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Water Stewardship: Attributes of Collaborative Partnerships between Mining Companies and Communities

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Abstract: With many of the world's largest mines operating in jurisdictions of water scarcity, competition for water has become a frequent source of tension between mining companies and other water users. Water stewardship is, therefore, becoming an important strategy for the mining sector to address stakeholder concerns and earn social acceptance. Collaborative partnerships between mining and other water users are a necessary component of advancing water stewardship, but the attributes needed to implement a successful water stewardship strategy are understudied. This paper addresses this gap by examining two exploratory case studies in Peru and Mongolia, where collaboration has been used as a strategy for promoting more sustainable outcomes in water-scarce regions. The findings suggest that while questions remain about who is best suited to lead collaborative partnerships, trust in the entity responsible for leading collaborative partnerships (especially in situations of high conflict) and a willingness to allow each partner to play to their strengths are critical attributes of success. We conclude that the outcome of collective action between mining companies and other water users offers the potential to deliver both business and social value, and to advance more sustainable water management.

Keywords: water; mining; collaborative partnerships; stakeholder engagement; stewardship; sustainable development

1. Introduction

The Intergovernmental Panel on Climate Change [1] predicts that by 2025, 60 per cent of the world's population will be living in countries classified as "water stressed", with the United Nations [2] estimating that to meet global needs, the world will need 30 per cent more clean water by 2030. This poses a challenge for industries such as mining where water is a critical input for mineral separation and processing, transporting ore and waste, tailings management, dust suppression, washing equipment, and human consumption at mine sites [3]. It is now estimated that two thirds of the world's largest mines are in countries facing water scarcity risk [4], a situation set to intensify in the coming years [5]. This is likely to create increased competition between mining and other water users. A myriad of other negative consequences can result from poor water management practices at mines such as the discharge of contaminated water into local waterways or acid rock drainage. Consequently, water is now recognized as one of the fastest growing economic and social challenges facing the mining sector [6,7].

Water-related concerns can contribute to tensions between mining companies and nearby communities [8]. Of note, in the years 2000–2017, water was an issue in dispute within 58 per

cent of cases filed against mining investments with the International Finance Corporation's (IFC) Compliance Officer Ombudsman [9]. The sources of community conflict can be diverse, ranging from poor environmental stewardship practices, concerns about water quality impacts, or tensions due to the considerable volumes of water used by mining relative to surrounding users [10]. In an industry that has tended to treat community engagement as an add-on (versus a strategic business function) [11], one factor motivating corporate action on water stewardship is the cost of conflict. A 2014 study reported that a mining project with a capital budget of between US$3–5 billion could lose up to US$20 million per week (in delayed production in net present value terms) due to social unrest [12]. The study also revealed that there is growing recognition in the mining sector that community conflict—and a reputation for failing to address it—can adversely impact revenue streams both at the affected site and at prospective operations in other jurisdictions [12]. While reputational costs can be more challenging to quantify, researchers at Harvard suggest that 70–80 per cent of market value comes from intangible assets, such as brand equity [13]. With another study demonstrating that more than 60 per cent of market capitalization for publicly traded gold companies links to the quality of stakeholder relationships [14].

In response, many mining companies are seeking to demonstrate improved water management practices within their operations [3,15,16]. These efforts typically focus on reducing water volumes used for mining, re-using water from operations within the mining process, and designing zero discharge facilities that seek to capture and recycle all water from the site. More recently, there is growing pressure on the sector to adopt a catchment (or water basin) approach by becoming a proactive participant in resolving regional water challenges outside the mining concession or permit areas [10,17,18].

Today, both within and beyond the mining sector "... more and more companies are embracing "corporate water stewardship" practices that expand traditional notions of water management to include their water-related impacts within communities and the river basins and ecosystems in which they operate" [19].

While this recent transition in the direction of water stewardship represents a positive step towards greater accountability by mining companies [17], it also creates challenges. Success is highly dependent upon the ability to collaborate with diverse stakeholders (any person, group or organization that can place a claim on a company's attention, resources, or output [20]), something the mining industry has historically struggled to execute effectively. Increasing incidents of mining–community conflict in resource-rich nations [8,9,21–23] are one indication of the tension that exists between corporate and community actors and raises questions about whether the mining sector has, or can earn, the trust required to build and execute partnerships with stakeholders. Trust is defined as a central element in local communities' acceptance of mining and is shaped by perceptions of distributional and procedural fairness, and confidence in governance [24].

