

Restructuring and rescaling water governance in mining contexts: the co-production of waterscapes in Peru

Article

Accepted Version

Budds, J. and Hinojosa, L. (2012) Restructuring and rescaling water governance in mining contexts: the co-production of waterscapes in Peru. *Water Alternatives*, 5 (1). pp. 119-137. ISSN 1965-0175 Available at <https://centaur.reading.ac.uk/25979/>

It is advisable to refer to the publisher's version if you intend to cite from the work. See [Guidance on citing](#).

Publisher: Water Alternatives network

All outputs in CentAUR are protected by Intellectual Property Rights law, including copyright law. Copyright and IPR is retained by the creators or other copyright holders. Terms and conditions for use of this material are defined in the [End User Agreement](#).

www.reading.ac.uk/centaur

CentAUR

Central Archive at the University of Reading

Reading's research outputs online

Restructuring and rescaling water governance in mining contexts: the co-production of waterscapes in Peru

Jessica Budds

Lecturer in Environment and Development

Department of Geography and Environmental Science

University of Reading

Whiteknights

Reading

RG6 6AB

UK

j.r.budds@reading.ac.uk

Leonith Hinojosa

Research Associate

Geography Department

The Open University

Walton Hall

Milton Keynes

MK7 6AA

UK

l.hinojosa-valencia@open.ac.uk

Acknowledgements:

We thank Emma Norman, Christina Cook and Karen Bakker for their work in putting this special issue together, and for their comments on a preliminary version of this article. Thanks are also due to three anonymous referees for their feedback and suggestions for improving the paper. We express our deepest gratitude to those who supported and/or participated in the field research in Peru. Finally, we gratefully acknowledge financial support from the UK Economic and Social Research Council (ESRC) (PTA-026-27-0854, 2006 and RES-061-25-0446, 2010-2012).

Restructuring and rescaling water governance in mining contexts: the co-production of waterscapes in Peru

Abstract

The governance of water resources is prominent in both water policy agendas and academic scholarship. Political ecologists have made important advances in reconceptualising the relationship between water and society. Yet, while they have stressed both the scalar dimensions, and the politicised nature, of water governance, analyses of its scalar politics are relatively nascent. In this paper, we consider how the increased demand for water resources by the growing mining industry in Peru reconfigures and rescales water governance. In Peru, the mining industry's thirst for water draws in, and reshapes, social relations, technologies, institutions and discourses that operate over varying spatial and temporal scales. We develop the concept of waterscape to examine these multiple ways in which water is co-produced through mining, and become embedded in changing modes and structures of water governance, often beyond the watershed scale. We argue that an examination of waterscapes avoids the limitations of thinking about water in purely material terms, structuring analysis of water issues according to traditional spatial scales and institutional hierarchies, and taking these scales and structures for granted.

Keywords

Water governance, scalar politics, mining, institutions, Peru

1. INTRODUCTION

The governance of water resources, its principles, and the scale at which it is organised, is at the forefront of both water policy and scholarship within resource geography. By exploring the power relations that underpin nature-society relations, political ecologists have advanced our understanding of water (e.g. Swyngedouw, 2004; Linton, 2010). In doing so, they have delivered important insights into some of the perspectives, institutions and processes of water governance, such as water privatisation (e.g. Bakker, 2003a, 2003b), integrated water resources management (e.g. Norman and Bakker, 2009), hydraulic engineering (e.g. Swyngedouw, 1999), water technologies (e.g. Loftus, 2006), hydrological studies (e.g. Budds, 2009), and social struggles (e.g. Perreault, 2005). Although this body of work has acknowledged the scalar dimensions of water governance, and has demonstrated that both water and its governance are politicised, linkages with the politics of scale - the recognition that scale is socially constructed and politically mobilised - are relatively nascent (see Cohen and Davidson, 2011; Norman and Bakker, 2009; Perreault, 2005; Swyngedouw, 1999, 2007). Much work continues to take the hierarchical physical boundaries and administrative structures that characterise most instances of water governance as given, thus a closer examination of the scalar politics with which water governance is organised may yield valuable insights.

