between the social and economic needs and between public and private interests. However, when he evaluated the same reform eight years later, he revised his conclusion and found several flaws in the reform, rendering it incapable of protecting either environmental or social needs [3]. He states: "The emergence of new problems has led to fragmented institutional development in a bid to solve problems sector by sector, creating multiple bodies and mechanisms each with a limited and partial perspective way in which hydrological processes occur." [12].

Proposals for the improvement of Chilean water management focus upon strengthening public and user participation [11,13,14], building trust through transparency and improving adaptive capacity by paying attention to the socioecological framework [11,13,15,16]. Recently, various critical studies on political ecology verified the profound socioecological impacts that the neoliberalization process generated in Chile [17,18]. Considering the consequences of this process, some researchers point out that there are ongoing "socio-metabolic rifts", in which the acceleration of the extraction and production of commodities is provoking a rupture (a "rift") in the cycles enabling life to reproduce in different territories throughout the country [19,20].

One of those territories is the Petorca province in Chile. Here, water privatization and commodification together with the proliferation of fruit export has induced a dramatic scarcity of water for human consumption, which has led to a drastic decrease of the traditional peasant life. Since these groups depend on water to raise animals and plant basic crops for self-sufficiency, they are particularly vulnerable to such developments.

In this context, this article analyzes the impacts of the socio-metabolic rift in the rural areas of the Petorca province. It focuses on the community's water management and the community's strategies that arose while being faced with water scarcity, and how new forms of coping have been developed to deal with the situation. To this end, we will, added by contributions from political ecology and critical institutionalism, take the approach offered by critical political ecology to analyze research projects, reports and news about the Petorca water conflict, as well as interviews collected from the local inhabitants. We have sought to denaturalize the lack of water phenomenon in the province by analyzing the interactions in community water management and biophysical dynamics. Subsequently, we will reflect on the community strategies now emerging in Petorca that seek to maintain the community

ownership of water, and for dealing with the situation of water scarcity. To do so, we will focus on two locally created initiatives designated as Petorquina and Oficina de Asuntos Hídricos (Water Office).

2. Theoretical Background

In this article, we work on the “socio-metabolic rift” concept in order to understand the socioecological impacts that agribusiness expansion has caused within the territory of Petorca, and to reflect on its impacts on community water management. Taking the socio-metabolic rift analysis as a base, we apply critical institutionalism to elaborate the formal and informal processes conditioning the community’s water management. Our aim in using the critical institutionalist approach is to comprehend how power relations operating at a multiscale level influence forms of community water management throughout the province. Our objective is to display and comprehend the formal and informal relations that shape these forms of management and the meanings recreated by the community members.

2.1. Socio-Metabolism of Territories

The origin of the concept of social metabolism comes from Marx. He used this term to recognize the material exchange that human beings establish with nature in order to maintain subsistence. It is the basis on which he builds his conception of labor as “a process between man and nature, a process by which man, through his own actions, mediates, regulates and controls the metabolism between himself and nature” [21] (p. 283). To comprehend this socio-metabolic relationship, Marx places the understanding of the historical formation of these exchanges at the center of his analysis. From his studies on the capitalist transformation of agriculture, the food demands of vertiginous urbanization and the impact on soils degradation, Marx’s position is that this mode of production generates a rift in the metabolic balance existing between society and nature. The term rift refers to a rupture in the reproduction of the cycles that allow the functioning of the “natural laws of life” [21] that compromises the lives of future generations [22].

Several contemporary studies of political economy have incorporated Marx’s concept of social metabolism [22,23]. However, these studies employ a level of abstraction that does not reflect on how the socio-metabolic rift materializes in the territorial dynamics, nor how those who defend a different relationship with nature resist. In Latin America, the concept of the socio-metabolic rift is applied with its own regional particularities. Scholars from this region have highlighted the profound alterations generated by capital accumulation on the productive practices and the socio-community networks of those who inhabit the territories as being the key components of a socio-metabolic rift [24]. Nevertheless, these efforts still fail to highlight the biophysical dimension of this socio-metabolic rift.

A second group of studies being encouraged by the discussions generated over the incorporation of more complex views on socio-ecological processes involved during the production of goods and services, has conceptualized social metabolism from an ecological economics approach. For most of these scholars, social metabolism consists in “the manner in which human societies organize their growing exchanges of energy and materials with the environment” [25] (p. 58). From this definition, research in ecological economics focuses on quantifying flows of energy and materials. As a result, calculations of the metabolic profiles of countries or cities that account for the import and export of energy and matter have been expanded. From here, widely disseminated studies on the ecological footprint, virtual water or human appropriation of net primary production are beginning to emerge.

Considering those studies, Toledo claims that most “offer contemporary diagnoses, and almost without exception are limited to the analysis of energy and matter flows and their correlation with certain economic parameters” [26] (p. 46). He criticizes the concern of the ecological economics approach for influencing economic analysis by undervaluing the incorporation of historical, social and political components in the understanding of social metabolism. For this reason, Toledo claims that a more multilayered comprehension of the intangible aspects of socio-metabolic processes is needed, including “various types of institutions, forms of knowledge, worldviews, rules, norms and

agreements, technological knowledge, modes of communication and government and forms of ownership" [26] (p. 51).

