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# . Mapping and Managing Organization Objectives: A Case Study of the Alto Maipo Hydroelectric Project in Chile

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## ABSTRACT

This study presents a process that uses the method of alliances, conflicts, tactics, objectives and recommendations (MACTOR) to inform integrated water resources management (IWRM) strategies for complex, multi-organization hydroelectric projects. This process is applied to the Alto Maipo Hydroelectric Project (AMHP) in Chile. The process enabled qualitative and quantitative insight on the interconnected aspects of alignment and conflict between AMHP organizations by mapping the 'battlefield' on which they converge or diverge based on their organizational objectives and relative levels of influence. Study findings reveal environmental protection and water provision are the core objectives around which conflicts center. Study findings also point to a nuanced power struggle between state and local organizations that undermines project productivity. Project recommendations focus on improving communication and collaboration between aligned yet siloed organizations and on improving the mechanisms for information flow and advocacy for local community and governmental organizations. These findings demonstrate the utility of the MACTOR approach – as it is applied within the proposed process – as a way to inform IWRM strategies for multi-organization hydroelectric projects from a systems perspective.

## INTRODUCTION

It is becoming increasingly challenging to plan and manage water resources in light of water scarcity, pollution, and a growing percentage of the population moving to urban centers (United Nations et al. 2019). In the midst of these challenges, Integrated Water Resources Management (IWRM) offers a means to address the complex and multidimensional linkages between the various water resource stakeholder groups (Davis 2007; Gallego-Ayala and Juízo 2014; Suárez et al. 2014; Hargrove and Heyman 2020). A core goal of IWRM is to thoughtfully consider and apply the knowledge of a diverse range of stakeholder groups to optimize social and economic benefits while not compromising resource sustainability (Hassing et al. 2009; Suárez et al. 2014; Davis 2007; Werkheiser and Piso 2015).

Large hydroelectric projects provide a salient backdrop for the use of IWRM strategies, especially related to conflict mitigation and the sustainable and equitable provision of both water and energy resources (Jusi 2013). Hydroelectric projects often fall within the realm of 'megaprojects', given their high cost and the impact they pose on society, the environment, and on the resources they depend upon (Ansar et al. 2014; Flyvbjerg 2014; Sovacool and Bulan 2011). Like most megaprojects, large hydroelectric projects involve multiple organizations from both public and private sectors. Here we define an organization as any organized group of stakeholders that may affect or be affected by the achievement of the purpose or purposes of a project (Freeman et al. 2010). Separate from an unorganized group of individual stakeholders, such as water or energy consumers, organizations have concrete objectives and a spokesperson who can represent the organization in an articulated manner. As a result of the inherently complex organizational environment within which large hydropower projects exist and operate, the true influence organizations can have on project development and management is extremely variable (Bourne and Walker 2006).

Organizations integrate within a wide and complex network of competing interests and objectives (Davis 2007). The process of management throughout and beyond the construction of megaprojects have been widely discussed in the literature, with the chief objective of obtaining the support of the many organizations involved (Ignatius Teye Buertey 2016). Yet it remains challenging

to navigate the complex drivers of alignment or misalignment of organizations based on their objectives and interests, often leadingto conflict and suboptimal project outcomes and increased project costs (Flyvbjerg et al. 2003; Ignatius Teye Buertey 2016; Jergeas et al. 2000; Newcombe 2003; Yang and Shen 2015). There have been many past instances where hydroelectric projects were not implemented due to their potential and perceived impacts on the environment and on local communities. For example, in the Chilean Patagonia, the Alumysa Aluminum Reduction Plant project (US $ 2.75 billion) was discarded in 2006 (Dashwood 2012) and the HydroAysen hydroelectric generation project (US $ 3.2 billion) discarded in 2014 (Merino and Bello 2014), both as a result of the strong demands of environmentalist and local community organizations. These examples, and many others, show the participation, and perception, of relevant organizations in the development of a megaproject in general, and a hydroelectric project in particular, can have a critical impact on project success (Davis 2007). This highlights the impetus for IWRM strategies that undergird and support productive communication and collaboration surrounding the economic, social and environmental implications of large hydroelectric projects.

As a large hydropower project located within the fragile multi-use Río Maipo watershed, the Alto Maipo Hydroelectric Project (AMHP) located 60km southeast of the capital city, Santiago [population 7.1 million (INE 2018)], Chile, in the Cajón del Maipo, offers a compelling multi-organization IWRM case study. Since its inception, many regional water supply utilities, rural potable water organizations (APRs), citizen activist groups, farmers, and social organizations, including the urban water service company Aguas Adinas, have vehemently opposed AMHP. They claim the project threatens the security and supply of potable water to the seven million inhabitants in the Santiago Metropolitan region, including farmers with 120,000 ha of irrigation and ten rural communities where drinking water is supplied by APR systems. APRs, which are managed, maintained and operated by the local community, have different regulation and performance frameworks than urban water companies such as Aguas Adinas. Some predictable environmental impacts from project construction include river sedimentation, area desertification, and significant reduction in groundwater recharge rates (SEA 2018). In contrast, advocates purport AMHP will bring much needed employment and innovation to the region, and bolster energy security in Chile (SEIA

2007). Despite these conflicting perspectives, a marked underestimation of implementation costs (initially US$700 million USD, now 3.05 billion) coupled with market challenges (Torrealba 2018), it is estimated that the Alto Maipo project will begin injecting electricity to the Central Interconnected System (SING) in late 2021 (Ministry of Energy 2012; El Mercurio 2020).

Past water resource experts have sought to promote IWRM strategies for basin management in Chile (Donoso 2018). Despite these efforts, however, there are still no policies in Chile that explicitly consider critical issues, such as social equity, environmental protection, environmental management, coordination of different uses and conflict resolution, all key aspects of an IWRM plan (Bauer 2009, 2015; Suárez et al. 2014). A history of neoliberal water management model undergirds this outcome, which fundamentally favors large private corporations, especially hydropower projects (Bauer 2015). Chile has a long history of water-related conflicts – initiated and promulgated by the Chile 1981 Water Code, which officially established that water resources are national and public goods. In this legal framework, water rights could be commercialized and transferred as a commodity between private parties (Bauer 2009, 2015; Bitran et al. 2014; Correa-Parra et al. 2020). While the 1981 water code has since been modified in 2005, critics still point to this law as a key hindrance to IWRM policy and practice in Chile (Bauer 2015; Bitran et al. 2014). When referring to larger hydroelectric projects, the complexity and issues around IWRM are further confounded by the clout and prominence of Chilean energy law, further privileging private access to water resources for energy creation (Bauer 2009, 2015). Bauer (2015 p. 147) echoes these points, stating, “the critical problem of the Chilean water model is the lack of institutional capacity for governance or integrated water resources management, and the problem has worsened as water conflicts have become closely linked to conflicts in the energy and environmental sectors.”

By virtue of the inherent interdependence of social, environmental, technical, political and economic impacts of large hydropower projects, IWRM strategies requires a systems-lens through which to manage the objectives of organizations in order to promote just and equitable distribution of resources, and to mitigate conflict (Grigg 2016; Hassing et al. 2009; UNDP 2008). Past research has focused on ways to visually and quantitatively analyze and interpret the systemic interaction between organizations. One powerful approach is the ‘Stakeholder Circle’, developed by Bourne and Walker

(2005), that provides an effective means to visualize the set of organization in a project, and offers a systematic way to represent the pattern of influences between these organizations. However, a weakness of this approach is the lack of identification of organizational attitudes or positions, as it does not reflect whether the organizations perceive the project positively or negatively Mok et al. (2015). Other studies, such as Rowley (1997), point to the use of social network analysis (SNA) as a way to understand the structural characteristics of the organizational network, wherein organizational influence is limited by patterns of relationships with other organizations inside the network structure (Wasserman and Galaskiewicz 1994). SNA is a useful method to examine the simultaneous influence of multiple organizations, and to predict corresponding responses and organizational strategies (Chinowsky et al. 2008; Rowley 1997). However, SNA does not allow for the explicit consideration of competition and power dynamics between organizations.

Similar to these studies, we posit that informing a IWRM strategy for the Río Maipo watershed following completion of the AMHP, as well as future water basin management strategies in Chile, requires a systems perspective to expose and decipher the complex and nuanced interconnections between organizations. Considering that the key sources of organizational alliances or conflicts are rooted in the alignment or discord between enmeshed organizational interests and objectives, we propose a multi-step stakeholder mapping process that uses the MACTOR (Matrix of Alliances and Conflicts, Tactics, Objectives and Recommendations) method to quantify, map and evaluate the balance of power between different organizations based on their converging or diverging objectives (Arcade et al. 2009; Godet 1991, 1994). This process seeks to leverage the strengths of the aforementioned approaches that map the patterns of influence between organizations with the explicit framing of organizational competition and power-struggles that often lead to conflicts.

