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Understanding Conditioning Factors for Hydroelectric Development in Chile: Bases for Community Acceptance

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Abstract: Chile has defined an energy development policy in which hydropower is an important part of the energy grid. This energy source has not yet been accepted by many people in local communities. For future hydroelectric development to be more widely accepted, the Chilean Ministry of Energy developed a methodological framework called Objects of Valuation. This framework is aimed at identifying the main community interests that may condition hydroelectric development. The objective of this paper is to analyze the scope of the framework based on a review of the scientific literature and information generated through participatory activities in three basins that have high hydropower potential. Analyzing the results obtained from the application of the framework, four complementary intangible factors not represented by the framework are identified: the lack of validation of a formal participatory process, under-recognition of different worldviews, distrust regarding the development of hydroelectricity, and a sense of self-determination in the community. These factors could potentially condition community acceptance of hydroelectricity, thereby limiting the framework as a decision-making tool. We recommend that this methodological framework should be complemented by the incorporation of intangible elements in the decision-making process, using a systematic tool applicable to spatial planning and strategic environmental-assessment processes.

Keywords: hydroelectric development; object of value; community acceptance; public acceptance; renewable energy development



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1. Introduction

In recent years, one of the most important measures to mitigate climate change agreed upon by many countries worldwide has been promoting renewable energy sources as an alternative in order to move away from fossil fuel-based energy sources [1]. In fact, as of the end of 2021, more than 160 countries had policy targets in place at the national level to increase the use of renewable energy, up from 66 in 2007 [2]. Since its implementation in 2015, Chile's energy policy has resulted in an increase in renewable energies in electricity system from 42% to 55% by 2020. Within the forms of renewable energy, hydroelectricity is considered key and aims to attain a share of 20–25% by 2030 [3]. However, the emergence of social conflict as a result of opposition to infrastructure projects for these energy sources, especially among local communities, has slowed down or even stopped this process [4–7]. It is in this context that, in recent years, increasing attention has been paid to the social dimension of developing renewable energy projects in order to identify and understand the main factors that condition the level of acceptance by local communities [4,8,9].

It has been argued that one of the main reasons for low levels of acceptance by local communities is related to the implementation of territorial planning schemes and decision-making processes under a top–down approach. In other words, energy development and

the siting of its infrastructure is being proposed by authorities or development companies expecting it to be received by individuals and communities without contest [4,10]. This perspective often means that to the extent that communities do not actively oppose or contest energy infrastructure projects, they accept them [4].

On the other hand, countries that have been the most successful in implementing projects based on the use of renewable energy are characterized by the use of collaborative planning approaches encouraging an early and active participation in decision-making processes by local communities [10].

Considering this type of approach, Chile has defined its energy development policy [3,11], and has developed participatory instruments for territorial planning (see, e.g., [12–14]) whose application, in general, is aimed at making proposals for energy development in accordance with the different visions, aspirations, and interests of local stakeholders based on zonal preferences [12–14]. To this end, the Chilean Ministry of Energy (MINENERGIA) developed a new methodological framework for the territorial planning of hydroelectricity (considered a key source within the new renewable energy matrix) called the Objects of Value framework, with the aim of serving as a tool that allows it to identify and assess the main elements, actions, attributes, or other aspects that communities value in their territories [12,14]. In this way, a scenario of greater community acceptance for the development of the sector should be favored.

However, due to the ongoing development of this methodological framework without empirical results that allow its evaluation (at present, the first territorial study to build a transmission line is in the development stage. The Objects of Value framework is expected to be applied in that process), the main question that arises in relation to the objectives for which it was developed is: Are the elements and attributes represented by the Objects of Value sufficient to assess the community's acceptance of hydropower development in a given territory?

The aim of this paper is to analyze the scope of the Objects of Valuation framework on the basis of information from secondary sources and generated from a case study, in which this new framework is applied.

The scope of this study is to show—after applying the Objects of Value framework on a pilot scale—the limitations that could condition the evaluation of the community's acceptance of hydropower development using this type of tool. The paper proceeds as follows. The first section provides a brief description of the community acceptance concept used in the paper and the context of hydropower development, at present, and its associated community acceptance. The second section introduces the Objects of Value framework. The third section describes a case study in which the framework is applied in the context of hydropower development. The fourth section describes the main motivations behind recent conflicts over hydroelectric development in the study area. This is followed by a summary of the most relevant key factors identified in the study area to help us understand the community's acceptance of hydroelectric development in Chile. The following section builds on this information by discussing the scope of the Objects of Value framework as a tool for assessing community acceptance of hydroelectric development. The final section summarizes the main conclusions and indicates in general terms some important points to consider when implementing public policies that seek community acceptance of hydropower development.

2. Theoretical Framework and International Context

2.1. Community Acceptance

Community acceptance in the context of energy development refers to the “specific acceptance of siting decisions and renewable energy projects by local stakeholders, particularly residents and local authorities” [15]. Following the conceptual framework of [15], community acceptance is one of the three dimensions of social acceptance, all interrelated (Figure 1); the other two are sociopolitical acceptance, related to the “support or resistance toward policies that effectively promote the implementation of renewable energies” and

market acceptance, defined as the “degree to which renewable energy technologies are adopted by consumers but ultimately also by investors and within firms”.

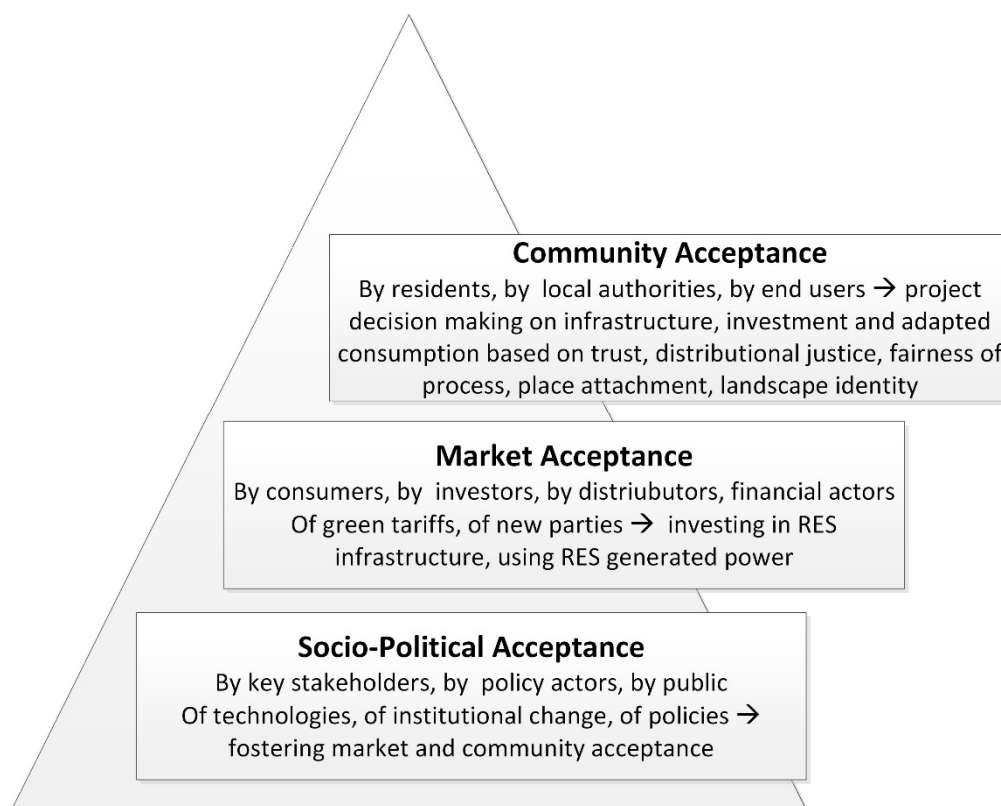


Figure 1. Three dimensions of social acceptance of renewable energy. Based on [10,15,16].