Considering these limitations, we use González et al. [27] and Porto-Gonçalves's [28] contributions to propose an understanding of social metabolism in order to overcome the separation between biophysical and sociopolitical or economic-political emphasis. Following on this, we recognize the analysis of social metabolism as the sociohistorical research into the energy–material flows that configure the reproduction of different life forms which coexist within a given territory [27]. This socio-metabolic dynamic is not at all foreign to the existing power relations between different classes and social groups. When life forms are put at risk or put in opposition by these relationships, social conflicts inevitably emerge [29]. Thus, we propose to territorialize the debate on social metabolism, with the view toward understanding how socio-metabolic dynamics are geographically configured, involving the biophysical characteristics, diverse life forms and power relations deployed throughout the territory. Responding to Toledo, we then use the theory of critical institutionalism to shed some light on those dynamics and the multi-layered processes of institution building.

2.2. Critical Institutionalism and Social Innovations

Critical institutionalism emerges as a questioning of "classical" institutionalism. "Classical institutionalism, or "Mainstream" institutionalism as labeled by Cleaver [30] looks to explain the behavior of different actors or groups of actors within a particular context and by established formal institution, those institutions being rules, norms or values that determine behavior. However, the understanding of how institutions are defined differs depending on which direction such scholarly research follows, reaching from a comprehension of institutions as made by aggregated rational choices of individuals on the one side, to an integrated institution building on the other [31]. E.g., classical rational choice theory defines institutions as being made on the bases of utility maximization. Following this theory, actors are fully autonomous, utility-maximizing and—of course—fully rational [32,33].

However, those rational-choice assumptions are criticized as oversimplifying and overlooking inherent power structures. In response, critical institutionalism seeks rather to broaden this approach by recognizing the inherent institutional complexity for each analyzed situation [34]. Critical institutionalism points out the three main concerns: "(a) the complexity of institutions entwined in everyday social life, (b) their historical formation; and (c) the interplay between the traditional and the modern, formal and informal arrangements." [34] (p. 6). By this, it "(...) offers the conceptual toolkit for illuminating process (how particular governance arrangements emerge and are enacted); power (how they are shaped to benefit some and not others); and meaning (how they become invested with meaning and so gain legitimacy and endurance." [35].

A leading scientific approach in analyzing natural resources management, which has evolved from the classical strain employs the eight design principles—mostly seen as a key to implementing good governance on the commons—and the Institutional Analysis and Development (IAD) framework [36,37]. Both have been developed by Elinor Ostrom and her colleagues. The eight design principles are characteristics that Ostrom found repeatedly in different case studies and defines them to be guidelines to successful common pool resource management. Cleaver [30], however, criticizes the premises taken by Ostrom [36], saying that institutions develop through purposeful design. In contrast to that she proposes the concept of "institutional bricolage", which describes a new composition of informal and formal institutions (values, norms, rules). In doing so, she emphasizes the process character of institution building on the one hand and the merging of formal and informal institutions on the other. Cleaver [30] (p. 45) defines institutional bricolage as: "The adaptive processes by which people imbue the configurations of rules, traditions, norms and relationships with meaning and authority. In so doing they modify old arrangements and invent new ones but innovations are always linked authoritatively to acceptable ways of doing things. These refurbishments are everyday responses to

changing circumstances.” Consequently, actors constantly redefine the institutions at hand while the institutions’ resilience depends on the social fitting [35].

This paper follows Cleaver’s approach and defines institutions as formal and informal rules, norms and values that shape human behavior. Focusing on community water management, organizations and actors are not defined as institutions themselves.

In addition to critical institutionalism, we used insights from approaches made by social innovation to describe the emerging water management strategies of the communities. Those approaches focus on real political case-study experience and provide useful indicators for evaluating institutional changes on a local level. Following Roose [38] we define “social innovations” strategies that are characterized by (a) pursuing the quality of life enhancement, (b) creation of new relationships, trust development and the empowerment of marginalized groups, (c) transformation of institutions, and finally (d) the emergence from the territories (cf. [39–42]).

We decided to analyze those social innovations by leaning on the concept of “institutional bricolage” developed by Cleaver [30], as it helps to lift the curtain on often hidden or less obvious dynamics, and as stated above, moves away from the assumption of purposefully designed institutions, which is commonly used in development theories. Without judging or romanticizing community management, institutional bricolage opens our eyes to the processes developed by the items at hand, such as everyday practices or learned heuristics. One hurdle when analyzing social innovations seems to be the term itself. Why is a certain social behavior an innovation? Can it be described as innovation if the similar behavior has been observed in other contexts already? We argue that the concept of institutional bricolage is useful in understanding social innovations, as it describes how, by piecing together (possibly already existing) formal and informal institutions in a new or different context, a new creative strategy can arise.

3. Materials and Methods

For the research of the case study of Petorca, two information production techniques were used: (a) documentary analysis and (b) semi-structured interviews.

For the documentary analysis, we focus on key data that allow us an analysis of the territorial transformation of social relations on the use of land and water on the case study. This material was classified into the following types: (a) previous research into the socioecological transformations happening in the province of Petorca, (b) official documents from public institutions with analysis regarding the situation of water uses and agriculture on the case study (Hydraulic Works Directorate, National Irrigation Commission, Ministry of Agriculture, etc.), (c) reviews of national media in Chile that had reported on the situation in Petorca, recording the main events associated with the social conflict in that region.