In this paper, we explore the plurality, reconfiguration and rescaling of water governance in the context of the increased demand for water resources by the growing mining industry in Peru.¹ While existing research on the relationship between water and mining has centred on documenting how mining impacts water resources and users (e.g. Ochieng et al., 2010; Urteaga, 2011; Younger and Wolkersdorfer 2004), we turn our attention to the politics that mediate the use, management, regulation and framing of water in mining contexts.

In Peru and other Andean countries, the exploitation of metal ores has rapidly increased since the 1990s (Bebbington, 2009; Bridge, 2004a). This is due to several factors: the rising demand for, and price of, metals; Peru's liberalisation of its mining sector to (international) private companies for increased fiscal revenue; and technological advances that permit exploitation of more complex deposits. The mining 'boom' has resulted in the growth of concessions for mineral exploration and exploitation, which has increased demand for the natural resources - especially water - that are necessary for extraction (Bebbington and Williams, 2008). As a result, the development of mineral extraction has transformed some parts of the Andean highlands from *campesino*² agriculture to mining areas (Bebbington, 2009; Bebbington et al., 2008; Bury, 2005).

Mineral extraction and processing require large flows of fresh water. As mineral deposits are often located in places where supplies are scarce - due to arid climatic conditions, location in headwaters and/or full allocation of existing sources - the expansion of mining has greatly increased demand for, and competition over, water resources. The principal implications of mining for water are depletion of sources and contamination. Although the water used by mines in our case study region in southern Peru - Tacna and Moquegua Departments, where several large open-cast copper mines are in operation or under development - is 'local' to the mine, many of the ways in which it is defined, used and governed happen over wider spatial and temporal scales. In particular, both water extraction and contamination can occur in locations distant from mines that are not otherwise affected by mining. While the material effects of mining for people and ecology are important, our interest is to examine the politics of water governance in relation to mineral extraction, in order to show how water and mining co-produce each other such that mining configures waterscapes in distinct ways.

In order to approach the relationship between mining and water, we start from the idea that water is not merely a material substance that is subject to human manipulation, but a 'hybrid nature' in which water's materiality and its social relations constitute and express each other (Linton, 2010; Swyngedouw, 2004). Redefining water as co-produced enables us to think about not only the social processes that shape water, but also the ways in which water also shapes social relations (e.g. Bakker, 2003a; Linton, 2010; Loftus, 2009; Perreault, 2006; Swyngedouw, 1999). Thus, our starting point is that the flows, forms, practices and discourses that characterise water in mining contexts will reflect the material and social processes through which instances of water become formed. This requires attention to a range of moments, such as physical flows, patterns of access, technologies, institutions, practices, legislative reforms, governance frameworks, and discourses around water, which are mediated by social and political processes and collectively constitute the waterscape of a given context.

Our aim in this paper is to consider the implications of the mining industry for water governance. In doing so, we develop the concept of 'waterscape', which we argue represents a useful framework to approach the multiple processes and dynamics that

¹ The Political Ecology of Extractive Industries and Changing Waterscapes in the Andes, funded by the Economic and Social Research Council, 2010–2012 (RES-061-25-0446).

² 'Peasant' farmers, mostly from the Quechua and Aymara indigenous groups.

mediate water over space and time, in a way that avoids the limitations of thinking about water in purely material terms, analysing water issues according to traditional spatial scales, and accepting hierarchical forms of institutional administration as given.

The paper is structured into four sections. Following this introduction, in Section 2 we review debates over water governance and the politics of scale, and develop the concept of waterscape to capture the practices and narratives through which water is co-produced as a result of mining, and embedded in flows, artefacts, institutions and discourses. In Section 3, we analyse the relationship between mining and water governance in Peru, exploring the processes of restructuring and rescaling water governance arrangements in relation to the development of the mining industry and its need to secure water in the face of natural and produced scarcity. In Section 4, we close by arguing that the concept of waterscape better captures the politicised and multi-scale ways through which mining and water shape each other.