Community acceptance is expressed through the opinions of actors and the actions they take toward energy development in their territories. These actions can be supported by responses, such as active resistance, apathy, uncertainty, passive acceptance, or support [17]. It has been shown that actions taken and opinions expressed by local communities are mainly related to psychosocial factors, such as place attachment, identity of place, values, trust, and fairness of the process (see [16,18–20]).

Despite the importance of this process, in general, authorities and development companies pay attention to community acceptance only when a specific project is being questioned or when there is a fear of this occurring [17].

2.2. Public Policies, Community Acceptance, and Hydropower Development in Chile

Following the global trend, the government of Chile has increasingly recognized the importance of exploiting the potential of renewable energy sources [3,21,22]. In this regard, Chile defined a new energy development policy for the period 2015–2050, the main target of which is to have 100% of energy generation based on renewable energy sources by 2050 [3]. Hydropower is especially important, as it is viewed as a domestic “clean” source that enables a reliable, environmentally sustainable, price competitive, and accessible supply for the population [3,23].

Despite all of the advantages of hydropower, the installation of hydroelectric projects no longer receives the community’s acceptance that it may have had in the past and has instead met with local opposition [5,6,8,24–26]. The lack of an institutional capacity to effectively address the trade-offs associated with the sustainable use of natural resources and the implementation of public policies ignoring local and regional interests have led to an atmosphere of unrest since the 1990s [24,27]. During that decade, the first signs of high-profile conflicts in Chile started to emerge, which led to confrontations between

communities and the hydroelectric industry [6]. On occasion, the new complexity of the situation has produced important delays in original investment plans and has, in some cases, led to projects being abandoned [5–7]. This situation is evident throughout the national territory, but is especially relevant in the southern region of Chile, where hydroelectric potential tends to coincide with (i) natural areas that are highly valued locally, nationally, and internationally due to their landscape, biodiversity, and cultural value [28,29], and (ii) areas in which the interests of indigenous people and local communities are strongly represented [8,27,30–32].

To reduce these conflicts, the MINENERGIA has shifted its attention toward improving the understanding of people's responses to hydropower development and its associated infrastructure [3,33]. This change in focus is evident in the energy development policy. This policy recognizes that in order to promote hydroelectric development that is more sustainable and accepted by communities, it will be necessary to change the traditional territorial planning paradigm of the hydroelectric sector, which is centralized and technocratic, to a decentralized and participatory approach that considers the characteristics and vocations of local territories [11]. In this regard, MINENERGIA assumes that, in accordance with what has been stated by the World Commission on Dams [34], this type of approach will facilitate an integrated analysis of these elements of a territory, which will allow authorities to anticipate possible conflicts when deciding on a territorial intervention.

It follows that one of the main challenges will be to develop methodological frameworks to clearly and objectively identify the interests, aspirations, and visions present in the territories.

To partly address this challenge, MINENERGIA developed a methodological framework called Objects of Value, which is intended to perform territorial diagnoses that can be used as inputs for the process of planning hydroelectric development and the power transmission grid [12,14]. In this way, information can be generated that would allow the main interests that communities have regarding their territories to be described. On the other hand, MINENERGIA expects that applying this type of tool, with a participatory approach, will reduce information asymmetries and distrust among actors, leading to a context in which greater community acceptance of hydroelectric development can be expected [12].

3. Objects of Value Framework

The Objects of Value are defined as “variables of different nature (e.g., environmental, social, technical-economic, cultural, etc.) that represent objects of great value to communities and that may or may not have a degree of guardianship or protection by the State” [12]. As the variables represent objects of great value to the community, it is considered that the impact of hydroelectric development on the Objects of Value would condition community acceptance of such development.

The Objects of Value framework is adapted from a methodology known as High Conservation Values (HCVs) [35]. The HCV concept was first presented by the Forest Stewardship Council (FSC) in 1996, and since then has been used to identify and manage environmental and social values in productive landscapes in order to preserve them [23]. In the case of adapting it to MINENERGIA's needs, HCV was expanded to include other economical, sociocultural, and productive attributes [14,23]. This new scheme focused on territorial attributes to which the community has assigned a certain value for conservation, rather than landscape attributes.

It is important to point out that, although the development of the Objects of Value framework followed the general scheme proposed by the High Conservation Value methodology [35], it also included “local” information and knowledge gained from participatory activities with thematic experts and community representatives. This allowed the collection of perceptions of local actors regarding the Objects of Value in their territories [12,14]. In this way, the framework was socially validated with respect to the objective for which it was developed. On the other hand, its suitability for identifying and quantifying valuable

elements of a territory is also supported by the fact that many of the elements it represents have been considered as legally valid arguments against hydroelectric projects. For example, central elements that have been valued by communities when opposing hydroelectric projects in the Patagonian and Northern Patagonian regions of Chile, territories considered for intervention, include: (i) indigenous communities, (ii) sites of cultural significance for Mapuche communities, (iii) environmental attributes of tourist importance, and (iv) pristine ecosystems with high biological richness [6,8,27,31,36].

For hydroelectric development planning (without considering related transmission grids), MINENERGIA determined 53 Objects of Value, taking into consideration the characteristics of the national territory with the guidance of key actors and thematic experts, and classified them into five categories: fluvial, terrestrial, social, cultural, and productive (Appendix A) [12]. All of the Objects of Value correspond to physical objects that may or may not be present in a certain basin. To meet the aim of identifying objects of great value to communities in basins with hydroelectric potential, they must be recognized, quantified, and spatially represented at the sub-sub-basin level (corresponding to third-order basins established by the Chilean government as the smallest hydrographic unit in a main basin) following these general steps [12]:

- If an Object of Value is identified in a sub-sub-basin with hydroelectric potential, it is quantified using an indicator. Objects of Value are identified and quantified based on secondary information of a public nature. If the information does not exist, it is generated directly through fieldwork in the sub-sub-basin.
- After describing and quantifying the Objects of Value, a decision rule is applied to determine their presence in the sub-sub-basin. If the indicator value falls above, below, or between certain thresholds, then the objects are categorized qualitatively into classes.

The Objects of Value identified in the territory should be discussed with the local communities (in particular, with residents and authorities) with the aim of collecting feedback about their interests, concerns, and expectations, so that these can be interpreted and included in the assessment and weighting of the objects.

Figure 2 shows an example of the general steps followed to identify and develop Objects of Value, and Figure 3 shows an example of the results in terms of specific fluvial, productive, and cultural Objects of Value.

As a practical example, the Objects of Value scheme as the input for hydroelectric planning can be included in an analytic framework to evaluate different scenarios for hydroelectric potential in a basin. To develop the analysis, the analytic framework needs to be tailored to a specific question. For example, depending on the hydroelectric development goals established for a particular basin, the following questions could be of particular interest: How many of the community's Objects of Value does the hydroelectric development potential interact with? How much hydroelectric potential could be developed without interfering with cultural sites? How much hydroelectric potential could be developed without interfering with 80% of sites of tourist interest? It is important to point out that, in the end, the selection of alternatives for hydroelectric development should be understood as a decision problem with two objectives: maximizing the potential hydroelectric development and minimizing the effects of this development on Objects of Value [12].