The sources for the interview analysis are based on a qualitative study done by Roose [38]. In her dissertation, Roose takes Petorca as a reasonable example for discussing the facilitators and pitfalls of the transition towards sustainable water governance and the impact of emergent social innovations in the context of a socioecological conflict. This hypothesis refining (and generating) in-depth case study generates strong context bound data. Consequently, its transferability is limited. However, the study follows academic criteria, such as objectivity, validity and reliability in order to assure transparency, controllability, and if possible, replicability. During the field stays of 2016 and 2017, interviews with different stakeholders directly or indirectly related to water management in Petorca, such as small, medium and large farmers, local, regional and national public authorities, water user organization leaders, academic experts, members of non-governmental organizations (NGOs), activists and other inhabitants of the province and multiple field observations were conducted (community and congress meetings, activists’ meetings etc.). In the context of this empirical field research, Roose [38] maintained the common academic standards for interacting with human subjects, leaning on the basic principles of the ethical codex of the German Society for Sociology (DGS) and the Professional Association of German Sociologists (BDS) from 1993: The objectivity and integrity of researchers, risk assessment

and damage avoidance, voluntary participation, informed consent, as well as confidentiality and anonymization [43].

Accordingly, the names, places and other identifying features in the interview transcription are mostly fictitious, and are indicated as such. In order to obtain a wider range of perspective, interviews of partners of different age, sex and educational background were selected, when possible. Each interview was transcribed and analyzed by inductive and deductive categorizations building, based on the method of qualitative content analysis by Mayring [44] using the software for data analysis MAXQDA 12. The deductive categorizations were based on the indicators and recommendations given by Scharpf [45] and Ostrom [46] to analyze formal and informal institutions. Further the insights from González et al. [47] and Pradel Miquel et al. [40] were used to build deductive categories for topics related to social innovations. This process has been repeated until the analysis seemed to have reached information saturation. This means that additional interview analysis did not reveal further information [48]. In total, 36 out of 53 were analyzed.

4. Socio-Metabolic Rift in the Case Study of Petorca

The next section provides a general discussion on the socio-metabolic rift in Petorca. Firstly, we focus on the climate and rainfall patterns. Secondly, we stress the impact of largescale agricultural business in that area.

This case study focuses on the province of Petorca, which is in the northern part of the Valparaíso region. It is described as a “transition area”, given its climatic and geomorphological characteristics, lying as it does between the regions denominated as “Small North” and “Central Valley”; that is, between the semi-arid and the temperate climate. Its two main basins are fed from the Ligua and Petorca Rivers (see Figure 1). An important aspect of the province’s basins is their location on a low mountain range, where the contributions to the aquifer system and to the surface water of the basins are predominantly by irrigation and not by glacier. Hence, water availability in that area depends mostly on rainfall.

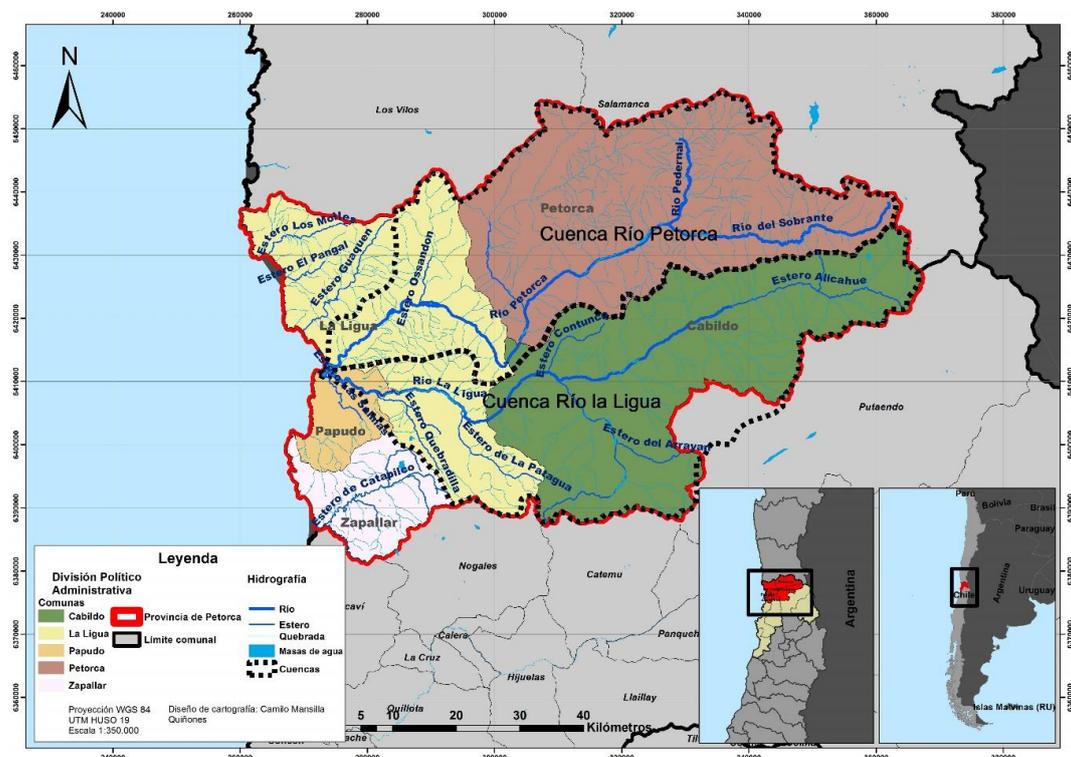


Figure 1. Basins of the Ligua and Petorca Rivers [49].