A further consideration is the relationship between national and local or regional governments. National governments of resource-rich countries may view mining as an important economic contributor. Local or regional governments within those same countries may have a different view. The concerns of sub-national governments about the potential for adverse impacts from mining in their areas may result in a lack of willingness to enter into collaborative partnerships that appear to benefit an industry opposed by local stakeholders.

With these considerations in mind, the core research question investigated in this paper is what attributes of success do productive water stewardship collaborations between mining companies and communities share? This question is investigated by studying two exploratory case studies in Peru and Mongolia, where collaboration has been used as a strategy for promoting more sustainable outcomes in water-scarce regions.

2. Materials and Methods

A multi-methods approach is employed in this paper, beginning with a quantitative media analysis and then utilizing qualitative techniques to investigate the core research question. The research approach is anchored in stakeholder engagement theory, which Freeman [25] places within organizational management and business ethics. Freeman's premise is that to be successful and sustainable over time, business must align the interests of its stakeholders—not just shareholders—to create value for all. Although mining companies have not always engaged effectively with stakeholders, there is growing evidence of the sector's recognition that social and business risk are inter-related and that there is business benefit to placing greater priority on stakeholder engagement [12–14]. With mining companies and communities sharing a common interest in access to water—and the effective, efficient management of limited water resources—stakeholder engagement theory offers a useful frame for investigating the characteristics of successful shared approaches to support sustainable water stewardship.

In the first phase of the study, media analysis is used to investigate the frequency with which water was a key contributor to mining–community conflict in two purposefully selected countries with areas of water scarcity: Peru and Mongolia. These two countries were chosen as study regions because both are rich in mineral resources, have shown a steep growth in mining in recent years, and exhibit evidence of increasing conflict between mining companies and the communities impacted by their operations. Both countries also have a mix of large-scale mines (significant water users and therefore the focus of this research) owned by multinational corporations, state-owned agencies, and joint ventures, and in both countries the national governments have recognized mining as an important contributor to the host country's economy. These factors contribute to an interesting examination of water stewardship issues and suggests the findings may be generalizable to other resource-rich jurisdictions where mining occurs within close proximity to communities.

To focus the research, two initiatives, one from each study country, were selected for detailed case study analysis to explore the attributes of successful collaborative partnerships that are needed to advance water stewardship. The Peru case was selected following the media analysis that yielded an article from August 2014 reporting on how an expansion project at the Cerro Verde copper mine in the Arequipa region of Peru had not experienced the type of conflict and protests affecting several other mining projects [26]. With estimated reserves of 4.63 billion tonnes of copper, Cerro Verde is one of the largest copper deposits in Peru. The mine is located in an area of water scarcity, adjacent to a region of the country where agriculture is the predominant industry. For these reasons, the expansion project was selected to investigate how water issues were considered during the expansion planning, to determine if a collaborative approach to water stewardship was established, and, if so, to evaluate the effectiveness of that multi-stakeholder process. The Mongolia case was selected for two reasons. First, it represented a revelatory case study [27] by allowing investigation of phenomena to which few scientists have been privileged due to the first-hand experience of one of the authors. Second, the project has received recognition as a best practice example of a shared approach to water management by an international development institution and the sector's leading industry body, the International Finance Corporation (IFC) and the International Council on Mining and Metals (ICMM), respectively [9]. While it is not possible to generalize all findings from this small sample, the attributes of success are predicted to be informative for future collaborative partnerships between mining companies and communities.

Methods employed in the case research included a review of publicly available documents, in-field observation, and either qualitative interviews (Peru) or meeting facilitation (Mongolia). It is noted that the use of one-to-one interviews do not provide parallel information to focus groups, yet points of intersection are noted between the two approaches: for example, both cases sought to establish common ground and building understanding amongst diverse stakeholder groups. With limited ability to compare the qualitative data, this research seeks to examine the attributes of success within these different approaches to water stewardship and to triangulate the data from the two approaches with desktop and field research.

2.1. Media Analysis Approach

To investigate the number of mining community conflicts in Peru and Mongolia with water as a key or underlying issue, an analysis of recent media coverage was undertaken. Media articles from a five-year period (2012–2016) were sourced from the news database, Factiva. In total, more than 600 articles focusing on Peru and Mongolia were identified using the search term "mining + conflict".

It is important to note that media coverage within the Factiva database does not capture all situations of company–community conflict. For example, Mongolia may be under-represented in the international media coverage as compared to Peru, one of the world's best-known mining jurisdictions. Nevertheless, "International events data, day-by-day coded accounts of who did what to whom as reported in the open press" [28], are a valuable source of quantifiable information to support an investigation into water as a nexus point between mining companies and resource-rich communities.