Choosing the alternative that minimizes the effects of hydroelectric development on Objects of Value is based on the assumption that underpins the application of the framework: preserving Objects of Value, as elements valued by the community, can condition community acceptance of hydroelectric development. Therefore, the alternative that minimizes the effects of hydropower development on Objects of Valuation is the one that would potentially have a higher degree of community acceptance. Depending on the question, the exercise may include the allocation of weights to Objects of Value (see Figure 4). For example, if the question to be answered is how much hydroelectric potential could be developed without interfering with national parks, then a high weighting is applied to the Object of Value "national park" in relation to the other Objects of Value present in the study

area. In practice, this weighting would result in the analytical framework never selecting an area with hydroelectric potential that overlaps with a national park [37].

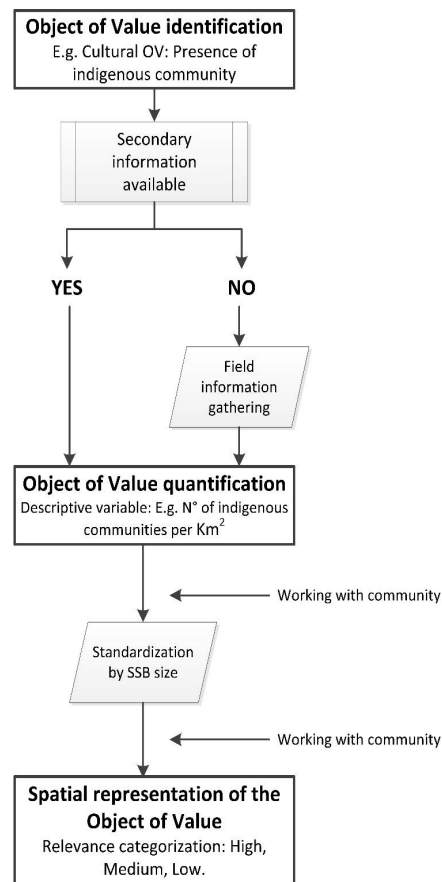


Figure 2. General steps for elaboration of Object of Value in sub-sub-basin (SSB). Source: Own elaboration.

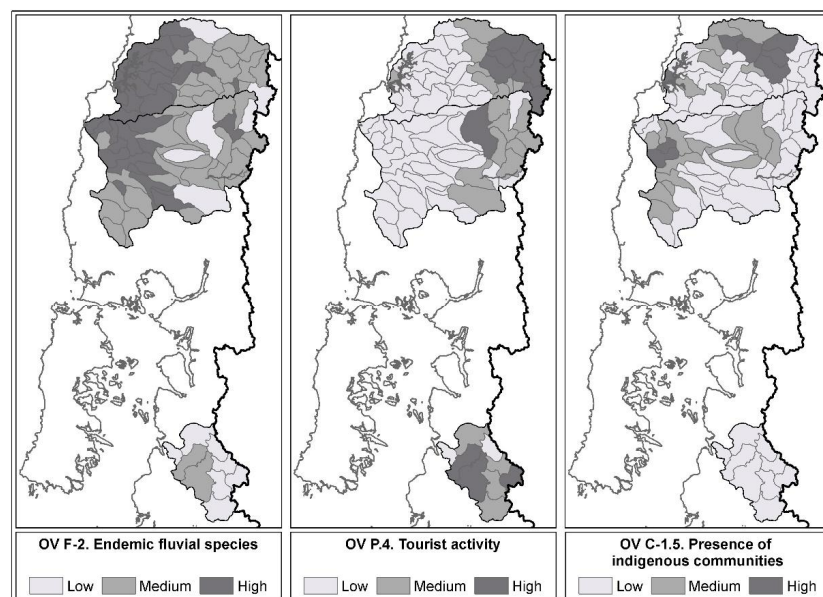


Figure 3. Examples of Objects of Value in Valdivia, Bueno, and Yelcho River basins in southern Chile: fluvial (F-2), productive (P-4), and cultural (C-1.5). Source: [37].

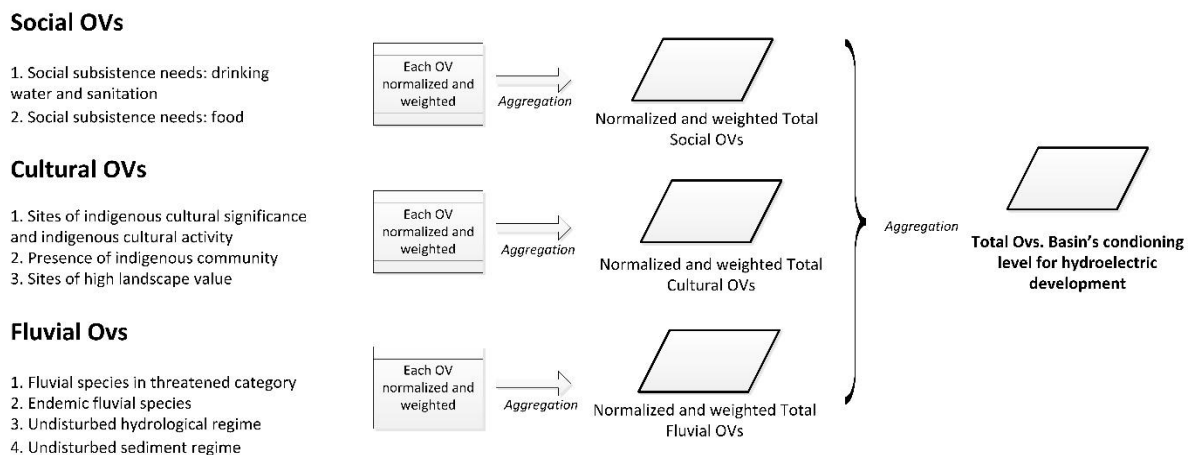


Figure 4. Example of estimating the level of community acceptance of hydroelectric development in a territory. Source: Based on [14].

4. Materials and Methods

To address the aim of the paper, two main activities were performed:

- Evaluation of the Objects of Valuation framework as a tool to identify conditioning factors for community acceptance of hydroelectric development.
- Identification and general analysis of the main factors and processes behind recent conflicts over hydroelectricity development.

4.1. Case Study: Evaluation of the Objects of Valuation Framework as a Tool to Identify Conditioning Factors for Community Acceptance of Hydroelectric Development

To evaluate the Objects of Valuation framework as a tool to assess community acceptance of hydroelectric development, we used information generated from a case study in which the Objects of Value framework was applied. The case study was part of a project called “Analysis of the conditioning factors for hydroelectric development in the Maule, Biobío, Toltén, Valdivia, Bueno, Puelo and Yelcho basins, from generation potential to socio-environmental dynamics” [12,37], whose main focus was to apply the Objects of Value methodology in 7 basins with the greatest hydroelectric potential in the country. The project was financed by the Ministry of Energy in the context of implementing Energy Policy 2050; it was conducted between August 2015 and August 2016 and involved the participation of an interdisciplinary team that included some of the authors of this paper.

As part of the implementation process, participatory activities were performed between November 2015 and March 2016. These activities included 5 outreach seminars, 18 workshops, and 31 semi-structured interviews, with the aid of cartographic support material, with key actors from the 3 study basins totaling 216 participants. A key informant was defined as a person who may or may not be involved in the hydroelectric context and who has great knowledge of the study area and the Objects of Value. The identification and selection of these key actors was performed through the “Snowball” technique [38], taking into account stakeholders from municipalities and the first participative activity as the main information source. The stakeholders included representatives of indigenous and non-indigenous communities, NGOs, and productive sectors, academics, municipal staff, and public officials at the regional level. All participatory activities were conducted in districts located in the zones with the greatest hydroelectric potential in the study basins (see further details in [37]). As an additional result, these activities made it possible to validate the Objects of Value framework and to identify some conditioning factors of the community’s acceptance of hydroelectric development not captured by the tool. At present, the importance and validity of these factors as determinants of community acceptance was an analysis based on secondary sources of information.