However, rainfall has been constantly and significantly decreasing for almost a decade. According to the national water directive [50], the average annual rainfall of northern part represented by the region of Valparaíso (including Petorca) is characterized with an average rainfall of 434 mm/year [50]. Rainfall basically concentrates on the winter months (April–August). The dry season lasts for about 7–8 months. In Petorca, the average annual rainfall between 2011 and 2016 has been steadily decreasing, showing a 32% total reduction with respect to the average annual precipitation of the last 30 years [51]. This process in Petorca is linked to the climatic phenomenon coined as “mega-droughts”. The term “mega-droughts” is used to indicate an “extraordinary phenomenon for its duration and extension, unparalleled in historical or paleoclimate instrumental records of the last 1,000 years” [52], which mainly affected central Chile, creating a rainfall deficit of 30% between the years 2010–2015.

Although dry periods are frequent in central Chile, happening randomly, mostly every 2 to 9 years, with a duration of mostly one to two years, data indicate that this phenomenon is independent of the El Niño Southern Oscillation (ENSO) [53]. Latest findings from the Center for Climate and Resilience Research (CR2) have led them to affirm that the atypical length of the “mega-droughts” has as its main factor “an uninterrupted reiteration of a large-scale circulation pattern during austral winter hindering the passage of extratropical storms over central Chile” [54] (p. 436). This process is currently enhanced by changes in atmospheric circulation driven by anthropogenic climate change [53]. Climatic transformations and basin overexploitation is now producing serious water scarcity. 14 rulings by the Chilean State declaring the province of Petorca as a “water scarcity zone” have been consecutively published since 2010 [55].

In addition to the rainfall decrease, the expansion of fruit production in Petorca enhances pressure on water, and has radically transformed the provinces’ agricultural landscape since the eighties. The agricultural census data from the years 1975–1976 shows that, of the total cultivated land, only 2.9% was planted with avocados, while the latest fruit register of 2017 shows that currently, avocado plantations represent 60% of the cultivated area in Petorca [56].

One of the strategies allowing such expansion involves the purchase of dry soils on mountain hillsides at a low price. Those territories were not used by small-scale farmers because of the difficulties in irrigation. This restructuring of land tenure is strengthened by the process of water neoliberalization in Chile embodied by the water code of 1981. This legislation separated the land property from the water property, and handed out water exploitation rights freely and in perpetuity to private entities. The acceleration of extractive activities pushed by fruit production, in addition to its intensive exploitation of the land, would not have been so “efficient” and dynamic without the legal conditions made possible by this ruling. During the nineties, those new agricultural entrepreneurs required maximized water supplies in order to irrigate their crops. This in turn led to an ever increasing request for provisional water rights (provisional rights are revocable rights granted to those basins declared as restriction zones) to the General Water Directorate (Dirección General de Aguas, DGA). This authority delivered water rights even after the basins were declared as depleted by this same institution. Both basins were declared “restriction zones”, defined as those hydrogeological sectors of common use where there is a risk of the serious reduction of a certain aquifer according the Water Code of 1981. As a result, the Ligua River was over-granted by 129% and the Petorca River by 87% when considering water demand and availability [57].

Additionally, in order to enhance the planted area, entrepreneurs started buying water rights from each other, generating a lucrative water market in the province. Stemming directly from the restrictions that were established for the granting of provisional rights from 2005, the price of water has risen steeply. Today, the price for buying exploitation rights in the province of Petorca is around \$25,000 per liter/second.

Further aggravating the situation, illegal water extraction by agricultural entrepreneurs has also been documented and verified. As the resource availability decreased, complaints about unregistered wells and drainage systems on largescale entrepreneurs’ fields increased. Complaints,

forcefully repeated, to the General Water Directorate (DGA), encouraged the institution to register 447 accusations of illegal water extractions between 2010 and 2014 [58].

A recent study of Panez et al. [20] analyses the socioecological impacts of avocado production on the territorial dynamics of the province. The high-water consumption for this crop in a semiarid region such as Petorca—estimated at 389.5 liters to produce one kilo—and the considerable expansion of plantations, has generated an intensification of water and soil exploitation. In their investigation, they calculated that for the 25 million tons of avocados produced in the 2017–2018 season, approximately 9,737,500 m³ (9.73 gigaliters) of water was required [20]. If this water consumption is projected into the next ten years, the water requirements would be equivalent to the amount of water that has decreased from the underground reserves of the Petorca and Ligua River Basins between 1950 and 2010 [20]. This data shows the acceleration in the flows of water consumption caused by fruit production and its relation to the depletion of water reserves.

This intensification generated various socioecological impacts in the Petorca province, ranging from soils depletion and increasing erosion processes, the decrease of aquifers' recharge capacity, to the loss of biodiversity in the area. In particular, peasant life-ways historically inhabiting the province are severely disabled due to the lack of water availability, preventing them from food cultivation and animal husbandry.

Furthermore, the lack of water compromises the human right to water as recognized by the United Nations (UN resolution 64/292 of 2010 and resolution 7/169 of 2015). In Chile, the human right to water is not constitutionally recognized, for inhabitants of the province's rural area to the extent that the collection sources for rural drinking water systems (springs and wells) have been depleted or considerably reduced.

To characterize more precisely what happens in places like Petorca, we affirm that a deep "socio-metabolic rift" in the territories is progressing [20]. This rift is relevant because the increase in agribusiness production "denies and prevents the other temporalities that are necessary for life cycles reproduction; basins recharge time, aquifers formation, soils infiltration, drinking water consumption, among others" [20] (p. 159). We note a socio-metabolic rift, not only because of the profound damage to the reproduction of socio-natural cycles, but also due to the "systemic deterioration and structural displacement of the endogenous productive practices and capacities of the local territories/populations" [24] (p. 282).