Outputs from MACTOR analyses take the form of influence maps and network diagrams that represent scenarios for how organizations form alliances (convergences) or present conflicts (divergences). These diagrams highlight organizations that have the greatest overall influence on the other organizations as well as overall project outcomes, and reveal the project objectives that have the most significant alignment or misalignment. The resulting analysis offers systems-level insight for how to leverage and promote existing organizational alliances and minimize confounding conflicts

153 that negatively impacts an organization's objectives, operations or existence (Vivanco-Aranda et al.
154 2011). Given its strength to emerge systems-level insights for complex multi-organization projects,
155 the MACTOR approach has been applied within many contexts, including planning in development,
156 labor and employment (Bettencourt 2010), socio-economic development (de Figueiredo Porto et al.
157 2010), air transportation (Godet 1976), food supply-chains (Vivanco-Aranda et al. 2011), and photo-
158 voltaic technology innovation (Lo et al. 2013).

159 In the sections that follow, we present a replicable mixed-method data collection and analysis
160 process based on the MACTOR approach to address research questions (RQs) related to IWRM
161 strategies of the Río Maipo watershed in light of AMHP. We then conclude with a discussion of the
162 study findings and associated policy recommendations. The RQs that guided this study are:

163 RQ1: How do AMHP organizations align or misalign based on their objectives regarding the
164 use of the Río Maipo watershed?

165 RQ2: What appears to be the objectives or desires where conflict or alignment exists
166 between these organizations?

167 RQ3: What does this systems analysis reveal about the interaction between AMHP
168 organizations in particular, and inform for future pursuits of IWRM in Chile in
169 general?

170 **METHODS**

171 Below we outline the mixed-method process used to collect and analyze data on AMHP
172 organization objectives and influence culminating with the MACTOR method. With the intention of
173 promoting future replication of this process to other IWRM contexts, we detail the following steps
174 below: i) identification of key organizations through a thorough review of secondary data (e.g.,
175 documents and reports); ii) supplementary interviews with organization representatives, iii) coding of
176 challenges, objectives and organizational influence from the secondary data and complemented by
177 transcribed interviews, iv) MACTOR analysis, and v) Insights and recommendations. Data collection
178 and analysis rested heavily on secondary data sources to minimize the subjectivity that comes from
179 perception – using interviews to both corroborate with and add nuance to the challenges, objectives,

and organizational influences identified via the secondary data. Figure 1 summarizes each step of this process below with an overview of methods and outputs for each step. As many steps were complimentary and required outputs from the previous step to proceed to the next, we combine selected study results from each step to facilitate the elaboration of the multi-step research process. In the subsequent sections, we further detail, analyze, and discuss the study findings.

***Step 1: Identification of Organizations***

A thorough review of secondary data covering topics of interaction and conflicts between related AMHP organizations enabled the creation of an exhaustive list of organizations to participate in the study. Secondary data sources included documents and reports, official web pages, social media pages, press releases and the public environmental impact evaluation (SEIA 2007), all representing the interests, vision, and objectives of the various organizations. Additional organizations were identified through snowball sampling from the reviewed documents and from study interviewees who were asked to indicate which organizations they interact with most (Palinkas et al. 2015). Creators of the MACTOR approach recommend identifying between ten to 20 key organizations to maximize the ability of the approach to characterize the complex interplay of these organizations, while avoiding outputs that are overwhelming and uninterpretable (Godet 1994). In total, eleven organizations were selected for this study. Table 1 provides a list of the organizations, their organizational role, as well as the secondary data sources for each organization that were used throughout the subsequent steps in the process.

***Step 2: Interviews with Organizational Representatives***

We conducted semi-structured interviews with organizational representatives to identify their positions, interests, motivations, limitations, and available resources to face conflicts with other organizations, and to provide qualitative richness and cross-validation of findings from the secondary data. Secondary data and interviews together provided the required inputs – objectives and inter-organizational influence – for the MACTOR analyses.

An interview protocol was discussed and validated by our research team and approved by the Universidad Diego Portales Research Ethics Committee. The research team consisted of the four co-

208 authors of this paper, including two civil engineering academics with knowledge about the MACTOR
209 method and water resources management, an industrial engineering undergraduate student, and a
210 sociologist with specialization in stakeholder conflict. The interview instrument was applied in
211 person. Although the intention was to interview at least one individual from each organization,
212 organizations who did not participate in the interviews were: Aguas Andinas (AA), Maipo Canal
213 Society (SCM), National Forest Company (CONAF), and the Ministry of the Environment (MMA).
214 For these organizations, the necessary information on their objectives and interaction with other
215 organizations was inferred from the answers given by the interviewees and corroborated with the
216 secondary data sources show in Table 1.
217 The following five questions were asked for the organizations who participated in the
218 interviews:
219 1. *What is the vision of your organization regarding the Alto Maipo hydroelectric project?*
220 2. *What effects does the development of the Alto Maipo hydroelectric project have on your*
221 *organization?*
222 3. *What are your organization's objectives at a general level and in relation to the Alto Maipo*
223 *hydroelectric project? What are your challenges and goals in this regard?*
224 4. *What is the relation of influence and dependence that exists between your organization and*
225 *other organizations linked to the project?*
226 ***Step 3: Qualitative coding of secondary data and transcribed interviews***
227 Secondary data and transcribed organization interviews were qualitatively analyzed in
228 Spanish to retain contextual richness and nuance. Transcripts were deductively coded within an Excel
229 spreadsheet, with the purpose of extracting relevant information for the MACTOR analysis,
230 specifically: challenges, objectives, strategies, inference of influence strength (described in Step 4)
231 between organizations (Godet 1994). Table 2 presents the nine challenges and associated objectives
232 that emerged from qualitative coding.
233 ***Steps 4 & 5: MACTOR Analysis & Associated Recommendations***
234 Our research team met in four, five-hour sessions to discuss and evaluate the aforementioned
235 influences, challenges, and associated objectives of AMHP organizations emerging from the

secondary data and interview responses (Godet 1991, 1994). The aim of these sessions was to systematically score organization influence and impact from project objectives. Subjectivity on scoring was minimized through focused discussion and consensus between research team members and supported using quotes from the organization's representative and supplemental documentation. Influence strengths and impacts of organization objectives were housed within two matrices required for the MACTOR analyses: the Matrix of Direct Influence (MDI) and the Matrix of Valued Positions (2MAO).

The MDI is a square matrix that houses ordinal scoring on the level of organization influence (impact of an organization's influence on the other organizations) and dependence (impact on an organization by the influence from other organizations). The strength of influence between organizations are classified on a scale of 0 to 4 according to the following criteria on the pair-wise impact a particular organization has on the other organizations' processes, project, mission, or existence:

- 0: No influence or dependency.
- 1: There is influence on the organization's processes; where a process is an everyday or minor task or operation the organization undertakes in achieving its mission.
- 2: There is influence on the organization's projects; where a project is a major effort by the organization to achieve its mission.
- 3: There is influence on the organization's mission; where the mission is an organization's reason for existence.
- 4: There is influence on the organization's existence

The 2MAO is a square matrix that houses qualitative scoring on the impact achievement of AMHP objectives have on the organization's processes, projects, mission, and existence. For each organization, the valuation is classified against each objective on a scale of -4 to 4, where the sign indicates how achieving said objective would result in a favorable (+) or undesirable (-) influence on the organization. The analysis is performed based on the following criteria:

- 0: The organization is indifferent to the objective being met.
- 1: Achieving the objective influences the operative processes of the organization.

- 2: Achieving the objective influences the implementation of projects by the organization.
- 3: Achieving the objective influences the mission of the organization.
- 4: Achieving the objective jeopardizes the existence of the organization.

Analyses performed on the MDI and 2MAO offer insight into an organization's power of influence and their alignment with other organizations, respectively. In particular, the mathematical operation of these two matrices can be used to infer i.) the combined direct and indirect influence between organizations, ii.) the relative level of power of each organization, iii.) the alignment (convergence) between organizations, iv.) the conflict (divergence) between organizations, and v.) major objectives or issues that drive alignment or conflict. All matrix manipulations were performed using the Lipsor/EPITA MACTOR software (EPITA 2010), where the matrix mathematics are per the MACTOR method outlined in Godet (2007) and presented in the Appendix.

Evaluation of the *combined direct and indirect influence between organizations* takes place within the Matrix of Direct and Indirect Influences (MDII), which combines direct (i.e., Organization A on Organization B) and indirect influence scores (Organization A on Organization B, through interaction with Organization C).