The study focused on the Valdivia, Bueno, and Yelcho River basins in southern Chile (Figure 5). In general, these basins are characterized by a high landscape value, great biodiversity, and high levels of endemism [28,29]. Regarding their hydrological characteristics, the 3 basins contain lakes of different sizes with a pluvial hydrological regime, with some river stretches presenting a mixed snowmelt–pluvial regime [39,40]. The basins together represent 22.8% of the country’s total undeveloped hydroelectric potential and are home to an emerging tourist industry associated with the rich landscape and hydromorphological characteristics suitable for recreational and sports activities.

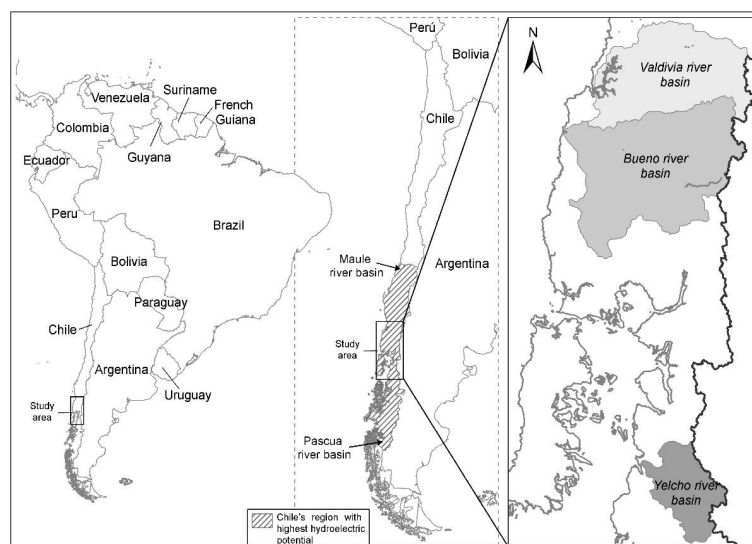


Figure 5. Study area.

From the 19th century to the second half of the 20th century, the Chilean government promoted a gradual colonization process, mainly with European immigrants, in the Valdivia and Bueno River basins, thereby establishing sovereignty in that area. One of the main effects of this process was the displacement of indigenous communities to areas of restricted access (such as Indian reservations), bringing about a complete change in the landscape’s organization [41]. The Yelcho River basin is the least populated of the three and the most isolated from urban centers. Occupation of this area dates back to the first third of the 20th century, and unlike the Valdivia and Bueno River basins, it was colonized under a non-government colonization policy by Chilean pioneers who moved from Trevelín and Esquel (Argentina) to occupy what is now Futaleufú and Palena [42,43].

4.2. Analysis of Main Issues of Conflicts Regarding Hydroelectricity

The importance and validity of the conditioning elements of community acceptance in the study area not captured by the Objects of Value framework to date was analyzed based on secondary sources of information. Information on the present or latent conflicts in the study area offers an opportunity to understand some factors and processes that in some way affect whether or not hydroelectric projects are accepted by the community. Among the sources associated with conflicts surrounding hydroelectric development in the study area are academic studies, media and NGO reports, and social media posts by community groups and activists [27,44–55]. These are described in more detail in the Results Section.

5. Results

5.1. Evaluation of the Objects of Value Framework

5.1.1. Validity of the Objects of Value as Factors to Assess Community Acceptance

In general, the elements that comprise the Objects of Value framework (Appendix A) were validated by stakeholders from study basins as valuable elements of the territory to the

communities and that, if affected by hydropower development, can become conditioning factors for community acceptance [37].

However, one of the aspects that emerged from the participatory activities was the importance assigned to social processes and dynamics, not reflected through the tangible physical variables of the Objects of Value framework, and which are generally not addressed by the State and proponents of hydropower projects. For example, factors such as distrust in participatory processes and a lack of recognition of their self-determination can be inferred from the following comments:

“Living in this area is difficult, we are making our homeland. We have to consider this value in the studies; it is invaluable”. Yelcho river basin’s stakeholder about colonization processes and self-determination.

“Everything that [the State] is doing seems to favor the businessmen more than the community, who are not taken into account. How these instances of participation are being generated is very questionable”. Yelcho river basin’s stakeholder about the participation process and the possibility of community influence.

“This tool will only benefit the business community, since it collects valuable information for them, without the business community being able to generate these instances of conversation with the community as was achieved here” Valdivia river basin’s stakeholder about distrust of the participatory processes surrounding hydroelectric development.

“We are told that we have the right to complain, but we want to assert our right as citizens to decide how to develop”. Valdivia river basin’s stakeholder about the right to self-determination.

In addition, the complete set of Objects of Value, by recognizing only tangible objects of the territory, do not consider the cosmovision of the local populations. This point is especially important for the case of indigenous Objects of Value (C.1.1–C.1.4 in Appendix A) since, as these are defined in accordance with the State Indigenous Law (Law 19.253), they can only arbitrarily and incompletely account for the ancestral territory claimed by the Mapuche ethnic group that differs from what is recognized by the Chilean State [37].

The ineffectiveness of the Objects of Value framework to recognize intangible elements is manifested in that none of the cultural, social, productive, and ecological factors of the Objects of Value framework (Appendix A) recognize the importance of water—a basic resource for the generation of hydroelectricity—as a strategic feature for the territory organization and development of local cosmovision [37].

5.1.2. Conditioning Elements of Community Acceptance Not Considered by the Objects of Value Framework

The process of applying the Objects of Value framework to the three study basins enabled the identification of at least four factors not considered by the framework that are important for understanding the community’s acceptance of hydroelectric development.

As the first factor, we identified a tendency related to the lack of validation of a formal participatory process, in terms of both its form and timing, and of its scope regarding the real influence of citizens in the final decision. In the current participatory process, companies design projects and propose them to the Environmental Assessment Service, a government agency responsible for environmental evaluation of investment initiatives, in most cases before consulting with local actors [7,24,56]. In this regard, communities are unsatisfied with the process, since it is conducted close to the final planning stages and “when everything is already decided”. In general, the environmental impact assessment only covers technical and environmental issues of the project, without taking into account other existing or potential projects in the same territory [57]. Hence, many projects lack sociopolitical acceptance in the broader context of opposition to policies that promote the implementation of renewable energies, apart from a specific project. Local communities cannot influence the EAS’s decisions regarding project implementation, and their participation is limited to influencing some of the project’s characteristics and claiming certain compensation if they

are affected [7,24,57]. On the other hand, the ambiguity existing in the Chilean legislation that supports the implementation of free, prior, and informed consent (in the context of ILO Convention 169) has contributed to the fragmentation of local communities and the “commodification” of consent, limiting its practical applicability to protecting the rights of Mapuche–Willeche communities and increasing distrust in the participatory process [49]. As reported in [26], in areas where there is conflict over hydroelectric projects, indigenous community leaders have negotiated the indigenous consent established in ILO Convention 169 in exchange for economic benefits. This has contributed to a general perception that the participatory process is useless. This aspect is very important in community acceptance of hydroelectric development, since the valuation of autonomy in decision making at the local level generates a social demand that can, in this sense, be considered fundamental.