2. WATER GOVERNANCE, POLITICS AND SCALE: TOWARDS THE WATERSCAPE

Governance and scale have always been central to political ecology and water resources. Political ecology is predicated upon both the plurality of multiple stakeholders in natural resource and environmental management, and the importance of historical and external socio-economic processes in shaping nature-society interactions in local settings (e.g. Blaikie, 1985; Bryant and Bailey, 1997; Robbins, 2004). Nevertheless, Brown and Purcell (2005) and Neumann (2009) have criticised much political ecology enquiry for both privileging the local scale, and neglecting the political construction and mobilisation of scale. Similarly, the optimal organisation and scale of water governance has been vigorously debated within water resource studies and policy. While some argue that greater inclusion of non-state actors in water management and governance should be accompanied by decentralisation to lower levels (e.g. Cohen and Davidson, 2011; Norman and Bakker, 2009), others contend that centralised coordination may be necessary for strategic reasons, because local management may only be effective for specific functions (e.g. Lebel et al., 2005).

This section is divided into three parts. In the first part we outline work on water governance in critical scholarship, and in the second we review the connections between the water governance literature and the politics of scale. In the third part we develop the concept of waterscape.

2.1 Politicising water governance

The increased currency of the concept of water governance reflects the shift from 'government' to 'governance' in relation to public policy and environmental regulation (e.g. Bridge and Perreault, 2009; Himley, 2008). The notion of governance reflects the changing nature of state power in economic, political and social life: it follows recognition of the transition from centralised authority to multiple instances of regulation and/or a reduced role in some aspects of public policy (especially under neoliberal frameworks), and the growing participation and influence of non-state actors in political arenas. Environmental governance thus concerns the organisational structures, institutional arrangements and decision-making processes and practices through which environments and resources are accessed, used, managed and regulated, which involves multiple formal and informal actors at different scales (Bridge and Perreault, 2009; Himley, 2008).

In a review of the multiple conceptualisations and applications of environmental governance, Bridge and Perreault (2009) stress the importance of considering the politics with which environmental governance becomes configured, both materially and discursively. They propose a critical and dialectical approach to interrogate both how

social relations (among state, private and civil society actors) shape environmental governance, and how such modes of environmental governance (as the product of interactions between human agency and nature's materiality) produce new socio-natural arrangements. Positioning environmental governance as inherently politicised invites critical engagement with the production, mobilisation and contestation of scale, by repositioning scale choices and processes of rescaling as the outcomes of socio-political processes, rather than as pragmatic and pre-given categories (Bridge and Perreault, 2009; Himley, 2008). For example, the creation of supranational agencies, processes of decentralisation and/or the formation of new instances of governance (such as corporate social responsibility initiatives or watershed committees) can be understood as the outcomes of efforts by private sector actors to redefine the geographical scope and participants of decision-making, in line with their particular interests (Himley, 2008).

The emergence of governance in relation to water can be associated with three structural shifts in the water sector over the last two decades. First, water management was usually organised on a sectoral basis, under which different aspects of water planning, use and management, fell under the remits of different government bodies, often with little or no coordination between them. This structure came under increasing criticism during the 1980s, and was gradually replaced with the perspective that water was a holistic resource requiring integrated and cross-sectoral administration.

Second, the management of water resources in accordance with political-administrative boundaries was deemed to be ineffective because water resources that were physically connected were subjected to different forms of use, management and regulation, again with minimal coordination across jurisdictions. This gave rise to the consensus that the watershed³ is the most appropriate unit of water management and governance (e.g. Molle, 2009; Moss and Newig, 2010). In turn, it was deemed preferable for local water management to be undertaken by committees of water users within a watershed, rather than by state agencies pertaining to political-administrative jurisdictions.