Evaluation of an organization's relative *level of power* ($R_i^*$) entails systematically comparing each organization's level of influence and dependence based on the MDII matrix. Values of $R_i^* >$ 1.0 implies an organization has an above-average power or competition over other organizations, while $R_i^* < 1.0$ implies a level of power less than the average and thus a disproportionate vulnerability to other organizations within this battlefield.

Evaluation of an organization's *convergence* and *divergence* combines information from both the MDI, 2MAO, MDII matrices to characterize the overall extent of an organization's alignment or conflict on project objectives – considering an organization's power struggles as inferred by the level of power score $R_i*$. The resulting output is the weighted valued position matrix 3MAO, used to calculate the weighted value matrix of convergences 2CAA (positive, alignment) or the weighted value matrix of divergences 2DAA (negative, conflict) by multiplying the respective positive and negative values contained in the 2MAO by their transpose. 3CAA is calculated as the average

intensity (weighted score) for organizations who hold the same position (whether positive or negative), where 3DAA is the same calculation by for organizations who hold opposite positions (i.e., one positive and one negative). Results from 3CAA and 3DAA are presented as a network diagram to highlight areas of strong alignment or conflict within the AMHP project battlefield.

Finally, evaluation of the major objectives where alignment or conflict culminate, entails subtracting the valued convergence matrix (2CAA) from the valued divergence matrix (2DAA) to create a new matrix (2MOO), and an associated graph of the net distance between objectives. A smaller net distance between objectives indicates a higher level of alignment between stakeholders on these objectives.

## RESULTS

This section presents the findings from the MACTOR analysis of AMHP organizations. The analysis begins by presenting results from the relationship between influence and power, followed by the assessment of organizational convergence (alliances) and divergence (conflicts). It concludes with an assessment of the overall level of organizational alignment or misalignment on project objectives.

### *Organization Influence and Power (MDII Analysis)*

Analysis of an organization's direct and indirect influence uses the MDI created by the research team. The complete MDI is presented in the Appendix Table A1. Calculation of indirect interactions per equation 1 for creation of MDII, enabled creation of a factor influence map and evaluation on the level of power (Ri*), presented in Figure 2 below. An influence map provides a two-dimensional analysis of the relative influence and dependence for each organization. In addition, an influence map shows the relative power and vulnerability of each organization (Arcade et al. 2009), thereby providing supplemental insight into alignment and conflict and power struggles surrounding project or program objectives (presented in the subsequent sections). High influence scores indicate that an organization has the capacity to influence one or more organizations' mission or existence.

Organizations that appear in the upper right quadrant of the influence map (Figure 2) are those with both high influence and high dependence, and are therefore most likely to be the heart of either

virtuous or vicious project outcomes. It can be seen that AES-GEN (Ri* 1.09) has the largest influence and dependence with other organizations – meaning they have a high potential for influence, while also having a high vulnerability to the decisions and actions of the other organizations. NO-AM (Ri* 0.95) also has a moderate level of influence and is yet vulnerable to outside organizations, especially state agencies. It can be seen that the state agencies, such as CONAF (Ri* 1.45), MMA (Ri* 2.02) and DGA (Ri* 1.70), all appear in the upper-left quadrant of the influence map, indicating a high level of influence and low level of vulnerability to other organizations. This high level of influence and low level of vulnerability is reflected by their high level of power scores (Ri*), where we see the top three scores are for these three state agencies. This shows the important role of these agencies in the context of water and land management in Chile. When asked about the dependence of AES-GEN on DGA and MME, the AES-GEN interviewee highlights the Chilean law that undergirds and gives power to these two agencies:

> *"DGA has to give permission for a lot of our processes, so their authorization role as the environmental institution is important in our process. Nowadays, when its superintendency has to audit us, they invite all the other agencies, so they can all see if you are complying with everything, therefore, with all of them, you have to have a super close and dependent relationship"*

Similarly, regarding their dependence on the MMA, the AES-GEN interviewee indicated:

> *"The MMA has been the most influential ministry for the project construction, because its superintendency can prevent the project from being carried out. The ministry dictates the general policies, processes bills, etc. But is the superintendency who supervises and executes the sanctions and they can stop the project."*

Additionally, these analyses show the highest scoring private company is AA (Ri* 1.16), meaning their influence over AES-GEN is large. Interestingly, AA was initially included in the list of opposing organizations, claiming that the AMHP threatened the security and continuity of Santiago's drinking water service (SEIA 2008). However, in June 2011, AA signed a contract with AES-GEN, in which they gave 2.5 $m^3/s$ of drinking water from Santiago to AES-GEN and, in addition, leased the back-up infrastructure from the tariff system to the electric power generating company, and seeing an

346 economic benefit from pre-sedimentation by the hydro-plant turbines (CIPER 2011; INDH 2012). As
347 the AES-GEN interview corroborates:

348 *"AA were neutral at the beginning, but later on understood they had an opportunity,*
349 *because the project allowed them access to water, independently of climate or stationary*
350 *issues. On the other hand, the Andean water catchments are all downstream from the*
351 *project's return point to the river, therefore they can use the water that passes through*
352 *the turbines without sediments, and their treatment process will be then much easier for*
353 *them."*

354 Organizations with lesser influence and greater dependence on other organizations included
355 the local community organizations (COM, Ri* 0.09; CTCM, Ri* 0.39) and the local government
356 (MSJM, Ri* 0.18). Indeed, local communities and governments are often the ones who are most
357 vulnerable and who experience the greatest impact from large hydro projects (Goodwin et al. 2006;
358 Latta 2007; Maher 2019). When asked about the engagement between AES-GEN and MSJM, the
359 AES-GEN interviewee indicated the importance of engaging the local municipality in discussion on
360 socio-economic and socio-environmental effects from the project. While they appreciated the way in
361 which the municipality aids in project operation, they mentioned the low level of power the
362 municipality has to impede project progress or existence.

363 *"The MSJM, as part of the community and the local council that allocates funds to local*
364 *projects, is a close partner for us. For example, when facing snow or floods during the*
365 *winter operation, we provide logistical support in order to allow fluid transit. We try to*
366 *keep a very close relationship. But as a good neighbor, we must have a good relationship*
367 *with the municipality – that is essential."*

368 Similarly, rural municipalities, like MSJM, often lack the capacity to self-advocate and
369 influence the other organizations (Goodwin et al. 2006), as indicated by a low Ri* score. This reality
370 was expanded upon by the MSJM representative:

*"The institutional role of the municipality is to represent each of its citizens against any public-private venture. The [AMHP] divided this community 70% in favor 30% against based on the data we have gathered. However, I feel that communities in Chile are not prepared to challenge a project of this magnitude, be it mining, hydroelectric, etc. And the municipalities are not professionally equipped to protect the community or local surroundings, they do not have a technical team dedicated exclusively to evaluating projects and present observations."*

This emergent hierarchy of power agrees with the three scales of power for water rights in Chile stated by Rojas Calderón (2014), from weak to strong: i.) communities, ii.) local organizations and local government (e.g., COM, MSJM), grassroots organizations and associations (e.g., NO-AM), iii.) and private surveillance boards composed of local agencies (SCM) and large private companies (AA, AES-GEN). Coincidentally, this partnership of private companies represents the proposed governing body of the upper basin of the Río de Maipo, where the primary control of water rights is controlled by these organizations de facto (Borgias and Bauer 2018).

***Alignment between Organizations (3CAA Analysis)***

Interpretation of organizational alignment is based on an analysis of third order convergence scores within the 3CAA and is facilitated by creating a convergence map (Figure 3), which shows interdependencies between aligning organizations. Overall, 3CAA scores – calculated by multiplying indirect influence scores (MDII), level of power (Ri*) and convergence scores on project objectives (CAA, from the 2MAO developed by the research team, Appendix Table A2) – ranged from 2.1 to 22.5. Figure 3 graphically represents the strength of alignment, based on convergence scores, between the various AMHP organizations. A thick red link signifies the strongest alignment (18.5 to 22.5), a thick blue link signifies a strong alignment (14.4 to 18.4), a thin blue link signifies a moderate alignment (10.3 to 14.3), a thin grey link signifies a weak alignment (6.2 to 10.2), and a faint grey link signifies a very weak alignment (2.1 to 6.1).