5. Results: Community Water Management in View of Socio-Metabolic Rift

To understand the role of the socio-metabolic rift in community water organization, the insights of Panez et al. [20] and the interviews from Roose [38] have been compared and analyzed with a focus on the processes of rural water organization. In doing so, three major impacts caused by the socio-metabolic rift have been found that triggered the weakening of community water management: a) The deepening of water commodification caused by the socio-metabolic rift; b) loss of autonomy of water user organizations attempting to cope with the lack of water availability in their collection wells; c) quantitative and qualitative loss of participation within community water organizations. Finally, forms of rural water management have been found that seem to resist those cooperation weakening triggers. These four main findings are displayed in the next paragraphs. The following discussion of the results uses critical institutionalism to explore how these resisting forms of rural community organization overcome the weakening factors described in a) to c).

5.1. Deepening of Water Neoliberalization

Faced with the dramatic deterioration of water availability for human consumption in the Petorca province, the context of water neoliberalization stimulated the emergence of the "drought business". In recent years, it has been noticed that well owners with available water are beginning to sell water rights at a high price to the State and to ESVAL, a private company responsible for the drinking water supply in the urban areas of the province [59].

Finally, in December 2018 the national government decided within an emergency plan for water problems in the province to buy water rights from private entities to support the supply of the RDW committees and cooperatives [60]. This measure is unique, since for the first time the government is now proposing to buy water rights from individuals as a solution, regardless of the fact that the State itself provided those water rights free of charge and in perpetuity.

This deepening of new business areas and commodification encouraged by the high economic value of water, evokes territorial disparities between those who command water and economic resources, and those who do not. The latter consequently depend on the State's support, which is perceived as insufficient, as it does not supply enough drinking water.

5.2. Loss of Autonomy of the Community Water Organisations Facing the Lack of Water Availability in Their Collection Wells

In the Petorca province, the decrease of surface and underground water availability impacts the traditional forms of the water collection of rural potable water organizations (through springs and low depth wells). Increasingly, wells are being deepened to obtain water from underground aquifers, but such deepening projects require substantial financial investments. However, community water organizations cannot afford to make these investments from their own limited resources. For this reason, these groups depend on state support to deepen wells and improve collection and distribution systems. According to the Hydraulic Works Directorate (Dirección de Obras Hidráulicas, DOH), 27 projects were implemented between 2012–2018 to deepen water wells of the RDW committees and cooperatives in Petorca, for a total amount of \$3.46 million (information obtained under the Transparency Law on August 29, 2018). Further aggravating the situation, the amount of investment needed tends to rise due to the depletion of underground sources, so that more and more wells need to be deepened (the last project, implemented in 2018, had an investment of \$170,000 and resulted in a well with a depth of 172 meters).

Moreover, the emergency policy measure of supplying RDW with water trucks is being constantly delayed. In 2014, the Petorca government counted 19,465 people being supplied by water trucks [61] (see Figure 2). In times of greater water scarcity, families in Petorca province are provided with 50 liters per person per day simply to perform their daily activities (the average consumption rate in Chile is 167 liters per person, according to the National Human Rights Institute (Instituto Nacional de Derechos Humanos, INDH) [58].



Figure 2. Truck delivering potable water in Petorca. Source: Own photograph [62].

Activities as basic as bathing, washing clothes, brushing teeth, washing dishes or using the toilet, have become a constant problem. These aspects increase the dependence upon the State for community water supply, as the traditional organizations neither command the economic resources nor the technique of guaranteeing drinking water for their members.

5.3. Quantitative and Qualitative Complications in Community Organization

The socio-metabolic rift causes socio-demographic changes in the Petorca province. Predominantly young people are migrating to the capital or to other regions of Chile because small-scale agriculture cannot provide any long-term means of livelihood and largescale agriculture has not been able to compensate for the employment loss. Currently, the ageing of people in Petorca is above the national average, while the population growth is approximately half of the national growth level [63–65]. According to a study undertaken by the University of Concepción [50], most of the small-scale farmers are between 60 and 70 years old.

This demographic trend is impacting community water organization. Firstly, the number of members in water user organizations is decreasing, and those remaining members criticize the lack of generational adjustment in their directory boards. In addition to this quantitative weakening, also the quality of water user organization has been affected. Interview analysis shows that small-scale farmers, as well as other experts working in that area, perceive that the motivation to participate in community organization is decreasing. E.g., members of “Channel Associations” are not willing to clean channels, but prefer individual solutions such as digging private wells.

This lack of cooperation is an example of what Roose [38] identifies as individualistic/selfish-rational action orientation. An orientation that she found to be predominant in various interviews conducted with actors in Petorca Province. A small-scale farmer of Petorca supports this conclusion when telling about her experience with her community: “Everyone said: ‘Well, if there’s no water. What can we do?’ They don’t move. Like I said before, they aren’t united. Not one person is looking for another one or for more. No. They don’t move.” (Interview from Roose [38], translated by the authors).

Considering this, the socio-metabolic rift implies a break within the internal relationship of the community. In other words, water scarcity is provoking a withdrawal of interest in the community organization. As already seen in different cases of water conflicts [36,46], it shows that also in Petorca the extreme lack of water has caused a rejection of community organization because water users lose the expectation of being able to change their situation, asking: “Why should we get together if there is no water?” (Interview from Roose [38]). Underlining this argument, inhabitants of the province stated that there would be more community organization in the Petorca river basin, where there is comparatively more water available, than in the La Ligua river basin, as also confirmed in the study conducted by Henríquez et al. [66].