The second factor is the under-recognition of different worldviews. In the study area, hydroelectric potential is located in rural areas where the predominant economic activities and lifestyles are based on residents’ use of the territory they inhabit for their own local development. This differs from the economic rationale associated with the hydroelectric sector, which uses the resources of a territory to generate development outside it. From this perspective, farming and tourism may be seen by the energy sector as economic activities, whereas local actors see them as ways of life and cannot conceive of the idea of replacing them for an alternative activity. Indeed, tourism is perceived as a form of endogenous development in the three study basins, and its benefits are seen not only as economic, but also as social and cultural, in that it involves the participation of many people and allows the community to maintain its identity, customs, values, traditions, and natural heritage. When local actors perceive a threat to this activity due to hydroelectric development and come to understand that they lack the power to influence it, they understand that their perspective is neither recognized nor valued. This is accentuated further when it comes to the Mapuche–Willeche people residing in the basins of the Valdivia and Bueno Rivers. In this case, there is a different worldview in which the material is not separated from the spiritual and, therefore, potential impacts on specific places cannot be mitigated or compensated [27,58]. In both cases, different worldviews are involved and communities in dialogue with hydroelectric companies feel either undervalued or not correctly served. This factor has a significant influence on community acceptance of hydroelectric development.

The third factor is distrust regarding the development of hydroelectricity and the actions of both MINENERGIA and the companies in charge of designing the energy projects. In this sense, the community participating in this study showed distrust of the real objectives of the government for promoting hydroelectricity and questioned the role it played, as generally is the case for communities. The community saw the government as a facilitator of project approval, and not, as the residents thought it should be, as a defender of their common good. In addition, community members complained of a lack of transparency in the participation and dialogue processes with both companies and the government and expressed distrust regarding the real influence that they had on the decision to develop a project in their territory. In the case of the Mapuche–Willeche communities, the distrust includes the feeling that the State still does not understand the meaning that the territory, historically inhabited by the communities, has for them.

The fourth factor is the existence of a sense of self-determination in the community. This relates to the possibility of being able to directly influence the decision-making process when it comes to the location and characteristics of a hydroelectric project. The Chilean legislation, at present, does not contemplate this scope of intervention within the formal framework of the participatory process [57]. In particular, the historical presence of Mapuche–Willeche communities in the basins of the Bueno and Valdivia Rivers [27,41] and the processes related to the occupation of the Yelcho River basin [43] have influenced the formation of a community with a strong sense of identity and territoriality, which translates to a sense of self-determination, and therefore a high valuation of decision-making power at the local level. For example, in the case of the Yelcho basin, the fact that the territorial configuration, at present, was mainly created by the efforts of pioneers outside of the State’s

development policies coupled with a historically distant relationship with the central government reinforces both the sense of local identity and the distance from the country's objectives [43]. Additionally, as pointed out by Zunino et al. [59], this basin is characterized by the influence of “lifestyle migrants” who moved to the region in search of a better way of life. These people tend to perceive initiatives, such as hydroelectric development, as strong modifiers of the environment representative of the economic model that they reject, and they influence the community to oppose these initiatives.

Similarly, in the case of the Mapuche–Willeche communities, the specific land conflicts and territorial demands are closely related to the processes of self-recognition and cultural strengthening that these communities have experienced, which are often not aligned with the social, political, and economic developments that the State of Chile aspires to [58,60].

5.2. Main Issues of Conflicts Regarding Hydroelectricity

As mentioned before, the analyses of current or latent conflicts in the study area offer an opportunity to assess the importance and current validity of the conditioning elements of community acceptance not captured by the Objects of Value Framework. In this regard, six conflicts observed in the study basins were briefly analyzed. Their main characteristics are shown in Table 1.

Table 1. Main conflicts regarding hydroelectricity in the study area (based on [27,44,45,47–55]).

Conflict	Basin	Main Actor-Types Involved	Main Issues
San Pedro Plant, 144 MW (2007–present) [51]	Valdivia River	Hydroelectric energy company, national government agencies, non-indigenous community organizations, indigenous organizations, tourism entrepreneurs	Risk associated with project implementation and project start-up (e.g., landslides, structural failure of dam wall) due to presence of geological fault. Impact on environment component: rainforest temperate forest (biosphere reserve). Impacts on both material and productive value of the territory. Impact on local territorial organization and little recognition of different world views.
Neltume Plant, 490 MW (2010–2017) [52]	Valdivia River	Hydroelectric energy company, national government agencies, non-indigenous community, indigenous organizations, NGOs, indigenous communities	Disturbance of cultural significance sites of Mapuche–Willeche people. Impact on environment component: disturbance of Lake Neltume and surrounding land. Impact on local territorial organization and little recognition of different world views.
Pilmaiquén Company's Rucatayo Plant, 59 MW; Osorno Plant, 58.2 MW; and Los Lagos Plant, 50.8 MW (2006–present) [45,49,53–55]	Bueno River	Hydroelectric energy company, national government agencies, indigenous communities	Disturbance of cultural significance sites of Mapuche–Willeche people, including the river itself. Lack of consultation with indigenous population. Impact on local Mapuche–Willeche territorial organization. Lack of transparency and interventions in Mapuche–Willeche representation in territorial decision making. Intervention divided into two projects with overlapping areas of influence. Commercialization of consent. Judicialization.
Las Flores Plant, 4.2 MW (2011–present) [27,49]	Bueno River	Hydroelectric energy company, indigenous communities, national government agencies	Lack of consultation with indigenous population. Impact on local territorial organization. Environmental impact. Lack of transparency and interventions in Mapuche–Willeche representation in territorial decision making. Ecological and spiritual fragmentation of territory. Fragmentation of hydroelectric project. Judicialization.
Riñinahue Plant, 0.839 MW (2014–present) [27]	Bueno River	Hydroelectric energy company, indigenous communities, NGOs	Disturbance of sites of cultural significance to Mapuche–Willeche people. Environmental impact. Impact on local economic activities (tourism).
Río Isla Plant, 4.2 MW (2009–present) [47]	Bueno River	Hydroelectric energy company, indigenous communities, NGOs, national government agencies	Disturbance of sites of cultural significance to Mapuche–Willeche people. Environmental impact. Lack of transparency and interventions in Mapuche–Willeche representation in territorial decision making. Impact on local economic activities (tourism). Lack of consultation with indigenous population.

¹ At the time of the study, the conflict was open.

Each factor was then supported by information on conflicts associated with hydroelectric projects.

Lack of validation of formal participatory processes: One of the cross-cutting factors arising from the analysis was the lack of validation given to the participatory process in the context of environmental impact assessments and distrust in them. This is made explicit in the following arguments by the Mapuche–Williche communities in the context of the conflicts in the Bueno River basin:

“The citizen participation process is invalidated by the short time available to comment on a project. If the project is approved anyway, what is the point of writing detailed environmental impact assessment (EIA) studies, such as the one carried out by Ingendesa on the Osorno hydroelectric plant of Empresa Eléctrica Pilmaiquén S.A., where all the environmental, sanitary, economic, social, cultural and anthropological damage to the local communities is demonstrated? Mrs. President, we are concerned about the collusion between the companies and the State institutions that should protect us, which produces a natural distrust in the non-representative territorial dialogue tables established by the government” [61].

“We are surprised by the things that the government does, because really these consultations should have been done when the company first arrived, but they did not do it and went with the mafia project, deceiving many people, and they are still deceiving.” [62].

The mistrust is not limited to process of consulting with citizens and the indigenous population, but extends to the environmental impact-assessment process. This is due to the strategies of the hydroelectric companies and the effective implementation of the regulations. For example, the Las Flores hydroelectric company presented its hydroelectric project in two phases, avoiding the need for an environmental impact study [27]. In this situation, the community felt deceived and deprived of meaningful participation in the decision making (without an environmental impact study, there is no requirement for a participatory process). Likewise, Kelly [49] indicated that there was confusion about the Pilmaiquén intervention, because the communities had not been informed that two hydroelectric plants were being planned with overlapping areas of influence. The lack of communication and presence in the territory also contributed to distrust in the participatory and evaluation processes.