Third, the water sector has been characterised by an increase in the participation of the private sector in the provision of water services and the management of water resources (e.g. Bakker, 2003a, 2003b; Budds, 2004; Budds and McGranahan, 2003). Private sector participation has implied an organisational shift in the form and scale of water governance, through processes such as commercialisation, decentralisation and private water concessions and water rights. It has also entailed a discursive transformation, as processes of privatisation are contingent upon water being redefined from a public good to a commodity (Bakker, 2003a; Kaika, 2003).

These shifts have transformed the nature, scale and the social relations of water governance. The reconfiguration of principles, structures and discourses, and the participation of non-state actors with different scalar dimensions, have important implications for the nature of state power in relation to processes of water governance (e.g. Norman and Bakker, 2009). A focus on governance has increased attention to the non-state stakeholders who actually did (e.g. informal water vendors), or potentially could (e.g. non-governmental organisations), play a greater role in using, managing and regulating water, and the need to involve a wider range of actors both in water management and decision-making processes (e.g. Cohen and Davidson, 2011).

Critical scholarship on water governance has taken up, and delivered critical insights into, the nature and dynamics of these shifts and their socio-ecological implications. On the one hand, political ecologists have recast water governance structures and processes as having been configured through contestation and struggle, such that they reflect and

³ Cohen and Davidson (2011: 1) define the term 'watershed' as a "hydrologically defined unit: an area of land draining into a common body of water such as a lake, river, or ocean".

embody dominant interests and positions. On the other hand, some scholars have moved towards a relational approach to water governance, by focusing on the state as a set of relations that produce people and places as opposed to a merely physical apparatus (e.g. Loftus, 2009), and on the relationship between water and people rather than the governance of the material resource (e.g. Swyngedouw, 1999). In this respect, water governance (in its various forms and moments) has been understood and explored as a form of state re-regulation to secure capital accumulation, through both material and discursive means, which in turn produces particular forms of authority and social order (Bakker, 2003b; Budds, 2004; Harris, 2006; Loftus, 2006; Loftus and Lumsden, 2008; Swyngedouw, 1999, 2005, 2007).

2.2 Water governance and the politics of scale

Despite recognition of the politicisation of water governance, and the importance of scale in the water sector, analyses incorporating the politics of scale into accounts of water governance are not as extensive as might be expected. The politics of scale redefines conventional and spatial hierarchies – ‘international’, ‘regional’, ‘national’ and ‘local’ – from fixed ‘containers’ of space that organise social processes, to categories produced by human efforts to interpret and order such processes (Brenner, 2001; Marston, 2000; Marston and Smith, 2001; Swyngedouw, 1997). As Bridge and Perreault (2009) note, critical scholars have recognised the social construction of scale in environmental governance, yet have tended to take the adoption of ‘natural’ scales for granted.

Analyses of the scalar politics of natural resources and environmental issues have produced several important insights. First, scales or boundaries have been repositioned as the products of processes of social definition, contestation and struggle (e.g. Brown and Purcell, 2005; Delaney and Leitner, 1997; Fall, 2005; Swyngedouw, 1997, 2007). Second, resources and issues are framed, mobilised and organised according to particular scalar dimensions in order to justify certain perspectives, and/or reconfigure power and authority (e.g. Bolin et al., 2008; Cowell, 2003; Dore and Lebel 2010; Lebel et al., 2005; Mansfield and Haas, 2006). Third, questioning existing categories of space has transcended the idea of ‘jumping scale’ to describe the ability of social actors to operate in multiple arenas (Perreault, 2005). Fourth, some analyses have shown that the characteristics of environments or resources also shape the scale of social relations, including forest (McCarthy, 2005), water and natural gas (Perreault, 2006) and urban environments (Swyngedouw and Heynen, 2003). The politics of scale has prompted some scholars to redefine scale from vertical hierarchies to horizontal configurations, through flat ontologies (Marston et al., 2005), networks (e.g. Bulkeley, 2005) and borderlands (e.g. Fall, 2005).