5.4. Forms of Community Organization Resisting Dispossession

Despite of the above-mentioned factors that are weakening the community water organization, the Province of Petorca does, nevertheless, display successful cases of cooperation between users. We classify those cases as “social innovations”. According to the criteria mentioned in 2.2: they (a) pursue an improvement of quality of life, (b) create new relationships, develop trust and empower marginalized groups. By this they (c) transform existing institutions (formal and informal norms, rules and values) and finally (d) emerge from the territories (cf. [39–42]).

In order to show how different initiatives have enhanced community organization, we decided to analyze two of them in more depth: (1) The cooperative Petorquinoa which was initiated in 2015 and consists of small-scale farmers who replaced their traditional crops with the production of quinoa—a crop which requires comparably little water and (2) the Water Office (Oficina de Asuntos Hídricos, OAH) of the Petorca basin, initiated in 2016 as part of the municipality of Petorca, which facilitates community water organization aiming for a re-communalization of water management.

Regarding the latter, we put a special focus on the activity called *Minga por el agua* that took place in a small community of Petorca. This self-organized project took place in 2016 in order to install a water connection to eight households and was strongly supported by the OAH.

Based on the interview analysis, we explore the social innovations motivations, strategies and organizing difficulties and impact on the general community water organization.

Looking at OAH and Petorquinoa, what stands out is that both initiatives were organized as a reaction to water scarcity. A member of Petorquinoa reports on how the lack of access to water and the inevitable deterioration of small-scale agriculture motivated him to find new solutions:

“We are dried out. In this context, it’s very hard to develop as a farmer. The people are leaving. (. . .). We got to the quinoa because we had no water. This was fundamental. And we are (doing) quinoa now. And we built the cooperative because of that. Because we needed to continue to exist like we always have.” (Interview in Roose [38], translated by authors)

This member of the initiative not only joined because of economic reasons, but also to preserve the culture and traditions of the area’s rural inhabitants. It shows that Petorquinoa was built to find a way to preserve the traditional small-scale farmers’ way of life, which is threatened by water scarcity. Hence, in the case of the Petorquinoa, community organization is not the primary goal but a means.

Other than that, the objective of the OAH is directly related to community organization, as shown by the following response of the director on being asked about her inspirations:

“(I am) inspired by the vision of a participative system of water management where public (institutions) and community build an alliance. As an answer to the water scarcity that lasted 20 years from 1996 to 2016.” (Interview from Roose [38], translated by authors).

The OAH aims to strengthen community organization to be able to confront the injustice and lack of transparency of the existing institutional framework, which has been unable to either solve the origins of the water scarcity or the unequal access to water [38]. For this reason, we conclude that the OAH itself is a critique of the current power structures of water governance.

An initiative supported by OAH was the “*Minga por el agua*” in Petorca which is a self-organized activity involving members of different RDW committees and cooperatives, with the aim of installing water connections to eight households in a small community of Petorca. RDW committees and cooperatives usually manage drinking water. Although being supported by the municipality, the installed water connection has not been approved by the authorities of hydraulic works (DOH), nor by the water directive authority (DGA). As a consequence, it does not provide officially authorized potable water. Nevertheless, it can be informally used rather for other purposes, such as self-sufficient farming or clothes-washing, and therefore relieves local water stress.

Despite their different objectives, both social innovations face the same difficulty: the weakening of the community organization. However, the initiatives found key strategies to overcome those mechanisms that are impeding the development of cooperation and trust [38]. Those central principles need to be discussed more comprehensively in the following.

6. Discussion: Underneath the Surface of Community Water Management

The term “critical institutionalism”, coined by Frances Cleaver et al. [30,67], points out the context and complexity within institutions in order to explain actors’ behavior by highlighting path-dependency and the importance of informality [34,35]. Taking this approach, we recognize one outstanding internal link between the above described impacts of the socio-metabolic rift on community organization, which elicits several trust decreasing mechanisms: inequality of power—determined by an institutional framework that is characterized by neoliberal paradigms (maximum freedom (for some) to pursue deregulations favoring free market conditions). Further, we use the concept of institutional bricolage to shed light on the internal relations of the social innovations mentioned above.

6.1. Unequal Power within An Institutional Framework of Minimal Rules

The group of actors directly or indirectly influencing water governance in Petorca is large and of heterogenic power. This implies significant dissimilarities of financial and decision-making power, as well as educational backgrounds. The institutional framework around this is characterized by weak public management with little oversight or sanctioning mechanisms, as well as internal and external deficits and failures of communication, causing problems due to a lack of transparency and the inability to access information.

Unequal power within an institutional framework of minimal rules creates a situation where more powerful actors have major action possibilities. For example, the regulative framework states that water user organizations decision-making is done by votes that carry weight according to the water rights possessed by each member. A leading member of the DGA summarizes:

“The Confederation of Canalists (umbrella water user organization) of Chile pretends to be all about the small-scale farmer (. . .). If they say: ‘We represent 70 or 80 % of all farmers.’ ‘Right’, I would say, ‘yes, you represent 80 % of all farmers, but let’s be clear: How many of these farmers are water rights owners?’ Let’s say out of 200 farmers, 150 own 15 or 20 % of the water and the other 80 % belongs to 5 or 6 farmers. Who runs the river? The one who owns the bigger amount of water (. . .). You will never see a peasant being president or managing the water. You will see the big-scale farmer, not the peasant.” (Interview from Roose [38], translated by the authors)

Then again, the informal leeway inherit in this framework reflects the highly skewed power relations reinforced by this framework, as, for example, it enables largescale agriculture to install illegal drains without higher risks, as they can provide the financial resources for such infrastructure as well as for any potential fines (previous regulation established fines of a maximum of \$1,000 for illegal water extraction. Since 2018, the fines have hardened, sometimes as high as \$65,000). A small-scale farmer describes this situation as follows:

“The regulatory framework is pretty ambiguous, at least, because it regulates issues that are of interest to some persons and to others not (. . .) here in this province the same persons who make the law are big producers who own large fields on the hills, in other words, they are pulling the strings, they own the law, they own the power and they own everything. (. . .) hence, it is difficult to be able to do something against that.” (Interview from Roose [38], translated by the authors).