Distrust regarding the development of hydroelectricity: Different arguments identified from the conflict analysis supported the existence of this element as a factor conditioning community acceptance. One example is a document issued by Millaray Huichalaf, a Machi (community health authority), arguing that the permit for constructing the Osorno hydroelectric plant in 2009.

“Was obtained after an irregular environmental evaluation process and after pressure from EEP S.A. [the company that owns the project] to avoid implementing an indigenous consultation process and having to obtain the consent of the communities that make use of the natural ceremonial complex. Such pressures allowed the hydroelectric project to be authorized two months before ILO Convention No. 169 was to enter fully into force in Chile” [53]. This is in addition to the fact that during September 2013 and February 2014,

“EEP S.A. took advantage of holding meetings with communities that were willing to negotiate, in order to comply with the condition established by the environmental authority. This, in open contradiction with human rights standards and at a time when ILO Convention No. 169 was already in full force” [53].

Another aspect of the same factor was the secret negotiations conducted by the companies that own the projects with some representatives of the indigenous communities, generating the commercialization of consent and deepening distrust on the part of the communities [49]:

“Statkraft, as the current owner of the hydroelectric projects, has contributed significantly to the violation of the rights of the riparian communities, through the deployment of practices aimed at buying the will of the Mapuche people and communities of the Pilmaiquén River basin. These interventions have deteriorated the trust and social fabric in the territories” [53].

“We also regret that leaders have betrayed their Mapuche principles and have personally negotiated the collective rights of our people and today have the audacity to run for political office at the national, regional and communal levels. The Puelwillimapu Territorial Alliance does not negotiate the Ñuke Mapu and does not identify itself with any Political Party, it only recognizes its Ancestral Authorities as pu Machi, pu Lonko, pu Nguillatufe ka Pu Werken” [63].

Under-recognition of different worldviews: The conflict analysis also revealed the existence of different worldviews. For example, Cuadra [48], analyzing the Neltume plant conflict, concluded that the indigenous communities’ notion of territory is not limited to indigenous property, but also refers to the ancestral and collective use of the property, which implies geographic, material, and symbolic dimensions. The installation of hydroelectric projects would not only affect the physical space in which communities exist, but also interfere with the ways in which communities relate to the space from a symbolic point of view, and with the power relationships required to maintain control over the area.

Regarding the conflicts in the Bueno River basin, Mapuche–Willeche leaders have expressed that:

“the flood will affect everything; the whole territory is about to disappear. . . . You cannot leave it under water, because the entire Mapuche philosophy and worldview would disappear”, and, “We have a firm position against negotiating over our sacred spaces. The mitigation actions a Company can do, do not compensate for the damage that will be done to the Mapuche people. . . . It goes against our spirituality and all our lives that we have developed in this environment” [48].

Similar arguments are used by Millaray Huichalaf, a Machi of the Lof, located on the Pilmaiquén River (Bueno River basin), in an attempt to defend the community from the Osorno and Los Lagos hydroelectric projects:

“Statkraft continues to insist on building both power plants on the Pilmaiquén River, ignoring the sacred character of this river, around which the communities have lived since time immemorial. . . . The construction of any power plant on the Pilmaiquén River will mean cutting the ancestral cycles that connect the communities with their ancestors and territory, and against which we have assumed the responsibility towards our future generations to conserve this sacred space, the only way to project our existence as a socially and culturally differentiated people” [53].

The same line of argument emerges from the Mapuche–Willeche communities in the conflicts over the Riñinahue mini-hydropower plant and the San Pedro hydroelectric power plant:

“All of the Valley of Riñinahue, I have heard elders say, is a great Ngen Ko, a great spring of water, and this spring of water feeds all that you see here. This young forest, those hills. This is like a Kultrun [drum], and this great Ngen Ko, this great strength of water, of life, of existence, of fertility, is what sustains all of us here” [27]. “The San Pedro river or Wazalafken, is a Ngen, and through this Ngen Ko our ancestors pass, our forces that help us to revitalize our kimiin and those that put us in tune with our spiritual world. That is why the San Pedro Hydroelectric Power Plant project transgresses our good life and interrupts our spirituality” [64].

These arguments emphasize that the fragmentation caused by hydroelectric projects has an impact on the spiritual realm, such as “the Ngen Ko spirit, guardian of water” [27].

Sense of self-determination in the community: Territorial claims, particularly by indigenous Mapuche–Willeche communities, is another factor that conditions community accep-

tance of hydroelectric development mentioned in the arguments of various social actors. These claims are identified in the Valdivia and Bueno River basins, and they are clearly related to territorial control and community self-determination. For example, in the case of Neltume, Cuadra [48] described such claims through the opinion of a Mapuche–Willeche leader recorded in one of the indigenous consultation sessions:

“We will see, after what we are informed in this meeting, what we are going to decide and then we will communicate our decision, because we are the originators here, the company is a newcomer” [48].

In the same way, with the Osorno and Los Lagos hydroelectric projects, authorities of the Mapuche–Willeche people, in a letter addressed in 2015 to the Michelle Bachelet, president of the Republic of Chile at that time, stated that:

“there is also a serious problem of abuse and discrimination against the actors who are ‘invited’ to participate in these bad institutional practices, where not all lonko are included in the discussion of regional and investment issues. From the Spanish to the Indigenous Law we are recognized as ancestral authorities, which endorses and protects us: it is worth remembering that in the Indigenous Law of Chile, as far as the communities of the Willeche People are concerned, the interlocutors of the State are the ‘cacicados’, being that there is legal recognition of their traditional system and their territorial scope” (Art. 61) [61].

The factors from the above analysis (impact on environmental component, territorial claims, and existence of different worldviews) are congruent with the motivations that determined the occurrence of conflicts over hydroelectricity in other river basins, such as Biobío [8,27,65,66], Baker and Pascua [67], Toltén [8,46], Maipo [68,69], and Puelo [70]; therefore, they could be considered as transverse factors that can potentially condition project development in all basins in Chile with exploitable hydropower potential.

6. Discussion

A key argument supporting the adoption of the Objects of Value framework by MINENERGIA is that identifying and assessing such objects would make it possible to assess the community acceptance of hydroelectric development in a given territory. This argument assumes that the Objects of Value describe those elements or attributes of a territory that are effectively valued by communities, and if they are affected by energy development, they can become the main cause of conflict between the community, investment companies, and the government. However, as noted in the previous section, it became evident that there is a set of intangible factors not covered by the Objects of Value framework that allow a better understanding of communities’ responses to hydropower development. These results agree with the evidence shown in the literature (see, e.g., [10,18–20,71,72]), which indicates that the critical aspects to be considered to explain community acceptance of local development projects go beyond the mere identification of elements that can be objectively observed and measured.

The above argument means that altering a territory by developing hydroelectric projects affects not only physical elements of economic, ecological, or sociocultural importance, but also intangible aspects whose existence derives from the community’s relationship with its geographic surroundings [18,71,72]. This relationship is not necessarily limited to residence, ownership, or dependence on the natural resources that exist there, but also depends on a series of historical, psychological, social, and cultural processes that construct a sense of identity and belonging to that space by the social group that inhabits it [72,73]. Similarly, this idea shared by a group about its relationship with the space also serves as a claim on natural resources, that is, it defines for the group or community who has a legitimate right to transform the space and how, which may or may not be defined as property rights [73,74].