High convergence scores indicate a symbiotic alignment, where both influence and objectives are favorable for an organization's mission or existence. Figure 3 shows the strongest alignment exists between MMA and NO-AM. Interestingly, NO-AM indicated they have had minimal contact

with MMA, and that they were not pleased with the ministry's capacity to handle the environmental evaluation of AMHP:

> *"The first time the country's highest political authority on the environment [MMA] received us allowed for a brief conversation. We were then told that they can't do much because they only have two inspectors for the metropolitan region, and the Alto Maipo project is a giant project. But millions of dollars in public resources are wasted in discussing tourist areas of interest, which will have been wasted if the Alto Maipo project comes into operation."*

It is possible that the strong alignment between MMA and NO-AM emerged from a shared focus on environmental concerns, mitigated through Chilean regulation, primarily Environmental Law 19.300 and Water code 1981. As NO-AM mentions: "*We asked them [MMA] to comply with the law [for environmental regulation, law 19.300 of 1994], which, even if it was not sufficient, was the law."*

Figure 3 also shows that the strong alignment between MMA and NO-AM is complimented by a strong convergence between MMA and CONAF. This is not surprising, as these three organizations have the mission to support ecosystem health and management, where CONAF upholds the protection and conservation of forests, NO-AM seeks protection of the rivers of the Cajón del Maipo and its surroundings, and MMA, seeks a more general equilibrium of natural Chilean ecosystems in Chile (Ministry of Environment 2020). Interestingly, these three organizations are not formal allies, even though our findings show that they align on many AMHP project objectives. A reason for this hidden alignment is perhaps because state institutions must typically remain neutral per Chilean law and regulation – ruling in relation to the project only within their technical competences (Silva 2010).

A similar alignment was found to exist between NO-AM, CTCM, and COM, as they share the territorial and environmental consequences associated with the development of AMHP, leading them to have common interests. It is also possible to see a triumvirate alignment between AA, GDW and MMA, which could be expected, given their mission to protect and conserve water sources. AA and DGA are organizations whose mission is based on water resources (drinking water supply, water quality, and water rights management), and the MMA (water protection and conservation of water,

land and air), therefore, alignment is likely associated with a unified mission to care and protect in-land water ecosystems.

While community - and municipal-level organizations show minimal alignment with the larger private and state-level organizations, we see a moderate to strong connection between the SCM and JVSM, and the other state organizations in charge of supporting environmental protection (CONAF, MMA) and the Chilean Water Code (DGA). Despite having low-levels of power and high levels of dependency on other organizations, MSJM and COM appear central in the alliance battle-field.

It can be seen that AES-GEN has the weakest alignment with the rest of the organizations, with all links being weak or very weak. The weakest of these alignments are from MSJM and COM, indicating they have both a low level of influence on AES-GEN activities as well as a minimal alignment on project objectives.

***Conflict between Organizations (3DAA Analysis)***

Interpretation of the conflict between organizations is based on an analysis of third-order divergence scores within the 3DAA and is facilitated by creating a divergence map, presented in Figure 4, which shows interdependencies between conflicting organizations. Third order divergence scores ranged from 0.8 to 13.2, with a max divergence score about two times less than the top third order convergence score (22.5). A thick red link signifies the strongest misalignment (10.8 to 13.2), a thick blue link signifies a strong misalignment (8.3 to 10.7), a thin blue link signifies a moderate misalignment (5.8 to 8.2), a thin grey link signifies a weak misalignment (3.3 to 5.7), and a faint grey link signifies a very weak misalignment (0.8 to 3.2).

This analysis shows a clear focal point of conflict on AES-GEN, in particular between CONAF (10.2), MMA (10.7) and NO-AM (13.2). With a mission to halt construction of the AMHP, and a moderate Ri*, it is expected that NO-AM would have the strongest divergence score (13.2) with AES-GEN. However, it is MMA and CONAF that pose the most detrimental conflict for AES-GEN, given their collective mission of environmental protection and stewardship along with the power to derail the company's mission. Similarly, from analysis of indirect organizational influences, MMA had the largest level of power and lowest dependence on the other organizations, while AES-GEN had

the largest dependence on the other organizations, as evidenced by their centrality in the conflict network (Figure 4). Finally, we see that SCM and JVSM have low levels of conflict, both with AES-GEN as well as the other environmentally-focused organizations, despite having relatively high-power level scores Ri* (Figure 2).

### *Net Distances between Objectives*

The graph of net distances between objectives, presented in Figure 5, offers insight on the relationship between objectives where organizations take the same position, whether for or against, based on their interconnectivity and strength of alignment or opposition. This analysis reveals groups of objectives between which there is strongest alignment (objectives with low net distances) or conflict (objectives with large net distances) (Godet 1994). This graph reveals the objectives for which organizations are most divergent relate to aspects of environmental protection, provision of water and energy services and community prosperity. This shows how AMHP potentially imposes a tension between the needs and benefits of providing energy and overall community prosperity, with the potentially detrimental effects on water availability and quality and environmental degradation. Conversely, the objectives with smaller net distances and thus greater alignment are those related to the social approval and financing of the project, together with social cohesion. This implies that social issues are less likely to drive conflict or alignment between organizations, and that the key battleground surrounds the impact on environment, water availability and water quality, which comes with a host of indirect societal, economic and environmental consequences. These results show the interconnected battlefield between organizational objectives, and how these objectives do not exist in isolation and thus must be managed thoughtfully to minimize conflict.

## DISCUSSION

Findings from this study offer systems-level insights regarding organization power dynamics, the presence of alliances and conflicts between organizations (addressing RQ1), whether perceived or unperceived, and the objectives on which organizations align or misalign (addressing RQ2). This

enables us to discuss core aspects of collaboration, communication, alignment and conflict mitigation towards productive management of AMHP and the Río Maipo watershed (addressing RQ3).

Regarding RQ1 (alliance, conflicts, power dynamics), we see that the most powerful stakeholder organizations are state agencies. However, despite state agencies having the greatest influence on other organizations, whereby the management of water resources in Chile is the responsibility of many institutions (i.e., Directorate of Hydraulic Works (DOH), CONAF, and the Ministry of Agriculture), the previously mentioned studies on Chilean Water law and water governance highlight weaknesses in institutional capacity to administer water law and manage multi-organization interests and conflicts, in particular the DGA's power to monitor and enforce water rights transactions (Bauer 2015; Bitran et al. 2014; Budds 2004; Roose and Panez 2020). The DGA representative reinforced this point:

> *"Firstly, our unit has to approve all the projects throughout Chile and this activity is done at our headquarters where we have only 5 people working. You see that the permit fee that they require is more than the installed capacity and there are also a lot more conditions ... There are emblematic cases that are more time consuming. The Law establishes that the DGA while it does not have all the antecedents cannot respond, that to the extent that you have a long line of reviews you go out of one and you get into another the main problem from the point of view of In view of time, it is the environmental evaluation ... if it does not have a favorable environmental evaluation, all permits are prohibited ... and when the environmental evaluation is finished they come to us."*

In contrast to the state agencies and larger private companies, we see that local grassroots organizations, such as MSJM (Ri* 0.18) or COM (0.09) are less able to promote their objectives. Local organizations generally lack the necessary maturity or capacity to negotiate before large companies or institutions (Goodwin et al. 2006), despite an enthusiastic social-environmental dynamic that arise with the support of social network media (Twitter, Facebook, Instagram, etc.). This immaturity limits their ability to advocate for their interests, and undermines a true IWRM program (Donoso 2018; Hassing et al. 2009; Jusi 2013; Suárez et al. 2014; UNDP 2008). The 2005 Chilean

Water Law also lacks support mechanisms and modalities through which to protect and support local communities and organizations in response to their demands (Roose and Panez 2020).

Despite a formal regulatory framework to engage interests of local organizations, past grassroots citizen action groups in Chile have had enormous impact on hydroelectric programs. For example, the campaign "Rio Pueblo Sin Torres" (Rio Pueblo without Towers), was a highly successful communication initiative that promoted awareness of the conflict between the community of Cochamó and the company Mediterráneo. Their Facebook page has over 53,000 followers (the town only has a population of 4,000) showing the significant diffusion and reach a local organization can have (Velásquez 2018). Another example is the organization 'Patagonia Sin Represas' (PSR - Chilean Patagonia without Dams). PSR also used social networks as a tool to amass support, power and legitimacy with a structural change of the power, upscaling until the highest political levels in the country take notice (Romero Toledo 2014). Nevertheless, the strengthening of user organizations strongly depends on the existence of a legal framework that enables a diverse range of organizational participation in decision-making.

Regarding RQ2 (the objectives on which organizations align or misalign), our results show that the most powerful organizations are those who also align most on environmental objectives. Private and community-based organizations who align with aspects of environmental protection find a favorable relationship with these organizations. As previously mentioned, our results revealed a general non-existence of 'alliance clusters'; that is, aligned organizations appeared, through analysis of secondary data and the interviews, to advocate for their mission separately with little to no cooperation to face opposing organizations. The only organizations that confirmed formal alliance were NO-AM and CTCM, where the other aligning organizations, such as DGA, SCM, AA, and JVSM, appear to act in isolation, maintaining a neutral or regulatory role based on the legal confines of the Chilean Water Code (BCN 2018).