To enhance understanding of the situation within Mongolia, media results were compared against primary and secondary data sources, including industry journals and grey literature publications of international agencies such as the IFC and ICMM, as well as reports done by in-country civil society and development agencies. Of note, the database of the Office of the Compliance Advisor/Ombudsman (CAO) [29] for the private sector lending arm of the World Bank was reviewed for conflicts. The results complement the media analysis with two identified conflicts. Both conflicts related to Oyu Tolgoi, one of the world's largest known copper-gold deposits and a mine operating in the South Gobi. In both cases, water was the focus of the complaint.

2.2. Case Studies

As noted earlier, two examples of collaborative water partnerships were selected for analysis, both of which have been recognized as leading practice examples within the sector [9]. The same core research question is investigated for both cases, but slightly different methods are employed.

To inform both case studies, desktop research was conducted to review current academic literature on water management in the mining sector, as well as collaborative approaches to advance sustainable development. Reports of third-party groups such as the World Economic Forum (WEF), management consultancies, industry associations, and non-governmental organizations (NGOs) were also reviewed.

To develop the Peru case, two fields visits to the Arequipa region of Peru provided valuable observational data and the opportunity to conduct in-person qualitative interviews (N = 17). A semi-structured interview guide used a series of open-ended questions to frame the discussion. Purposefully selected interview candidates represented a diversity of groups involved in the water supply discussion, and the construction and operation of a wastewater treatment plant. Interviewees were recruited first by using personal contacts and the contacts of colleagues working in development and mining in Peru. This initial list was complemented with the use of snowballing to develop a final group of interview candidates that included government regulators (N = 3), civil society groups (N = 2), local water authorities (N = 2) contractors and maintenance personnel (N = 3), wastewater treatment plant operators (N = 3) and company officials (N = 4). Interviews were conducted under a University of British Columbia ethics certificate (H16-00245). Transcripts were analyzed to identify key themes, issues, and recommendations.

The Mongolia case drew upon first-hand experience of one of the authors who provided technical expertise as a consultant to the South Gobi Water and Mining Industry Roundtable, a project focused on strengthening the water management and stakeholder engagement practices of participating mining companies [30]. The project has been operating since 2012; however, the author has been engaged for the past three years. Observational data, and publicly available reports and water balance data were collected during eight in-country trips between April 2016 and June 2018, with each trip lasting between one and two weeks. Three trips included visits to mine sites in the South Gobi. Seven sessions were held in the capital, Ulaanbaatar, including one-day workshops attended by approximately 15 company representatives, as well as half-day leadership meetings with more senior management representatives.

One workshop in the province of Dalanzadgad was jointly attended by government representatives from the local River Basin Administration (RBA). During each field visit, the author also attended in-person meetings with government representatives, development institutions, mining companies, consulting firms, researchers, and non-government/civil society organizations.

In both case studies, triangulation of observation, meeting facilitation or interviews, and the document review provides a more accurate account than any of the methods would provide alone [31].

3. Results

3.1. Media Analysis

Once articles reporting on "mining + conflict" in Peru and Mongolia had been collected from Factiva, the first step in the analysis was to remove articles reporting on conflicts that did not appear to be driven primarily by community stakeholders concerns with mining companies' operations. For example, articles reporting on military conflict and/or terrorism, financial divestment campaigns or legal cases before the courts but addressing pre-2012 situations were excluded. Once the screening process was complete, 540 articles referencing mining-community conflict in Peru remained, with a further 76 articles referencing mining-community conflict in Mongolia.

The remaining subset of news stories reporting on mining–community conflict were grouped by country, and then sorted to identify specific mining projects mentioned in the media coverage (Table 1). Next, the remaining news articles were reviewed and hand-coded to identify causes of conflict.

Table 1. Projects affected by mining-community conflict with the trigger for conflict as reported within the media article. Articles were sourced from the Factiva database.

Media Analysis of Mining–Community Conflict			
Peru **Total of 540 New Articles "Mining + Conflict"**		**Mongolia** **Total of 76 News Articles "Mining + Conflict"**	
Project Referenced	**Conflict Trigger**	**Project Referenced**	**Conflict Trigger**
Conga	Water	Oyu Tolgoi	Tax and royalties/Water
Tintaya	Environment	Tavan Tolgoi	Export issues
Pierina	Water	Southern Gobi	Tax evasion
Quellevecco	Water	Gatsuurt	Environment/Reclamation
Tia Maria	Water	Khan Resources	Arbitration
Santa Anna	Water		
La Zanja	Water		
Yanacocha	Water		
Constancia	Beneficiation		
Canariaco	Water		
Toromocho	Resettlement		
Rio Blanca	Unclear		
Las Bambas	Various		
Michiquillay	Unclear		
Corihuami	Beneficiation		
La Granja	Unspecified		
Marcona	Labour issues		

In Peru, 17 individual mining projects sparking conflict with nearby communities were identified through the media analysis. In some cases, the causes of conflict are clearly identified: water (N = 8); labour issues (N = 3). In others, the causes of conflict can be complex and interwoven: for example, articles reporting on land use or environmental conflict (N = 2) may reflect concerns about water. Therefore, it is relevant that water is directly mentioned as a driver of concern in almost 50 per cent of the news reports.