Existing work that has explored the scalar politics of water governance has focused on three main areas: the watershed as governance unit, the rescaling of governance under neoliberalism, and the production of scale through water. We briefly discuss each of these in turn.

The watershed is widely advocated as the appropriate unit of water governance on the basis that it represents the physical hydrological unit, yet, this ‘natural scale’ is increasingly questioned (Cohen and Davidson, 2011; Griffin 1999; Norman and Bakker 2009). We develop five points:

- First, the watershed scale is ambiguous, as it can be “as small as a sidewalk puddle or as large as the Great Lakes” (Cohen and Davidson, 2011: 2). This is reflected in the nested hierarchy of sub-watersheds that characterise many basins.
- Second, the extent to which hydrological units constitute ‘natural scales’ is debatable (Cohen and Davidson, 2011). Hydrological processes are extremely heterogeneous,

complex, dynamic and multi-scale, implying that they do not constitute a coherent scale in themselves (Jakeman et al., 1993). Watershed boundaries are also defined (and redefined) by people, and are thus partly subjective (Blomquist and Schlager, 2005; Cohen and Davidson, 2011).

- Third, hydrological processes and units are conventionally conceptualised and measured as biophysical entities, obscuring that they are socially shaped in multiple ways (Budds, 2009; Linton, 2008, 2010). River basins and water flows can be modified through hydraulic infrastructure, economic development and water policies, thereby rendering watershed boundaries infinitely porous (Bolin et al., 2008; Dore and Lebel, 2010; Turton et al., 2006).
- Fourth, while hydrological units correspond poorly with political-administrative jurisdictions, conversely social organisation, electoral representation and environmental regulation do not coincide with hydrological units (Cohen and Davidson, 2011; Dore and Lebel 2010). While some authors reject that the appropriate scale for water governance can be simply derived from its physical boundaries (Cohen and Davidson, 2011; Lebel et al., 2005), others contend that water occupies multiple and overlapping socio-ecological scales (Bolin et al., 2008; Dore and Lebel 2010). Cohen and Davidson (2011) highlight two particular shortcomings of the watershed as a governance unit. The first is 'problem-sheds', whereby watersheds frequently impact, and are impacted by, factors beyond their boundaries, which challenge watershed-based governance. The second is 'policy-sheds', whereby policies formulated according to watershed and political-administrative units are unlikely to be reconciled.
- Fifth, the framing and adoption of watersheds is political (Cohen and Davidson, 2011). Swyngedouw (1999) shows how the adoption of the river basin as the key governance unit in Spain at the turn of the 19th century rendered water governance technical, by privileging the knowledge and expertise of water engineers. Similarly, Blomquist and Schlager (2005) argue that reconfiguring watershed-based governance to restrict decision-making to water users can also exclude the participation of political authorities and citizens in water affairs.

Turning to the rescaling of water governance under neoliberalism, existing work has explored the material and discursive processes through which economic shifts reconfigure scale, and scale choices become politicised. In their analysis of Canadian-US transboundary water bodies, Norman and Bakker (2009) found that decentralisation had not resulted in the delegation of decision-making power from higher to lower levels of government, and that, although processes of participation had increased, local groups had not become more empowered. Similarly, examining the implications for resource management of the rescaling of the Bolivian state under processes of neoliberal restructuring, Perreault (2005) observed that, despite the creation of increased spaces for local participation, *campesino* irrigators formed national-level networks to contest the neoliberalisation of water through the discursive mobilisation of customary usage.

Finally, Swyngedouw (2007) demonstrates that the production of nature is an integral part of the production of scale. In his analysis of Spain's modernisation under General Franco, he demonstrates how national territorial integration (and political authority) was achieved through the construction of hydraulic infrastructure to connect river basins. Swyngedouw thus stresses how not only social relations, but also (hybrid) nature, co-produce scale.