Therefore, identifying and analyzing the existing links between community and space (and also the links between the members of a community) would allow a better understanding of the drivers of community acceptance of hydroelectric development. In this

regard, the literature is clear that several factors and processes are key to understanding communities' responses to (i.e., acceptance of) sectoral developments (e.g., hydroelectric development) that intervene in their territories. These factors and processes include: (i) place attachment, (ii) identity, (iii) sense of community, (iv) trust between actors (within and outside the community), (v) the existence of individual values (e.g., biospheric, altruistic, egoistic, and hedonic), and (vi) the existence and quality of a binding participatory process [10,17–20,71,72,75]. It follows that in order to identify “adequate” areas for the development of hydroelectricity, a scenario in which a high level of community acceptance is expected, it is necessary to develop and apply planning support tools that allow the identification and description of both tangible and intangible aspects that drive the responses or behaviors of communities and their members toward hydropower development.

Moreover, community acceptance will depend in part on the sociopolitical acceptance of hydropower development (Figure 1). For example, as identified in this research, the institutional arrangements that govern citizen participation in the environmental assessment of hydropower projects lack sociopolitical acceptance because they are considered as processes that do not allow for effective community participation. It is important that all actors involved in the process of developing and implementing a new energy matrix accept the institutional arrangements that will govern this process, if the goal is to gain community acceptance of hydroelectric development.

In this sense, although the new energy development policy has attempted to change the development paradigm of the sector, such as by promoting decision making that involves local actors, it results in homogeneous territorial planning policies at the national level that do not have the flexibility to incorporate the visions, values, and interests of local communities. An example of this is the Objects of Value framework, a tool meant to be applied consistently throughout the country. This type of scheme loses all meaning, for example, when it comes to inferring community acceptance in Mapuche–Willeche territories, since the native peoples' concept of territory differs from that incorporated by the state [58,60]. In this respect, the concepts established in the Chilean institutional framework (e.g., “significant impact” and “area of influence”) do not allow for the flexible incorporation of the worldview of the original peoples and their concept of spatiality. The state's fragmented logic in understanding the territory leads to undervaluing the impact of hydropower development on indigenous territories [76].

Although the Objects of Value framework is not sufficient to describe the abovementioned factors and processes, some of the variables considered would allow us to indirectly and qualitatively infer their status or degree within a territory. For example, the presence of indigenous communities or indigenous land could serve as a proxy that would allow us to infer a context characterized by a great attachment to place and a sense of identity by indigenous communities. In this regard, the condition that derives from the close relationship between indigenous communities and their inhabited space has been clearly described in the literature [27,58,60].

Additionally, because applying the Objects of Value framework requires a large amount of local information, much of which is not available at present (e.g., culturally significant sites of indigenous character), it is costly in terms of human and financial resources. On the other hand, both the construction of the framework and the weighting and validation of Objects of Value require continuous participation by local actors (particularly residents, local authorities, and representatives of local trade associations), given that the objective is to value their visions and interests. This is a major barrier, as the participatory process is not considered reliable by local communities [46,49].

This study showed that territorial evaluation tools based on tangible or physical objects do not provide a complete assessment of community acceptance. This is especially relevant in places inhabited by indigenous communities in both Chile and Latin America, where the places acquire the connotation of intangible and immaterial goods [77]. Indeed, the deep connection that indigenous communities have with nature means that both their traditions and their culture are strongly rooted in their territory. In this context, it was

proposed to incorporate intangible elements in the planning process using a rigorous and systematic tool applicable to the participatory processes of territorial planning and strategic environmental assessment. In this regard, Figure 6 shows a territorial analysis scheme that sets out the main milestones that should be met and the essential information to estimate the level of community acceptance in a territory, which can subsequently contribute to territorial planning of hydropower development.

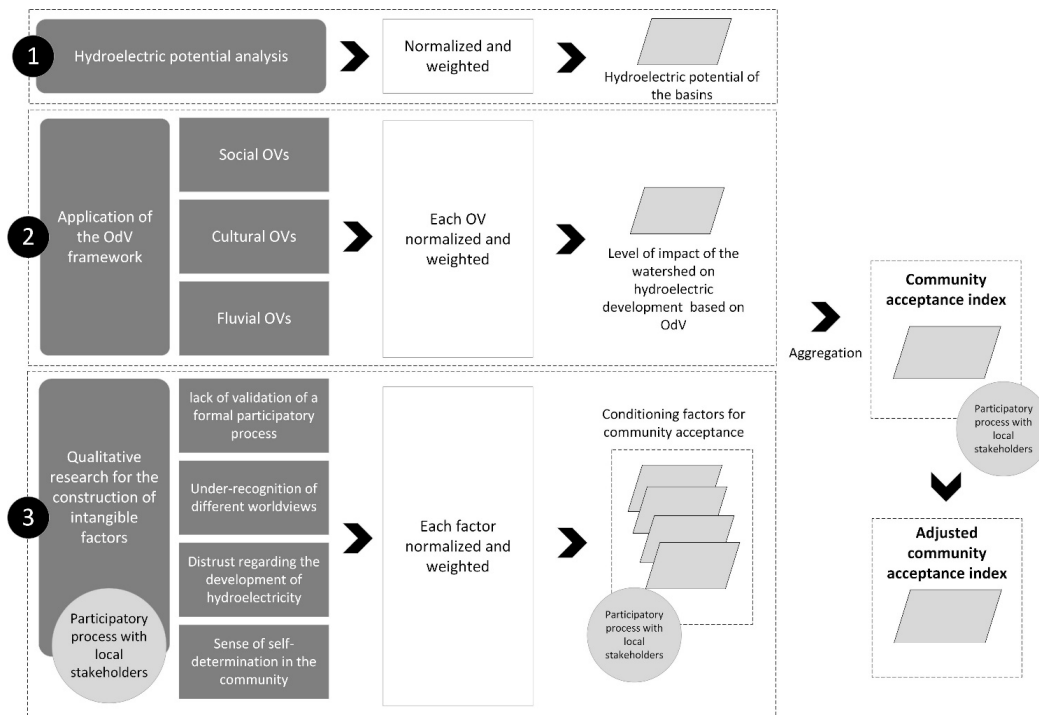


Figure 6. Territorial analysis scheme for estimating community acceptance.

7. Conclusions

Achieving community acceptance of hydroelectric development is a fundamental objective in order to meet the goal established by Chile's National Energy Policy 2050 of having an energy matrix based on the use of renewable natural resources (e.g., sun, wind, and water). This aim, identified as a global challenge, demands the identification and understanding of the main factors underlying community acceptance, which are priority tasks for stakeholders as well as researchers.

In general, the implementation of sectoral measures to avoid community opposition to the development of renewable energy has been characterized by an underestimation of the causes that determine community acceptance and its complexity, resulting in such measures being ineffective. This problem has been taken up by Chilean institutions using participatory working groups, which have declared with broad consensus the need to develop methodological frameworks that will allow the evaluation of the sociocultural and economic impacts of hydroelectric development on territories and communities.

The incorporation of the Objects of Value framework by the Chilean Ministry of Energy as a tool for including factors constraining hydroelectric development in the energy development policy is a significant advance in the recognition of social and environmental aspects that were not considered in earlier planning. However, this framework assumes that conducting territorial energy planning for hydroelectric development that protects citizens' interests in a given territory depends solely on identifying and protecting physical Objects of Value.

In this regard, a general analysis of the recent conflicts in the study basins and the perceptions of involved actors on hydroelectricity revealed four factors that are not represented

within the Objects of Value framework and could condition the community's acceptance of hydroelectric development in Chile. In addition to being consistent with the motivations that determined the occurrence of conflicts over hydroelectricity in other Chilean river basins, these four factors are also consistent with the main sociocultural dynamics and processes considered to be critical to explain community acceptance of energy development in the literature.