In Mongolia, five projects were the subject of news coverage reporting on conflict. Although significantly fewer mining projects were the subject of media reports within the Factiva database covering company–community conflicts in Mongolia, mining has expanded rapidly in the South Gobi Desert, home to vast mineral deposits including copper, gold, and coal. Nomadic herders and other water users populate this area of water scarcity. Although disputes have not attracted international media attention on the same scale as conflict in Peru, the potential for increased conflict is evident in Mongolia where mining has the potential to expand at a time when water scarcity and the adverse effects of climate change threaten traditional herding and grazing pursuits [32,33].

3.2. Peru Case

Peru is one of the South American countries where mining is a vital component of the national economy. In 2017, Peru was the world's second largest copper producer, with base and precious metals accounting for almost 60 per cent of the country's total export revenues, an amount equal to US$21.3 billion [34]. In addition, in 2017–2018, 23 per cent of foreign direct investment is expected to come from mining companies and the industry offers direct employment for approximately 200,000 people [34].

Despite its financial contribution, Peru has experienced a steep increase in mining–community conflict in recent years [6], such that securing a "social license to operate" is now the mining sector's single largest challenge [34]. An issue of ongoing concern is that water scarcity is a characteristic of many of the mineral-rich areas of Peru. Water shortages can be due to arid conditions, situations where surface water is abundant but only at certain times of the year in certain regions, and by the presence of pre-existing water users including farmers, hydroelectric power, mining, other industrial users, and communities [35]. Concerns about the allocation of scarce water resources has been a driver of social opposition for numerous mining projects in Peru, including Conga, Las Bambas, and Tía María.

The Findings

Qualitative interviews revealed that when personnel at Cerro Verde copper mine began planning a mine expansion—increasing production from 120,000 metric tonnes per day to 360,000 metric tonnes per day—the question of how to access the volume of water that would be required for processing the additional ore was an important one. The mine is located in the Atacama Desert, approximately 30 km from Peru's second largest municipality, the city of Arequipa. Access to clean water is one of the region's most important needs. This meant that securing access to water for mining operations was recognized as both a fundamental operations requirement and a potential risk. Mining company personnel knew that to reduce the risk of the type of conflict that had disrupted or stalled other mining projects in the country, it would be critical to engage stakeholders and to avoid placing the mine in competition with other water users for clean water.

As the mine expansion planning got underway in 2008, Cerro Verde evaluated the river basin and discovered that already limited volumes of fresh water had the potential to be adversely affected by drought. (Peru is one of the countries likely to be hardest hit by climate change [6]). The project planning team, therefore, assumed that any proposal to use fresh water for mining would likely generate concern from other water users. Social leaders encouraged mine planners to explore the possibility of treating municipal wastewater from the city of Arequipa in exchange for water for mining operations. At that time, the only wastewater treatment facility in the city of Arequipa (population approximately one million) was operating at capacity yet treating less than 10 per cent of municipal sewage. This meant most of the city's wastewater was discharged directly into the principal water source for the region, the Chili River, where fecal coliform counts vastly exceeded those set by health authorities and regulatory agencies.

For the mine planners, municipal sewage offered a source of water not in use by others, a more reliable supply than fresh water, and one that had the potential to increase given Arequipa's growing population. In addition, according to one government official interviewed, the Peruvian government is promoting the re-use of effluent as a sustainable water supply for the mining sector population.

This meant the project could help to meet an important policy objective of a key stakeholder, potentially generating the type of value inherent in stakeholder engagement theory. For local stakeholders, collaborating with the mine to secure municipal wastewater treatment could help them to address a key sustainability issue and deliver tangible benefits to river water users. It seemed that a shared approach to address water quality and supply issues could yield benefits for both business and society, as well as supporting more sustainable water management.