Combining the literature on Chilean Water law with the results from this study on specific organization alignment, conflict, and influence, we address RQ3 (overall study implications) with three overarching findings: i.) state agencies (MMA, DGA, CONAF) have the greatest power to realize their organizational objectives, yet they often work in isolation and are limited in their power

and capacity by the 2005 Chilean Water Law (that reformed a part of the 1981 Chilean Water Law) to promote a true IWRM structure, ii.) large private companies have a greater capacity to achieve their objectives than local community and grass-roots organizations, and iii.) the source of greatest conflict centers around environmental objectives.

***Recommendations for IWRM Policy and Practice in Chile***

Based on the study findings, we propose facilitating positive synergies among aligned organizations by promoting collaboration between CONAF and NO-AM to do joint work with the ME to leverage their power within the Chilean Water Law to uphold environmental standards and impacts on water resource availability. This outcome could be achieved through an adjustment of regulatory standards and communication protocols in Chile for megaprojects to better consider the environmental demands of all organizations, defining the control and regulation processes together with the increase in resources available for these types of environmental conflicts. Conjointly, it will be important to seek to minimize conflicts between organizations, in this case, between AES-GEN and the local community and governmental organizations affected by the project, through increased public and user participation and discussion (Borgias and Bauer 2018; Retamal et al. 2013; Larrain 2010).

The early formation of relationships and dialogue is key in minimizing conflicts between organizations. Past studies have shown that early alliances have more productive collaboration, establish more credibility in the local community, and are more effective at balancing collaborative initiatives against competitive interests (Hearld et al. 2012; Derakhshan, Turner and Mancini 2018; Baharuddin et al. 2017). Indeed, numerous examples help us understand that an organization's management, co-governance and social legitimacy are relevant concepts to consider in the success of future hydroelectric projects in Chile and beyond (e.g., Birnbaum 2015; Marrewijk 2005; Sandström, Crona and Bodin 2013). Similar to what we find in our study, this past work shows that in countries like Chile, power is concentrated on government agencies, leaving a legal deficit in local organizations to defend themselves against the impacts of megaprojects. NO-AM is an interesting exception, given that they are a community organization established by local stakeholders who have

economic resources as well as the professional and the international connections needed to engage in this territorial defense. In other words, NO-AM has been able to privatize local defense, which is not always possible for local community organizations. This is consistent with findings established by Aliste and Stamm (2016), who state that in Chile the main social-environmental conflicts are concentrated in wealthier socioeconomic sectors, raising concerns about the exclusion of proper defense of rural and impoverished sectors of society. This lack of public support could be ameliorated with the help of international non-governmental organizations (iNGOs) that have expertise regarding international law (e.g., World Wildlife Fund and International union for Conservation of Nature) (Eliantonio 2018; Barnes and van Laerhoven 2014), helping educate local organizations on best practices to self-advocate and build their organization's legitimacy. It is important to understand that external organizational legitimacy (Drori and Honig 2013) or social legitimacy (Suchman 1995) is a perception or assumption developed by the observer, but it is always socially constructed, depending on what each group expects from the entity. Indeed, our study shows that social approval and alignment goes beyond legal requirements and authorizations, and are better understood from a systemic perspective, where local organizations that interact and are affected by the project have a voice and an agency to impact project outcomes. Overall, the mitigation of future water use conflicts between organizations, and improved program planning, implementation and management in subsequent hydroelectric projects in Chile, requires a refined legal framework and protocol for information exchange and capacity building. (Ricart and Clarimont 2015).

***Study Limitations & Future Research***

There were some unavoidable issues with validity and generalizability resulting from the data collection and analysis activities.. Obtaining a rigorous representation of objectives and levels of influence between relevant AHMP organization was challenging, as it was not possible to interview organizational representatives from AA, MMA, SCM, and CONAF. We sought to circumvent this issue with the responses from the other interviewees in conjunction with information extracted from the secondary data sources, which included official information channels of each organization and the publicly available environmental impact evaluation. However, we recognize that a true representation of organizational influence on hydroelectric project success also requires consideration of individual

stakeholders, such as electricity and water consumers, a task that is more difficult to accomplish and evaluate with a MACTOR analysis. Excluding these types of stakeholder groups in this study potentially resulted in an incomplete assessment of stakeholder impact on IWRM strategies for AMHP.

Another study limitation relates to the transparency of information provided by the interviewed organizations, a common problem in both qualitative and quantitative studies. It is possible that the organizational representatives interviewed neglected to openly reveal their plans, strategies and objectives, as well as the type of relationship they may have with respect to the other organizations. In addition, there is a risk that the information delivered is not completely true or that the same organizations have a different vision with respect to the topics consulted. As mentioned previously, the research team sought to mitigate errors from false information by comparing data across interviewees and secondary data sources.

A final limitation relates to subjectivity imposed within MACTOR analyses conducted by the researcher team. Although our analysis was carried out with a multidisciplinary team composed of professionals with different backgrounds, degrees, and perspectives, there is an invariable potential for subjectivity, whereby the various forms of information used to perform the MACTOR analysis could have been interpreted differently. The research team sought to minimize subjectivity by gathering and contrasting various forms of secondary data, as well as the interview transcriptions to cross-validate the MACTOR outputs

Despite these limitations, we believe the MACTOR approach, as applied within the multi-step process presented here, provided useful insight into the interdependencies and associated alliances and conflicts between key project organizations of complex and large hydropower projects in general and AMHP in particular. This process could be improved upon in future studies to limit subjectivity, and improve insight on the interactions between organizations and individual stakeholders and their impact on IWRM strategies and hydroelectric project success. Such improvements to the methodology could include: i) Further engagement and discourse between organizations to modify MACTOR inputs and collaboratively evaluate outputs throughout the various stages of project planning, implementation and management, ii) Following-up this study in five to ten years to

compare and contrast findings with any landmark project outcomes related to AMHP management and coordination between organizations, and iii) complimenting MACTOR insights from other systems analyses, such as social network analysis (SNA), to gain a deeper understanding on alignment and conflict based on the flow of communication and knowledge between organizations and individual stakeholders.

## CONCLUSIONS

This study used a mixed-method process culminating with the MACTOR approach to identify and evaluate the interconnected drivers of alignment and conflict between 11 key organizations connected with the Alto Maipo Hydroelectric Project in Chile. Findings from this analysis revealed underutilized synergies between siloed state organizations, and the centering of conflicts or alignment around environmental protection and resource use. It was also seen that while state agencies have the greatest power to realize their organizational objectives with the Rio Maipo watershed, they remain limited in their power and capacity to realize these objectives by existing legal frameworks. Finally, the study revealed a substantial power gap between state agencies and local organizations. These findings point to the need for the development or refinement of policies and legal frameworks that foster connection and collaboration between aligned, yet currently, hermetic organizations to uphold environmental standards and impacts on water resource availability. Capacity building by local non-profits or iNGOs for local community and governmental organizations could help narrow the power gap with state agencies by promoting community-level advocacy for more productive negotiation and increased organizational legitimacy.

The MACTOR approach, as applied within the multi-step process presented here, provided a powerful way to visualize and evaluate the interconnected drivers of alignment or conflict between organizations involved with or affected by hydroelectric projects. However, future studies would benefit from a more iterative and reflective engagement of organizational representatives in the process throughout the implementation and early stages of project management. Future hydroelectric projects in Chile, and beyond, could benefit from the early application of this process as a way to

engage relevant organizations in a thoughtful discussion of managing objectives to mitigate conflict and promote alignment towards a common agenda for sustainable water resource management..

## DATA AVAILABILITY STATEMENT

Some or all data, models, or code that support the findings of this study are available from the corresponding author upon reasonable request. This includes:

- A coarse summary of qualitative analysis of secondary data and interview transcripts
- The complete MACTOR analyses within a LIPSOR MACTOR software file (xml format)

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## REFERENCES

Aliste, E., and Stamm, C. (2016) "Hacia una geografía de los conflictos socioambientales en Santiago de Chile: lecturas para una ecología pol-itica del territorio". *Revista de Estudios Sociales*, 55, 45-62

Ansar, A., Flyvbjerg, B., Budzier, A., and Lunn, D. (2014). "Should we build more large dams? The actual costs of hydropower megaproject development." *Energy Policy*, 69, 43–56.

Arcade, J., Godet, M., Meunier, F., and Roubelat, F. (2009). *Structural analysis with the MICMAC method & Actors' strategy with MACTOR method. Futures Research Methodology*. The Millennium Project: Futures Research Methodolog.

Baharuddin, H., Che Ibrahim, C., Costello, S., and Wilkinson, S. (2017). Managing stakeholders through alliances: a case study of a megaproject in New Zealand. *Management, Procurement and Law*, 170, 151-160.

Barnes, C., and van Laerhoven, F. (2014). Making it last? Analysing the role of NGO interventions in the development of institutions for durable collective action in Indian community forestry. Environmental Science & Policy, 53, 192-205.