Therefore, simply validating the Objects of Value framework as a tool for evaluating physical objects that the community considers valuable does not mean that those objects are the main determinant of community acceptance of hydroelectric development. In this sense, the framework is insufficient to reflect the reasons for community acceptance, and therefore its application should be complemented by incorporating in the decision-making process at least those factors identified in this study that are left out to date. This, by means of a methodological tool applicable to participatory processes that allows a systematic and rigorous approach to intangible factors.

It follows that the success of a renewable energy development policy will depend mainly on the recognition of territorial dynamics and visions of local development existing in territories (e.g., basins) with exploitable renewable energy potential (e.g., hydropower). In the case of Chile, the design and implementation of a narrow policy with a sectoral approach that includes only hydroelectric potential and does not include or recognize the importance of the territories' social capital will face the challenge of resistance and conflict. Including local actors in the decision-making process will allow greater political and community acceptance for territorial interventions by facilitating a multi-faceted approach for identifying elements of interest to communities, whether tangible or intangible.

Recognizing the mutual dependence between community acceptance and sociopolitical acceptance is key. In this regard, the likelihood of achieving community acceptance will depend on local communities "accepting" the consequences of the institutional arrangements that govern the implementation of the energy development policy. In other words, the governance system that underpins energy development must be supported by all actors at various decision-making levels (i.e., national, regional, and local).

The main limitation of the present study was applying the Objects of Value framework in the absence of a potential hydropower project in the basins under study according to the guidelines of Chile's energy policy at present. It should be noted that the present study was part of a technical-academic exercise aimed at refining the Objects of Value framework, which was developed in a previous stage of research, and applying it to a set of potential hydropower development scenarios. In that exercise (covering 2015–2016), the four intangible factors were identified, which are recognizable in the hydroelectric conflicts analyzed using current secondary information (2017–2022), demonstrating that these are still in force as the main conditioning factors for hydroelectric development in Chile, especially within the territory where the Mapuche–Williche communities are located.

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Appendix A

Table A1. Definition of fluvial OVs (Source: [12]).

Category	Number	Name	Definition
Fluvial	F-1	Fluvial species in threatened category	Species richness in threatened category (CR, EN, V, DD, or R) ¹
	F-2	Endemic fluvial species	Richness of endemic fluvial species
	F-3	Undisturbed hydrological regime	Disturbance level of hydrological regimen due to civil work presence
	F-4	Undisturbed sediment regime	Disturbance level of both natural regime and availability of sediments due to civil work presence and anthropogenic activities
	F-5	Freshwater systems with longitudinal connectivity at channel level	Non-fragmented longitudinal connectivity at channel level
	F-6	Fluvial systems with longitudinal connectivity of the riparian corridor	Longitudinal connectivity of non-fragmented riparian corridor
	F-7	Fluvial systems with lateral connectivity	Fluvial systems with non-fragmented lateral connectivity
	F-8	Accessibility of the hydrographic network	Accessibility to habitats in the river for fluvial species by sub-sub basin
	F-9	Fluvial systems with natural conditions of physic–chemical water quality	Fluvial systems with natural conditions of physic–chemical water quality
	F-10	Morphologically intact river systems	Sub-sub basin with low disturbance level regarding fluvial morphology
	F-11	Fluvial communities with low presence of exotic species	Fluvial ecosystems slightly affected by exotic species
	F-12	Critical fluvial areas for biodiversity conservation	Existence of key habitats to biodiversity conservation of riparian species
	F-13	Lake ecosystems	Size and natural conditions of lakes and lagoons
	F-14	Glaciers	Glacier presence

¹ CR: critically endangered; EN: endangered; V: vulnerable; DD: data deficient; R: rare. Based on Decree 29/2012 of Ministry of Environment of Chile.

Table A2. Definition of terrestrial OVs. (Source: [12]).

Category	Number	Name	Definition
Terrestrial	T-1	Terrestrial species in threatened category	Species richness in threatened category (CR, EN, V, IC, or R) ¹
	T-2	Endemic terrestrial species	Richness of endemic terrestrial species
	T-3	Critical terrestrial areas for biodiversity conservation	Key habitats for biodiversity conservation (e.g., breeding and migration sites; RAMSAR)
	T-4	Natural landscape areas	Basins with low anthropogenic impacts on natural landscapes
	T-5	Non-fragmented natural landscape	Non- or low-fragmented landscapes by sub-sub basin
	T-6	Terrestrial communities with low presence of exotic species	Terrestrial ecosystems slightly affected by exotic species
	T-7	Azonal terrestrial ecosystems	Ecosystems with low spatial distribution associated with specific soil conditions
	T-8	Terrestrial ecosystem in threatened category	Terrestrial ecosystem in threatened category based on Red List of Chilean Ecosystems [78]
	T-9	Protection from erosion	Critical area for maintaining and regulating fluvial regime or water quality, and controlling the erosion and terrain stabilities
	T-10	National parks	Official protected areas declared as national parks
	T-11	Official conservation areas excluding national parks	Official protected areas excluding national parks: national reserves, national monument, nature sanctuary
	T-12	Private interest conservation areas and priority sites	Areas considered priority sites for biodiversity conservation by the Ministry of Environment of Chile and private-interest protected areas

¹ CR: critically endangered; EN: endangered; V: vulnerable; DD: data deficient; R: rare. Based on Decree 29/2012 of Ministry of Environment of Chile.

Table A3. Definition of social and cultural OVs. (Source: [12]).

Category	Number	Name	Definition
Social	S.1	Social subsistence needs: drinking water and sanitation	Presence of small localities with relevant sanitation and drinking water requirements
	S.2	Social subsistence needs: food	Presence of small localities with irrigation requirements
Cultural	C.1.1	Sites of indigenous cultural significance and indigenous cultural activity	Existence of historical or sacred sites with high cultural signification for indigenous communities; and existence of sites where activities with high cultural value for the indigenous communities are conducted
	C.1.2	Relevance of indigenous land	Existence of lands that meet some characteristics established in Article 12 of Chilean Indigenous Law (n° 19,253)
	C.1.3	Relevance of indigenous development areas	Existence of geographic territories with high-indigenous-population density defined according to Article 26 of Chilean Indigenous Law.
	C.1.4	Relevance of indigenous land demands	Existence of land in conflict. These lands are not officially recognized as indigenous land by the Chilean state; however, they are being claimed at present by indigenous people for historical reasons
	C.1.5	Presence of indigenous community	Existence of groups of people belonging to the same indigenous ethnic group according to Chilean Indigenous Law
	C.2.1	Sites of cultural significance and cultural activity	Existence of historical or sacred sites with high cultural signification for non-indigenous communities; and existence of sites where activities with high cultural value for the non-indigenous communities are conducted
	C.2.2	Archaeological sites	Existence of places with historical or artistic value that, according to Chilean Law (n° 17,288), have to be conserved
C.2.3	Sites of high landscape value	Presence of unique and representative places for local population due to their high natural condition and landscape attributes	

Table A4. Definition of productive OVs. (Source: [12]).

Category	Number	Name	Definition
Productive	P.1	Agricultural production	Economic relevance or added value of agricultural activity
	P.2	Forest production	Economic relevance or added value of forest activity
	P.3	Sanitary services	Economic relevance or added value of sanitary services
	P.4	Tourist activity	Economic relevance or added value of tourist activity
	P.5	Aquaculture activity	Economic relevance or added value of aquaculture activity

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