Following a period of consultation with multiple stakeholders, which included more than 200 meetings, it was decided that Cerro Verde would finance, build, operate, and ultimately transfer ownership of a plant to treat municipal wastewater from the city of Arequipa. In exchange, the mine would receive a portion (1 m^3/s) of the treated wastewater for use in mining operations. The local water authority—Servicio de Agua potable y Alcantarillado de Arequipa (SEDAPAR)—would be responsible for managing distribution of the remaining treated water to the Chili River to improve water quality in the river, reduce fecal coliform counts, and improve bio-dissolved oxygen demand in the river.

In this initiative, access to water was viewed as a shared company–community problem. A key to the success of the project was the recognition that many stakeholders had important perspectives to share, as well as different needs and expectations. Within the city of Arequipa, the population has increased significantly in recent years due, in large part, to in-migration from the highlands. This has resulted in new neighbourhoods in areas where the city has not yet planned for services, making water supply a sensitive issue. Farmers in the nearby agricultural region of La Joya are equally important stakeholders but with very dissimilar needs and interests from those living in the city. The interests of government officials, water regulations and authorities, civil society organizations, and the company's head office executive and shareholders, made each group important. The diversity of stakeholder interests meant collaboration was needed to (a) understand diverse perspectives and to balance sometimes conflicting needs; and (b) to negotiate roles and responsibilities within the wastewater treatment process, a new water management initiative.

The company secured several important outcomes from the shared approach to water management. The expansion project was completed on schedule and unlike other projects in the region, Cerro Verde did not experience any lost production days to community opposition. A water supply for expanded operations was secured using treated wastewater. Moreover, because wastewater is not a source included in agricultural allotments, Cerro Verde avoided competition with farmers for scarce water resources.

Equally important when assessing collaborative partnerships is the fact that the shared approach delivers clear benefits to the community. Approximately 99 per cent of city sewage is now treated. Fecal coliform levels in the Chili River have been reduced and the improved water quality in Chili River basin will enhance agricultural production, as well as increase recreational activities and tourism opportunities for the region. In addition, as part of the wastewater treatment plant, water intake volumes from the Chili River are now measured. This systematic approach means that water authorities have access to scientifically measured water volumes. Sharing this information has helped to answer questions from stakeholders about water allocation and availability.

3.3. Mongolia Case

Mongolia has similarities with Peru with respect to rapid growth of the mining sector and its economic significance. Recent statistics indicate that mining accounts for 18 per cent of Mongolia's gross domestic product and employs over 20,000 people [36]. Mining is often regarded as the backbone for the country's future economic growth; however, the rapid industry expansion has created tensions with local communities that have traditionally relied on animal husbandry for their livelihoods [9]. Developing robust conclusions about the actual impacts of mining on water quantity and quality are especially challenging due to a lack of baseline data and effective governance mechanisms [37]. This uncertainty contributes to significant distrust between mining companies and local communities:

a baseline survey commissioned by the IFC in 2014 found that public trust was an all-time low [38] and this was not necessarily targeted at specific companies but rather affected the sector as a whole [9].

Despite mistrust in the industry, mining has expanded rapidly in the arid South Gobi, a region of scarce water resources that is home to vast deposits of resources including copper, gold, and coal. In 2012, against a backdrop of growing conflict between herders, NGOs and mining companies, the local legislature in the South Gobi implemented a new law to ban the use of groundwater for mining operations [9]. This represented a major risk for the mining sector because such a ban would significantly stall, if not halt, mining development. Many mining projects, including Oyu Tolgoi, the country's largest mine, rely on deep groundwater aquifers to extract the water for mining and processing [39]. Although the 2012 ban on groundwater use by mining has since been overturned, communities continue to express concerns about water issues, and trust levels between mining companies and communities remain low [9].

The IFC, a member of the World Bank Group and an investor in the Oyu Tolgoi project, subsequently engaged with partners in a program to strengthen the collective water performance and the stakeholder engagement practices of mining companies in the South Gobi [10]. A key part of this program involved convening quarterly round tables to bring together mining companies operating in the region. One of the authors of this paper has served as a technical consultant to the IFC and was a facilitator of the round tables. The goal of these meetings was essentially two-fold: To improve the water management and community engagement practices of the companies themselves; and to engage trusted third parties to understand local communities concerns and to communicate company efforts to address these issues. In working towards these objectives, the program team made a dedicated effort to complement related programs coordinated by other actors, including government and other multilateral institutions, who were often invited as speakers to roundtable discussions.

Performance data from participating companies was collected and reported in a variety of ways. At the interactive workshop on developing mine site water balances, described below, process flowcharts and water metrics tables summarizing site water use and management were prepared. The water use data from participating companies has subsequently been shared with local community members [31], representing a significant step towards transparency. Additionally, participants from the round table sessions have contributed to the design of a water and mining curriculum for a stakeholder training program. From 2014–2016, more than 1000 people participated in the training [10].