Bauer, C. J. (2009). "Dams and Markets: Rivers and Electric Power in Chile." *NATURAL RESOURCES JOURNAL*, 49, 71.

Bauer, C. J. (2015). "Water Conflicts and Entrenched Governance Problems in Chile's Market Model." 8(2), 26.

BCN. (2018). "Codigo de Aguas, Derecho de Aprovechamiento de aguas, Aguas/Legislacion/Chile, Ley: 21064." Biblioteca de Congreso Nacional de Chile/BCN.

Bettencourt, R. (2010). "Strategic prospective for the implementation of employment policies in the Azores." *Technological Forecasting and Social Change*, 77(9), 1566–1574.

Birnbaum, S. (2015). Environmental co-governance, legitimacy, and the quest for compliance: when and why is stakeholder participation desirable? *Journal of Environmental Policy and Planning*, 18(3), 306-323.

Bitran, E., Rivera, P., and Villena, M. J. (2014). "Water management problems in the Copiapó Basin, Chile: markets, severe scarcity and the regulator." *Water Policy*, 16(5), 844–863.

Blanco, V. (1997). “DE LOS DERECHOS DE AGUAS. EL CASO CHILENO.” *REVISTA CHILENA DE DERECHO*, 28.
Borgias, S., and Bauer, C. J. (2018). “Trajectory of a divided river basin: law, conflict, and cooperation along Chile’s Maipo River.” *Water Policy*, 20(1), 127–145.
Bourne, L., and Walker, D. H. T. (2005). “Visualising and mapping stakeholder influence.” *Management Decision*, 43(5), 649–660.
Bourne, L., and Walker, D. H. T. (2006). “Visualizing Stakeholder Influence — Two Australian Examples.” *Project Management Journal*, 37(1), 5–21.
Budds, J. (2004). “POWER, NATURE AND NEOLIBERALISM: THE POLITICAL ECOLOGY OF WATER IN CHILE.” *Singapore Journal of Tropical Geography*, 25(3), 322–342.
Chinowsky, P., Diekmann, J., and Galotti, V. (2008). “Social Network Model of Construction.” Journal of Construction Engineering and Management, 134(10), 804–812.
CIPER. (2011). “Convenio Entre Aguas Andinas S.A. y Aes Gener S.A.” Centro de Investigación Periodística.
Correa-Parra, J., Vergara-Perucich, J. F., and Aguirre-Nuñez, C. (2020). “Water Privatization and Inequality: Gini Coefficient for Water Resources in Chile.” *Water*, 12(12), 3369.
Dashwood, H. (2012). *The Rise of the Global Corporate Social Responsibility: Mining and the Spread of Global Norms*. Cambridge University Press.
Davis, M. D. (2007). “Integrated Water Resource Management and Water Sharing.” *Journal of Water Resources Planning and Management*, 133(5), 427–445.
Derakhshan, R., Turner, R., Mancini, M. (2019). Project governance and stakeholders: a literature review. *International Journal of Project Management*, 37, 98-116.
Donoso, G. (Ed.). (2018). *Water Policy in Chile*. Global Issues in Water Policy, Springer International Publishing, Cham.
Drori, I., and Honig, B. (2013). “A Process Model of Internal and External Legitimacy.” *Organization Studies*, 34(3), 345–376.
El Mercurio. (2020). “AES Gener pide a CNE a retrasar al tercer trimestre de 2021 interconexión de Alto Maipo.” *El Mercurio*, Santiago de Chile.
Eliantonio, M. (2018). The role of NGOs in environmental implementation conflicts: 'stuck in the middle' between infringement proceedings and preliminary rulings? *Journal of European Integration*. 40(6) 753-767.
EPITA. (2010). *La Prospectiva - MACTOR Software*.
de Figueiredo Porto, C. A., Marques, E., and Santos, A. B. A. (2010). “Prospective in Brazil: The power to build the future.” *Technological Forecasting and Social Change*, 77(9), 1550–1558.
Fiori, C., and Kovaka, M. (2005). “Defining Megaprojects: Learning from Construction at the Edge of Experience.” *Construction Research Congress 2005*, American Society of Civil Engineers, San Diego, California, United States, 1–10.
Flyvbjerg, B. (2014). “What you Should Know about Megaprojects and Why: An Overview.” *Project Management Journal*, 45(2), 6–19.
Flyvbjerg, B., Bruzelius, N., and Rothengatter, W. (2003). *Megaprojects and Risk: An Anatomy of Ambition*. Cambridge University Press, The Pitt Building, Trumpington Street, Cambridge CB2 1RP, United Kingdom.
Freeman, R. E., Harrison, J. S., Wicks, A. C., Parmar, B. L., and De Colle, S. (2010). *Stakeholder Theory: The State of the Art*. Cambridge University Press, The Edinburgh Building, Cambridge CB2 8RU, UK.
Gallego-Ayala, J., and Juízo, D. (2014). “Integrating Stakeholders’ Preferences into Water Resources Management Planning in the Incomati River Basin.” *Water Resources Management*, 28(2), 527–540.
Godet, M. (1976). “Scenarios of air transport development to 1990 by SMIC 74—A new cross-impact method.” *Technological forecasting and social change*, 9(3), 279–288.
Godet, M. (1991). “Actors’ moves and strategies: The mactor method.” *Futures*, 23(6), 605–622.
Godet, M. (1994). *From anticipation to action: a handbook of strategic prospective*. Future-oriented studies, UNESCO Pub, Paris, France.
Godet, M. (2007). *Manuel de prospective stratégique – Tome 2 – L’Art et la méthode*. Dunod, Paris, France.

743 Goodwin, P., Jorde, K., Meier, C., and Parra, O. (2006). “Minimizing environmental impacts of
744 hydropower development: transferring lessons from past projects to a proposed strategy for
745 Chile.” *Journal of Hydroinformatics*, 8(4), 253–270.
746 Grigg, N. S. (2016). “Systems Thinking as an IWRM Tool.” *Integrated Water Resource Management*,
747 Palgrave Macmillan UK, London, 119–138.
748 Hassing, J., Ipsen, N., Clausen, T. J., Larsen, H., and Lindgaard-Jørgensen, P. (2009). “Integrated
749 Water Resources Management (IWRM) in Action.” 22.
750 Hearld, L., Alexander, J., Beich, J., Mittler, J. and O'Hara, J. (2012). "Barriers and Strategies to Align
751 Stakeholders in Healthcare Alliances". *The American Journal of Managed Care*, 18(6) s148-
752 s156.
753 Ignatius Teye Buertey, J. (2016). “Stakeholder Management on Construction Projects: A Key
754 Indicator for Project Success.” *American Journal of Civil Engineering*, 4(4), 117.
755 INDH. (2012). “Mapa de Conflictos Socioambientales en Chile.” *Instituto Nacional de Derechos*
756 *Humanos*, <https://mapaconflictos.indh.cl/#/conflicto/12420> (Mar. 13, 2018).
757 INE. (2018). “SÍNTESIS DE RESULTADOS CENSO 2017.” Instituto Nacional de Estadisticas.
758 Jergeas, G. F., Williamson, E., Skulmoski, G. J., and Thomas, J. L. (2000). “Stakeholder Management
759 on Construction Projects.” *AACE International Transactions, PM.12*, 12.1-12.6.
760 Jusi, S. (2013). *Integrated water resources management (IWRM) approach in water governance in*
761 *Lao PDR: cases of hydropower and irrigation*. Acta Universitatis Tamperensis, Tampere
762 University Press, Tampere.
763 Latta, A. P. (2007). “Citizenship and the Politics of Nature: The Case of Chile’s Alto Bío Bío.”
764 *Citizenship Studies*, 11(3), 229–246.
765 Maher, R. (2019). “Pragmatic community resistance within new indigenous ruralities: Lessons from a
766 failed hydropower dam in Chile.” *Journal of Rural Studies*, 68, 63–74.
767 Marrewijk, A. (2005). Strategies of Cooperation: Control and Commitment in Mega-Projects.
768 *Management*, 8(4), 89-104.
769 Marrewijk, A., Clegg, S., Pitsis, T., Veenswijk, M. (2008). Managing Public-Private Megaprojects:
770 Paradoxes, Complexity and Project Design. International Journal of Project Management,
771 26(6), 591-600.
772 Merino, M. E., and Bello, M. E. (2014). “Discourse Coalitions in the Controversy around the
773 HydroAysen Project in the Patagonia Region of Chile.” *International Journal of Social*
774 *Science Studies*, 2(3), 1–11.
775 Ministry of Environment. (2020). “Estructura Organizacional.” *Ministerio del Medio Ambiente, Chile*.
776 Molle, F., and Wester, P. (2009). “River Basin Trajectories.” 327.
777 Newcombe, R. (2003). “From client to project stakeholders: a stakeholder mapping approach.”
778 *Construction Management and Economics*, 21(8), 841–848.
779 Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., and Hoagwood, K. (2015).
780 “Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method
781 Implementation Research.” *Administration and Policy in Mental Health and Mental Health*
782 *Services Research*, 42(5), 533–544.
783 Remington, K., and Pollack, J. (2008). *Tools for Complex Projects*. Routledge, Milton Park,
784 Abingdon, Oxfordshire.
785 Ricart, S., and Clarimont, S. (2015). Modelling the links between irrigation, ecosystem services and
786 rural development in pursuit of social legitimacy: Results from a territorial analysis of Neste
787 System (Hautes-Pyrénées, France). *Journal of Rural Studies*. 43, 1-12.
788 Rojas Calderón, C. (2014). “Autogestión y Autorregulación regulada de las aguas: Organizaciones de
789 usuario de aguas (OUA) y Juntas de vigilancia de ríos.” *Ius et Praxis*, 20(1), 123–162.
790 Romero Toledo, H. (2014). “Ecología política y represas: elementos para el análisis del Proyecto
791 HidroAysén en la Patagonia chilena.” *Revista de geografía Norte Grande*, (57), 161–175.
792 Roose, I., and Panez, A. (2020). “Social Innovations as A Response to Dispossession: Community
793 Water Management in View of Socio-Metabolic Rift in Chile.” *Water*, 12(2), 566.
794 Rowley, T. J. (1997). “Moving Beyond Dyadic Ties: A Network Theory of Stakeholder Influences.”
795 Academy of Management Review, 22(4), 887–910