This statement shows that the institutional framework is perceived as unfair, as it does not offer rules or norms that assure reciprocity that could create trust. Aggravating the situation further, the perception of a lack of fair-mindedness and reciprocity is fueled by accusations of corruption and conflict of interest against local and national authorities. Summing up, inequality of power relations is causing a decline in reciprocity; and at the same time, increasing the lack of transparency and consequently promoting interpersonal mistrust—all of which is triggering the weakening of water organization at the community level.

6.2. Strengthening Alternatives through Trust and Meaning

The very existence of the social innovations presented in this article draw attention to the questions of how and for what reasons they have arisen, and how these innovations are managed in coping with the weakening of community organization throughout the province. As stated above, we decided to answer these questions by calling on the concept of “institutional bricolage” developed by Cleaver [30]. Roose [38] observes that both initiatives are led by individuals who have earned the trust of their communities. This means that both have been working with the communities of the province of Petorca for several years, and had been able to establish their reputations. This facilitates their access to the community, as the water users accumulated significant positive experiences in previous interactions with those whom they represent.

Additionally, both initiatives focus on a rather homogenous group regarding their social constituency. Petorquinoa focuses on small-scale farmers, and OAH especially works with members of RDW associations. By this is meant the heterogeneity is being reduced, resulting in less inequalities in

terms of financial and decision-making power. Consequently, expectations of an unbiased reciprocity can grow.

In other words, the possibility that only a wealthy few benefit at the expense of more impoverished inhabitants diminishes, and the community's trust in a cooperative of this nature will become much more likely.

Besides the support given by individuals considered trustworthy and a balanced power structure, we can observe another factor facilitating this cooperation: clear goals. The *Minga por el agua*, for example, sets the very clear, non-abstract goal of improving the drinking water system. Thus, it allows participants to calculate their personal costs and the risks involved in cooperation when factoring in working hours and the lending of tools. In exchange, the (all female) owners of the households provided lunch. Additionally, new relationships have been established, and as a side benefit, it is most likely that an improvement in the reputations of those involved, as well as the ongoing development of mutual trust, will be gained. For example, two members of two households were very skeptical in the beginning; as their houses are further away from the others and on higher ground, they doubted that the water would reach their homes. However, the community convinced them to participate and successfully connected them as well.

Similar factors can be observed in the Petorquinoa initiative. The aim of producing quinoa is neither abstract nor unambiguously political. The members can calculate their personal risks of cooperating. Furthermore, by putting economic benefit at the center of attention, ideological barriers can be overcome which might otherwise impede community participation, considering the rejection of strictly political motives identified in the province and in Chile as a whole [38].

Nonetheless, higher understanding on the internal institutions can be reached, focusing on meaning and legitimacy [30,35]. As displayed above, Petorquinoa is not only a way to economically survive through agriculture, but also to preserve a traditional way of peasant life form. *Prima facie*, the tradition seems to not depend on the crop itself, as quinoa has not been a typical plant in the Petorcaen farmers' tradition. Hence, those farmers opt for a crop that seems to have promising figures on the national and international market, rather than crops typically used for self-sufficiency farming in that area. Nevertheless, taking a closer look on the history of quinoa, it shows that the crop is filled with ancestral meaning, as quinoa has been planted in the ancient traditions of Andean farming that goes deeper in history than those traditions to which the small-scale farmers in Petorca would typically refer to. Hence, the farmers can relate to this crop as being connected to their territory in terms of their ancestral traditions. Therefore, it may reach a higher legitimacy for the community itself, as also for potential buyers.

The activity "*Minga por el agua*" gives another example. The term "*Minga*" comes from the Andean indigenous communities and describes the self-organization of common projects, where people from different ages and gender come together. Those "*Mingas*" are not necessarily linked to water management. Rather than that, "*Mingas*" are an ancestral practice of cooperation fundamental for the life in the communities and replicate until today [68]. By self-naming the process of installing the pipeline "*Minga por el agua*", the practitioners highlight the importance and meaning of mutual organizing. By that, through tradition, they give legitimacy to the project's operating modes, such as the requirement of the work force. Finally, it can be stated that community is combining old and new, formal and informal institution, by taking this ancestral organizing practice, modifying it to their current needs and combining it with other tools such as the support of the OAH. In other words, they used institutional bricolage.

6.3. *Overcoming Information Gaps and Enabling Learning Circles*

Moreover, the rather small membership of both initiatives enables the overcoming of information gaps and lack of transparency by maintaining direct communication strategies e.g., via personal, face-to-face meetings. Additionally, the members mostly live in the same community. Hence, they maintain personal relations outside the structures of the initiative and keep the information

flow running outside of the meetings in informal settings. The OAH in particular takes on a role as a communication coordinator through establishing contacts between the community and public authorities. Through this means, the OAH not only strengthens communication inside the community, but also in between different actor groups.