Company water management practices were strengthened in several ways. One example is through delivering a training workshop to educate companies about how to develop a mine–site water balance and a water account (Figure 1 and Table 2). These workshops built upon best practice frameworks including the Minerals Council of Australia's (MCA) water accounting framework [40], and the new ICMM water reporting guidelines [18]. Consistent water accounting is important because without a reliable understanding of their own water use, companies are unable to benchmark their performance with other sites to identify opportunities to improve, nor do they have the data needed to communicate effectively with external stakeholders.

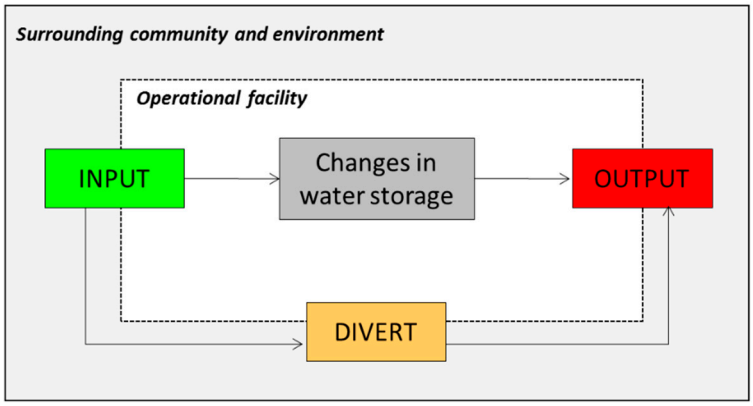

Figure 1. Visual representation of a mine site water system used to conduct water balance and accounting training, based on [40] and [17].

Table 2. Sample template for companies participating in the South Gobi Water and Mining Industry Roundtable in Mongolia to report water inputs and outputs [30].

Input-Output	Source/Destination	Inputs/Outputs
Input	Surface Water	Rainfall and Runoff External surface water storages
	Groundwater	Open pit dewatering Bore Fields Water locked in ore concentrate
	Other	Other (define)
		Total Inputs
Output	Surface Water	Discharge to surface water
	Groundwater	Seepage from storage facilities Reinjection
	Other	Evaporation from water storage dams and process ponds Evaporation from tailings dam Dust suppression Water locked in waste streams Water locked in product concentrate Other (define)
		Total Outputs

Participating in the roundtable also allows the companies to communicate their achievements to local communities through a third party (initially the IFC), which also offers an external assessment of company performance [30]. The program established a Voluntary Code of Practice (VCP) on water management, to which eight participating roundtable companies voluntarily committed. The VCP commits signatories to specific goals under six overarching pillars [9]:

1. Act transparently and with accountability.
2. Comply with national law and international standards.
3. Engage proactively and inclusively.
4. Effective water resource management and conservation.
5. Create positive impacts.
6. Support local water infrastructure and services.

Signatories file annual reports about their performance to the roundtable secretariat across all six pillars and these data will be used to track VCP compliance over time and to communicate

achievements back to local communities. The program is also pioneering efforts to share private water data (e.g., mine water use and hydro-geological water monitoring data) with the Mongolian government, thereby contributing towards improved regional water management and governance [9].

The principal outcome of the initiative, as noted by one of the signatories, is that it "provides the framework for a positive impact on water management by conserving ecosystems, strengthening communities, and committing to specific operational practices" [41]. Safeguarding water resources and promoting the efficient and transparent use of a scarce resource is viewed as an important step for building trust between mining companies and communities, a critical attribute for an industry regarded as central to the national economy [41].

4. Discussion

This research investigated approaches that contribute to successful collaborative partnerships as part of a water stewardship strategy. In particular, the research considered what attributes of success productive collaborations share.

Based upon the findings of the two cases, some common attributes of successful partnership projects can be observed. In both cases, access to water was viewed as a shared industry–community problem, and both employed effective multi-stakeholder processes. In Peru, the local government and the company organized more than 200 meetings to hear from, and understand, the diverse, and sometimes conflicting, perspectives of multiple stakeholders. In Mongolia, a multi-tiered strategy was used to respond to the complex tensions relating to the use and management of water by the mining industry. Roundtable discussions have built the capacity of companies to engage more effectively with local community members, while a consistent approach to water reporting has been introduced that will facilitate constructive dialogue.