Rowley, T. J., and Moldoveanu, M. (2003). "When Will Stakeholder Groups Act? An Interest- and Identity-Based Model of Stakeholder Group Mobilization." *The Academy of Management Review*, 28(2), 204.
Sandström, A., Croma, B., Bodin, Ö. (2013). Legitimacy in Co-Management: The Impact of Preexisting Structures, Social Networks and Governance Strategies. *Environmental Policy and Governance*, 24, 60-76.
SEA. (2018). "Comisión de Evaluación Ambiental de la Región Metropolitana." Servicio de Evaluación, Chile.
SEIA. (2007). "Forma de Presentación: Estudio de Impacto Ambiental." Sistema de Evaluación de Impacto Ambiental, Chile.
Silva, P. (2010). *En el nombre de la razón. Tecnócratas y política en Chile*. Ediciones UDP. Santiago, Chile.
Sovacool, B. K., and Bulan, L. C. (2011). "Behind an ambitious megaproject in Asia: The history and implications of the Bakun hydroelectric dam in Borneo." *Energy Policy*, 39(9), 4842–4859.
Suárez, F., Muñoz, J., Fernández, B., Dorsaz, J.-M., Hunter, C., Karavitis, C., and Gironás, J. (2014). "Integrated Water Resource Management and Energy Requirements for Water Supply in the Copiapó River Basin, Chile." *Water*, 6(9), 2590–2613.
Suchman, M. C. (1995). "Managing Legitimacy: Strategic and Institutional Approaches." *The Academy of Management Review*, 20(3), 571.
Torrealba, P. (2018). "Alto Maipo: Financistas internacionales llegan a Chile para evaluar su participación." *El Murcurio*, Santiago de Chile.
UNDP. (2008). "Conflict Resolution and negotiation Skills for Integrated Water Resources Management." Cap-Net, United Nations Development Programme.
United Nations, Department of Economic and Social Affairs, and Population Division. (2019). *World urbanization prospects: the 2018 revision*.
Velásquez, F. (2018). "El movimiento del Río Puelo que dejó sin permiso ambiental a la hidroeléctrica Mediterráneo." *diarioUchile*, Santiago de Chile.
Vivanco-Aranda, M., Mojica, F. J., and Martínez-Cordero, F. J. (2011). "Foresight analysis of tilapia supply chains (Sistema Producto) in four states in Mexico: Scenarios and strategies for 2018." *Technological Forecasting and Social Change*, 78(3), 481–497.
Yang, R. J., and Shen, G. Q. P. (2015). "Framework for Stakeholder Management in Construction Projects." Journal of Management in Engineering, 31(4), 04014064.
Werkheiser, I., and Piso, Z. (2015). "People Work to Sustain Systems: A Framework for Understanding Sustainability." *Journal of Water Resources Planning and Management*, 141(12).

## TABLES

**Table 1.** A summary of the organizations included in this study and the secondary data used to represent these organizations. Organization names are abbreviated in parenthesis for later use in data visualization (Figures 2 through 4). Where appropriate, we use the Spanish abbreviations used in Chile, with full names translated to English. More information on the secondary data sources for each organization can be found in the Appendix using the provided source numbers.

| Organization | Role | Org. Type | Secondary Data Sources |
|---|---|---|---|
| AES-GENER (AES-GEN) | Chilean electric power company in charge of implementing and managing the AMHP. | Private | 13, 14, 15 |
| Aguas Andinas (AA) | Chilean company of sanitary services. | Private | 1, 2 |
| General Directorate of Water (DGA) | State Agency that is responsible for promoting the management and administration of water resources. | National Government | 10, 11, 12 |
| Ministry of the Environment (MMA) | Ministry in charge of collaborating in the design and application of policies, plans and programs in environmental matters. | Regional Government | 7, 8, 9 |
| National Forest Corporation (CONAF) | Dependent entity of the Ministry of Agriculture, in charge of administering Chile's forest policy and promoting the development of the sector. | Regional Government | 5, 6 |
| Communal Union of the Neighborhood Board of San José de Maipo (COM) | Community organization maintained by the Neighborhood Boards of San José de Maipo | Local Organization | No published secondary data available |
| No Alto Maipo (NO-AM) | Organization that oversees the protection of the valleys and rivers of the Cajón del Maipo watershed | Social-environmental NGO | 18, 19 |
| Maipo Canal Society (SCM) | Non-profit organization of private law, responsible for the extraction and distribution of water from the Maipo River. | Irrigation Organization | 3, 4 |
| Maipo Surveillance Board (JVSM) | Non-profit entity of private law, which exercises the action granted by the Chilean Water Code. Administers and distributes water to those who have their associated rights. | River organization | No published secondary data available |

| | | | |
|---|---|---|---|
| Municipality of San José de Maipo (MSJM) | Autonomous corporation, in charge of the administration of the San José de Maipo commune. | Municipal government | 16, 17 |
| Chamber of Tourism of the Cajón del Maipo (CTCM) | Trade association, responsible for the promotion of tourism in the region of Cajón del Maipo. | Local Organization | 20, 21 |

**Table 2.** Challenges and associated objectives from coded interview transcriptions, with parenthetical objective abbreviations used in analyses shown in Figure 5.

| Challenge | Objective | Definition of Objective |
|---|---|---|
| Potential for high environmental impact | Protect the Environment (Pro. Env.) | Strengthen protection and mitigation measures for impacts on the environment |
| Social division | Social Cohesion (Soc. Coh.) | Maintain the interconnection and communication of neighbors and communities |
| Issues with energy availability | Increasing the Supply of Renewable Energy (Ren. Ene.) | Growth in the supply of renewable energy |
| Issues with water availability | Availability of Water Resources (Wat. Ava.) | Ensure the availability, correct use and distribution of water resources |
| Detrimental effects on water quality | River Water Quality (Wat. Qual.) | Strengthen the monitoring of water status. |
| Impacts on tourism | Protection of Tourist Areas (Pro. Tour.) | Protection and conservation of areas for sustainable tourism, ensuring the non-intervention of tourist areas. |
| Detrimental impacts on the quality of community life | Local Community Prosperity (Com. Pro.) | Promote the economic prosperity and success of near-by communities. |
| Initial Capital Investment of Project | Financing of Project (Pro. Fin.) | Ensure investment partners for the financing and development of the project. |
| Potential for social upheaval | Social Approval (Soc. App.) | Obtain the approval of the communities and society for the development and operation of the project. |

## FIGURE CAPTIONS

**Figure 1.** Overview of research activities, methods and outputs

**Figure 2.** Influence map for MDII, with Ri* presented in table to the right. Direct and Indirect influence scores normalized with max 90 (MMA), min 15 (COM). Dependence normalized with max 90 (AES-GEN) and min 36 (MMA).

**Figure 3.** Third-order convergence graph, showing the level of alignment between the various AMHP organizations; thick red link: strongest (18.5 to 22.5), thick blue link: strong (14.4 to 18.4), thin blue link: moderate influence (10.3 to 14.3), thin grey link: weak (6.2 to 10.2), faint grey link: very weak (2.1 to 6.1). Score ranges (i.e., strongest or weak) are designated by the equal division of the total range of scores.