The director of the OAH identified information transparency as a key to strengthen the community. Therefore, she aims to improve on this by establishing a public library on water governance, allowing easier access to information for the community.

Considering knowledge, the OAH is also a space where knowledge about water use is exchanged, including technical knowledge on how to manage water organization in their communities. Participants of the Minga and other activities supported by the OAH share their knowledge and tools to support themselves mutually among different water committees. They even organize activities in concert with deprived community water organizations that require more support due to the precarious conditions of their own water catchment and distribution areas. This self-organization in turn creates the opening to install one's own rules (formal and informal). The compliance with those rules is at this time increasing interpersonal trust and cooperation.

A central mechanism that allows initiatives to establish these lines of communication is self-organization. It is through self-organization that participants agree on which decisions to make, and how. For example, as is normal in a cooperative, the members of Petorquina decide that each person should have only one vote independently from the number of shares they own. This process ensures that decisions will be democratic, and that members will not be disadvantaged because of power inequalities, as it is usually the case in water user organizations (such as canalistas or junta de vigilancia, where the vote counts according to the amount of water rights owned). The creation of self-organized formal and informal rules allows the participants to enhance transparency, and consequently, trust, as the members themselves know the rules and why they have been established. Furthermore, self-organization opens up spaces for learning circles to flourish, allowing the actors to gather positive experiences and increase trust in cooperation. The following statement of a member of the Petorquina cooperative gives a practical example of such a learning circle:

"Another thing that should be mentioned is that we consent to the freedom to the producers. The idea is that the farmers pass all their quinoa to the cooperative, but there is no obligation to do that, because we understand that it is hard for the individual small farmer. Sometimes he may need money and if he can sell the quinoa, so he should sell it. But we want to progress to the point that in the end farmers can create a better business deal inside the cooperative than if they attempt this by themselves. Then, they will give us the quinoa because it's better for them." (Interview from Roose [38], translated by the authors).

Furthermore, this statement shows how self-organizing is done by bricolage of formal and informal institutions, and how those institutions pieced together may serve multiple purposes. Firstly, the cooperative has a common goal to sell quinoa. However, there are exceptions legitimized through the common understanding of the need to sell. Secondly, those exceptions not only allow members to freely manage their crops, they also aim for the learning-circle mentioned earlier, so that over the long term, trust will be built to invest into the cooperative rather than to act individually.

In summation, the results confirm that these social innovations are coping with the weakening of community organization by using different strategies that aim at well-defined levels. However, all of these initiatives facilitate trust growth through learning circles which then allow participants to construct positive experiences and create their own institutions (rules, norms, values).

7. Conclusions

Despite important efforts that have been made in some regions of Chile in order to achieve a balanced use of the waters according to both the current and projected availability in the valleys [16], we think it is important to deepen the reflection on socioecological transformations brought about by agribusiness expansion in Chile, the commodification of water and its relationship with communal

customs and practices of water management throughout the territories. Although we have repeatedly pointed out the weakening of community organization, we have highlighted in this article how, in a scenario of deep dispossession as experienced in the province of Petorca, we have witnessed ongoing practices emerging, which challenge the impacts of these socio-metabolic rifts.

Despite the negative consequences of the over-exploitation of land and water on the transmission of socio-natural cycles in Petorca, the experiences analyzed show that there are social innovations emerging that do not follow the tendency toward organizational weakening. On the contrary, they transform themselves according to context, and thereby resist. Socioenvironmental and territorial conflict studies, which tend to focus on the disputes between participants and the effects of extractive practices in the territories, with little attention to the emerging social dynamics, constructing alternative solutions that are under construction. We argue that it is important to enhance the visibility of those dynamics and include this type of experience in territorial and socioenvironmental conflict studies.

In summation, we consider that both of these experiences have the potential to cope with other political-epistemic horizons to counteract the predation of extractivism, monoculture and an alien concept of individualism introduced during the neoliberalization process throughout the country. Both Petorquinoa and OAH are experiences based on cooperation, trust and self-management. Those principles that have been highlighted by the Classic Institutionalism literature to be crucial in the functioning of common resource management—be it in a hierarchical-oriented, market-oriented or hybrid institutional environments [69,70]. However, we additionally stress that both the weakening of communal organization and the emerging alternatives reveal more complex characteristics. Power structures, the transformation of institutions and their contextually, meanings and legitimacy, as well as respect for the socio-natural cycles that enable life reproduction in the territory, are important factors emphasized by the analysis of Critical Institutionalism [35]. Therefore, our analysis of Petorca contributes to this debate by presenting the interrelation of the socio-metabolic rift with the creation and local transformation of institutions in water management. The concept of “institutional bricolage” developed by Cleaver [30] points to the dynamics and complexity with which institutions that manage common goods are produced and transformed. Through an analysis of the successful experiences regarding the common appropriation of the basic elements that make life possible in the territories, we use this concept to highlight the importance of power structures, flexibility and ambiguity. Through learning cycles, we are able to show that the creation of institutions is an ongoing, dynamic process. Based on that, we demonstrate that known concepts of social practice, such as traditions, can be classified as an innovation in other contexts as the formal and informal institutions behind them have been transformed to fit the new situation.

Our analysis allows us to conclude that these experiences of social innovation strengthen community water management. Understanding these experiences is one of the main challenges in facing the deprivation of the commons in different territories of the global south. Nevertheless, the question remains to which degree these new creative strategies may initiate an upward spiral towards incremental institutional change and pave the way towards a broader more solution-capable, sustainable water management.

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