Both cases also appear to allow each group in the collaborative partnership to play to its strengths. In Peru, social leaders introduced the idea for the mine to treat and then use municipal wastewater as a sustainable water source for mining operations. The company initiated a stakeholder engagement process to earn approval from pre-existing water users. Local government supported the engagement process, and worked collaboratively with the company to explore, and then promote, the role of the mining company in the provision of regional wastewater treatment. The local water authority became a partner to operate the plant and manage distribution of the treated wastewater not used by the mine. In Mongolia, the IFC has played a key role in facilitating cooperation between companies that are from a typically competitive industry, and has engaged diverse partners from multilateral institutions, governments, communities, and technical specialists to support various elements of the program's implementation.

In addition, and perhaps most importantly, both cases indicate that collaborative partnerships can deliver both business and social value. In Peru, using treated municipal wastewater gave the mining company access to a source of water that was not included in water allocations for agriculture. This meant the mine was not in competition with farmers for scarce supplies of fresh water and helped the mine's expansion project to avoid the type of company–community conflict that had stalled or derailed other mining projects in the region. This delivered significant business value. The project also delivered significant social value. Before the construction of the treatment plant, the City of Arequipa treated just 10 per cent of its municipal wastewater. Today almost all municipal wastewater is treated and that has resulted in significant improvements in the health of the region's main water source, the Chili River. In addition, the collaborative approach used to operate the plant also builds local technical capacity. In Mongolia, the introduction of a consistent water accounting approach builds business value by allowing companies to accurately benchmark performance across sites in Mongolia and internationally, facilitating the identification of opportunities for reducing freshwater consumption. Consistent water accounts also benefit local communities through ensuring that mine water-use data is reported consistently across companies, creating a platform for strengthening water governance over the longer term.

Sustainable water management requires financial resources, local knowledge, technical expertise, effective communication skills, and a willingness for each party in the collective initiative to play to its strengths. Because water is a shared resource, valued by both mining companies and host communities, it can be a highly emotional issue where trust plays a vital role. Lack of trust is a critical issue, a finding consistent with research studying the attributes of successful industrial symbiosis networks [42]. Stakeholders need to have a high degree of trust in the organizations collaborating on sustainability initiatives. There must also be high trust amongst the partners themselves, because individual partners can be required to set aside self-interest in the favour of collective action and shared benefits. These attributes raise interesting questions for future research about who is best positioned to convene collective action and who is best positioned to lead a given initiative.

Based on this initial research into the attributes of successful collaborative partnerships, we posit that while mining companies and their industry partners may appear well positioned to lead collective action, as Cerro Verde did in the Peru case, in many cases industry may not be the best choice. To their advantage, individual companies have significant financial resources, and often have a convening power that reaches through their supply chains into financial markets and government. In addition, personnel within mining companies have access to networks to recruit specialized expertise for social and environmental innovation. While each attribute is important for progressing improved water management and governance, we believe that in most instances concerns are likely to be raised about the ability of industry to act as a neutral party when designing projects in which they have a stake. In many jurisdictions, companies may simply not be trusted enough by other groups to lead collaborative partnerships. In addition, mining companies need to be careful not to create situations where communities are dependent on the mine for services government should provide. Miners do not have the skills of development agencies and company-developed community engagement strategies are typically linked with the life of mine, which may last for several decades but can be as brief as several years. As has been noted by other scholars, to be successful in implementing collaborative water management initiatives, mining companies will need to make organizational changes to treat sustainability and social responsibility as business strategy rather than discretionary spending [43,44].

Government seems the natural group to convene and to lead initiatives to protect the sustainability of water resources. Yet in both cases examined, government was a supporting partner not a leader. Nevertheless, governments are the guardians of their country's natural resources and have a fiduciary responsibility to citizens to ensure the sustainable use of resources such as water. In some jurisdictions, governments at the national, regional, or even municipal level have embraced this role. For example, in Australia's Fitzroy basin, the Queensland government has been an active participant in convening broader collective interests between agriculture, industry, research and communities towards improving the catchment river health [45]. In the Northwest Territories of Canada, settler and indigenous governments worked together to establish a collaborative partnership-based approach to water stewardship. Regulatory boards, agencies, environmental organizations, the mining and oil and gas industry, and the public came together to develop a strategy and associated action plan to address pressure on water supply from large-scale development and from climate change [46]. However, there can be instances where government may cede its authority to others for a variety of reasons. Government's abdication of its responsibility for the issues such as water governance may be attributed to lack of financial resources, lack of technical expertise, lack of capacity within the public sector, or an interest in securing foreign investment in the extractive sector, which can trump sustainability concerns.