**Figure 4.** Third-order graph of divergence, showing the level of misalignment or conflict between the various AMHP organizations; thick red link: strongest (10.8 to 13.2), thick blue link: strong (8.3 to 10.7), thin blue link: moderate influence (5.8 to 8.2), thin grey link: weak (3.3 to 5.7), faint grey link: very weak (0.8 to 3.2). Score ranges (i.e., strongest or weak) are designated by the equal division of the total range of scores.

**Figure 5.** Graph of net distances between objectives; thick red link: Largest net distance (23 to 26), thick blue link: Large net distance (17.5 to 23), thin blue link: mod (6 to 17.5), thin grey link: weak (0 to 5.5), faint grey link: Shortest net distance (-8.5 to 0)

## APPENDIX

### *MACTOR Mathematics*

Equations 1 – 4 present mathematical operations used in evaluation of an organization's power (eq 1), competition (eq 2), convergence and divergence (eq 3), and net distance of objectives (eq 4)

***Matrix of Direct and Indirect Influences (MDII):***

$$[\boldsymbol{MDII}]_{ij} = [\boldsymbol{MDI}]_{ij} + \Sigma Min\,([\boldsymbol{MDI}]_{ij}, [\boldsymbol{MDI}]_{ik})$$

Where,

$[\boldsymbol{MDII}]_{ij}$ is the combined direct and indirect influence organization $i$ has on organization $j$.

$[\boldsymbol{MDI}]_{ij}$ is the direct influence organization $i$ has on organization $j$ from the MDI

$\Sigma Min\,([\boldsymbol{MDI}]_{ij}, [\boldsymbol{MDI}]_{ik})$ is the sum of all indirect influences actor i exerts on actor $j$, and which flow through an intermediary actor $k$; where this indirect interaction is kept 'second order' – that is, flowing only with one intermediary actor at a time (Godet 1991)

***Evaluation of relative organizations' level of power ($Ri^*$):***

$$Ri = [\,(Ii - [\boldsymbol{MDII}]_{ii})\,/\,S\,] * [\,Ii\,/\,(Ii + Di)]$$

$$Ri^* = n * Ri/\Sigma Ri$$

Where,

$Ri$ is an organization's competitiveness score

$Ri^*$ is the normalized power score for each organization

($I_i$ – **[MDII]$_{ii}$**) is the organization's 'maneuver range, in other words its net direct and indirect influence (Ii) minus its retroaction or vulnerability from actions they take indirectly feeding back to influence them (MDII)ii

$S = \Sigma i\ Ii = \Sigma i\ Di$ factor for normalizing the maneuver range

*Ii / (Ii + Di)* allowing a relative integration of organizations' influence and dependence in the equation.

$\Sigma Ri$ is the sum of competitive scores

$n$ is the number of organizations

***Third order evaluation of convergence (3CAA) and divergence (3DAA):***

$$If\ ([\boldsymbol{3MOA}]_{ik} * [\boldsymbol{3MOA}]_{jk}) > 0\ (for\ 3CAA)\ or < 0\ (for\ 3DAA)$$

$$Then\ [3CAA\ or\ 3DAA]_{ij} = 1/2\ x\ (|\,[\boldsymbol{3MOA}]_{ik}| + |\,[\boldsymbol{3MOA}]_{jk}|\,)$$

$$Else\ [\boldsymbol{3CAA\ or\ 3DAA}]_{ij} = 0$$

Where:

$$[\boldsymbol{3MOA}] = R_i^* * [\boldsymbol{2MOA}]_{ij}$$

***Distance on objectives:***

$$If\ (\ ([\mathbf{2MOA}]_{ik} * [\mathbf{2MOA}]_{jk}) > 0\ (for\ 3CAA)\ or < 0\ (for\ 3DAA)$$

$$Then\ [\mathbf{2CAA\ or\ 2DAA}]_{ij} = 1/2 * (|\ [\mathbf{2MOA}]_{ik}| + |\ [\mathbf{2MOA}]_{jk}|\ )$$

$$Else\ [\mathbf{2CAA\ or\ 2DAA}]_{ij} = 0$$

$$[\mathbf{2MOO}]\mathbf{ij} = [\mathbf{2CAA}]\mathbf{ij} - [\mathbf{2DAA}]\mathbf{ij}$$

***Secondary Data Sources (from Table 1)***

1. https://www.aguasandinasinversionistas.cl/es/quienes-somos/nuestro-proposito
2. https://www.aguasandinasinversionistas.cl/~/media/Files/A/Aguas-IR-v2/annual-reports/es/190626-reporte-integrado-aa2018.pdf
3. https://www.scmaipo.cl/canalistas/
4. https://www.scmaipo.cl/canalistas/wp-content/uploads/2019/04/Boletin_Gota-a-gota_N1.pdf
5. https://www.conaf.cl
6. https://www.conaf.cl/cms/editorweb/institucional/CUENTA-PUBLICA-CONAF2018-CON-APORTES-COSOC.pdf
7. https://mma.gob.cl
8. https://mma.gob.cl/wp-content/uploads/2018/03/Estrategia_Nac_Biodiv_2017_30.pdf
9. https://mma.gob.cl/wp-content/uploads/2018/03/Informe-Final-Encuesta-Nacional-de-Medio-Ambiente-2018.pdf
10. https://dga.mop.gob.cl/Paginas/default.aspx
11. https://dga.mop.gob.cl/legistlacionynormas/Legislacin%20y%20Normas/LEY-21064_27-ENE-2018.pdf
12. https://dga.mop.gob.cl/acercadeladga/informesgestion/Informes%20de%20gestin/BGI_DGA_2017.pdf
13. https://www.aesgener.cl/#hello
14. https://conocealtomaipo.cl
15. https://www.aesgener.cl/wp-content/themes/aes_gener/pdfs/Politica-de-Vinculacion-y-Relacionamiento-con-comunidades.pdf
16. https://www.sanjosedemaipo.cl
17. https://www.sanjosedemaipo.cl/gestion/direccion-de-desarrollo-comunitario/
18. http://www.chilesustentable.net/tag/no-alto-maipo/
19. https://www.facebook.com/NoAlProyectoAltoMaipo/
20. https://cajondelmaipochile.cl
21. https://www.facebook.com/cctsjm/

**Table A1.** Matrix of Direct Influence (MDI) between AMHP organizations, defined by research team

| | AES-GEN | AA | SCM | DGA | MMA | CONAF | CTCM | NO-AM | MSJM | COM | JVSM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **AES-GEN** | 0 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 | 2 | 2 |
| **AA** | 3 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 3 | 0 | 2 |
| **SCM** | 2 | 3 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| **DGA** | 3 | 1 | 1 | 0 | 1 | 1 | 1 | 3 | 1 | 1 | 1 |
| **MMA** | 2 | 1 | 1 | 1 | 0 | 1 | 3 | 3 | 2 | 1 | 1 |
| **CONAF** | 2 | 1 | 1 | 0 | 1 | 0 | 2 | 3 | 1 | 1 | 0 |
| **CTCM** | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 2 | 0 | 0 |
| **NO-AM** | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 0 | 1 | 0 | 1 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **MSJM** | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 4 | 0 |
| **COM** | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 |
| **JVSM** | 2 | 2 | 2 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 |

**Table A2.** Matrix of AMHP organization position within the battlefield of objectives (2MAO), as defined by the research team

| | **Pro. Evn.** | **Soc. Coh.** | **Ren. Ene.** | **Wat. Ava.** | **Wat. Qual.** | **Pro. Tour.** | **Com. Pro.** | **Pro. Fin.** | **Soc. App** |
|---|---|---|---|---|---|---|---|---|---|
| **AES-GEN** | 0 | 1 | 1 | 1 | 1 | 1 | 3 | 3 | 2 |
| **AA** | 3 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 3 |
| **SCM** | 2 | 3 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| **DGA** | 3 | 1 | 1 | 0 | 1 | 1 | 1 | 3 | 1 |
| **MMA** | 2 | 1 | 1 | 1 | 0 | 1 | 3 | 3 | 2 |
| **CONAF** | 2 | 1 | 1 | 0 | 1 | 0 | 2 | 3 | 1 |
| **CTCM** | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 2 |
| **NO-AM** | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 0 | 1 |
| **MSJM** | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| **COM** | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| **JVSM** | 2 | 2 | 2 | 1 | 1 | 0 | 0 | 1 | 0 |

Pro. Env.: Protect the Environment; Soc. Coh.: Promote Social Cohesion; Ren. Ene.: Increase the Supply of Renewable Energy; Wat. Ava.: Ensure the Sustainable Availability of Water Resources; Wat. Qual.: Maintain River Water Quality; Pro. Tour.: Protect Tourist Activities; Com. Pro.: Promote Local Community Prosperity; Pro. Fin.: Ongoing Project Financing; Soc. App.: Encourage Social Approval