Another group well positioned to take both a convening and leadership role is NGOs, including environmental protection groups, development agencies and faith-based organizations, and groups such as the IFC. In both the Peru and Mongolia case, civil society/NGOs played an important role as catalysts for water stewardship. The perspective of these groups on sustainability is often broader than that of the mining industry, meaning that NGOs may be better positioned to identify opportunities outside the "business-as-usual" approach that miners may employ, and to identify opportunities for

cross-sectoral initiatives to drive progress on several sustainability targets. Initiatives such as the CEO Water Mandate, the Alliance for Water Stewardship, and non-governmental organizations such as the World Wildlife Fund (WWF), are all working to raise awareness of water risks and facilitate collective action on water. For example, these groups are advocating for context-based water targets, those that are "informed by sustainable thresholds or limits of a given basin based on science; respects the basin's environmental, economic, and social needs, and current and future conditions; and supports public sector objectives such as the Sustainable Development Goals" [47]. Many companies, both within and beyond the mining sector, acknowledge the important brokerage role that NGOs can play in mediating community-company tensions and have already established partnerships with various groups. It is suggested that the public perception of NGOs—that their core values are anchored in the common good, rather than corporate self-interest—has earned many such groups a credibility that industry can lack.

Appreciating that in each collective action initiative there may be unique geographic, governance, and stakeholder considerations, we suggest that the best group to convene and to lead shared approaches in sustainable water management is the one that is most trusted in the region. Identifying the most trusted party may be challenging. Research shows trust in government, business, industry, and even NGOs, has declined broadly in the past decade [48]. Further complicating the issue of identifying the most trusted party is the fact that there are varying amounts of trust in different regions of the world. For example, in the resource-rich countries of Africa and Latin America, trust in government is significantly lower than trust in business, yet in Asia trust in government is very high [49]. In countries such as China, where the NGO sector has been repressed, trust is low; North Americans place a lot of trust in NGOs. Two groups uniformly trusted across all geographic locations are science and academic institutions [48], suggesting these groups could be respected leaders on collaborative sustainability projects. While academic institutions did not play a significant role in the cases examined it is suggested that future partnerships would benefit from involving academia for credibility. It is also relevant to note that each successful project should build trust amongst the partners and provide a foundation for future collaboration.

In both cases examined, effective stakeholder engagement was found to be a critical determinant of success for developing multi-stakeholder collaborations. Collaborative partnerships are needed because while mining has an important role to play in addressing water supply and quality issues, industry will not be successful acting unilaterally. In fact, there are very sound arguments against mining companies taking ownership of water issues. As noted, this includes concerns that business may undermine the role of government or international development agencies, as well as potential stakeholder unease about a company's willingness to set aside corporate economic self-interest.

5. Conclusions

The premise investigated in this paper is that shared approaches to water management are required for sustainable outcomes. The two case studies helped to illustrate the determinants of success when planning a shared approach to water management: effective stakeholder engagement, convening power, financial resources, local knowledge, technical expertise, effective communication skills, and a willingness for each party in the collective action to play to its strengths. Trust, amongst partners and with the broader set of stakeholders, is argued to be the most important attribute. Given low trust levels in the mining industry and government, there appears to be a role for third-party groups such as civil society, multi-lateral institutions, and academia to adopt leadership positions. Leadership is important because without it projects are at risk of becoming paralyzed due to lack of decision-making and competing agendas, or the self-interests, of collaborators.

The fact that there are significant mineral resources in water-stressed countries suggests there are opportunities for mining companies and communities to take a shared approach to sustainable water stewardship. The two case studies highlight the positive outcomes possible when mining companies seek the nexus between the needs of business and those of society.

For companies, there is a clear return on investment that can be quantified (for example, no lost days of production due to protests, securing the water supply required for production, earning a social license to operate, reducing risk to shareholders). Society also benefits through the advancement of more sustainable water management. Furthermore, successful collaborative partnerships on water projects creates an opportunity to build trust and reputation capital for all convening parties, thereby creating an enabling environment for future projects.

Mining is one of the many businesses and industries that suffer from a lack of public trust. One reason trust is declining is a failure on the part of business to contribute to the greater good [9]. This suggests there is an opportunity for mining to earn public trust by working collaboratively with other interested parties to address issues of equal interest to business and society. According to research done by the World Business Council for Sustainable Development [50] collaborative partnerships provide opportunities to realign the objectives of industries such as mining with the values of society while also creating economic gain.

Questions remain about who should convene and who should lead collective action initiatives. Nevertheless, we argue there is no question that these initiatives are needed to address critical social and environmental issues, such as clean water and sanitation. When mining companies take a long-term, strategic approach to water management, the outcome can be collective action to deliver sustainable business and social value.

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