Collectively, this work has made important inroads into the scalar politics of water governance, by examining the power relations embedded in scale choices, processes of rescaling and the production of scale through water. This is important given that water is so deeply entrenched in hierarchical scalar arrangements: the hydrological cycle is conceptualised as operating at global, regional and basin scales, and water institutions are typically organised at the international, national, provincial and local levels (Moss and Newig, 2010). However, these structures easily obscure the wider connections, other social dynamics, and natural agency that also shape water and its governance over space

and time. In order to avoid defaulting into the materiality of water, conventional containers of space and structures of administration, we turn to the concept of waterscape.

2.3 The concept of waterscape

The term waterscape is increasingly emerging in work that links water and social power relations. In this sense,⁴ the concept has been employed to explore the ways in which flows of water, power and capital converge to produce uneven socio-ecological arrangements over space and time, the particular characteristics of which reflect the power relations that shaped their production (Bakker, 2003b; Baviskar, 2007; Budds, 2008; Ekers and Loftus, 2008; Loftus, 2006, 2007, 2009; Loftus and Lumsden, 2008; Swyngedouw, 1999, 2004). As such, a waterscape is not merely the context within which water is contained, but “a produced socio-natural entity” (Loftus, 2007: 49) in which social power is embedded in, and shaped by, both water’s material flows and its symbolic meanings, and which becomes embodied in, and manifested through, a wide array of physical objects and forms of representation (e.g. Loftus, 2009; Swyngedouw, 1999). For example, Swyngedouw’s (1999) work on the Spanish waterscape shows how political power and national identity were produced and consolidated through a national programme of large dams that would foster development by transferring water from the humid north-west to the arid south-east. Similarly, Baviskar (2007) notes how the construction of dams and the privatisation of water in South Asia have recast both social relations and institutional arrangements. At a micro scale, Harris (2006) demonstrates how changing practices around irrigation in Turkey defined and altered gender subjectivities and dynamics.

A defining feature of waterscapes, therefore, is the wide range of not just water flows, but also water-related artefacts, institutions and imaginaries, that embody and express power. Here, Ekers and Loftus (2008) note the importance of not only examining large-scale infrastructure and major projects, but also everyday practices related to water. For example, in his analysis of the waterscape of Durban in South Africa, Loftus (2007) argued that the everyday practices of collecting water from standpipes, kiosks and ground tanks among low-income communities that were unserved by the municipal water supply network shaped the social relations of this particularly uneven waterscape, in particular by engendering protest and struggle over new technologies and institutional practices introduced as part of the commodification of water. Loftus (2006) thus showed how water meters, alternative technologies and new pricing schemes were not merely practical measures to organise water provision, but instruments that embodied social power as they formed part of new strategies to foster capital accumulation from previously unserved informal settlements.

By focusing on multiple dimensions of water-society interactions, waterscapes can be defined as extensively as appropriate, from neighbourhoods and cities (e.g. Loftus and Lumsden, 2008), to urban centres (Bakker 2003b) or river basins (Budds, 2008; Furlong, 2006), and to regions (Harris, 2006) and countries (Swyngedouw 1999), and to emphasise historical trajectories (Loftus and Lumsden, 2008; Swyngedouw, 1999). However, it is important to stress that a waterscape is not simply an alternative spatial scale, but a socio-spatial configuration that is constituted by social and ecological processes, which become manifest through the particular nature of flows, artefacts, institutions and imaginaries that characterise a particular context. Indeed, the representations and meanings that are embodied within instances of water also

⁴ ‘Waterscape’ is also used to mean paintings depicting a water scene, public water features, and an aquatic specialisation within landscape ecology (Orlove and Caton, 2010).

differentiate waterscapes from solely spatial analyses and less critical institutional analyses (see also Linton, 2010). Such representations include the construction and enactment of particular 'worldviews' around water that become manifested materially in institutional arrangements and technologies (Loftus and Lumsden, 2008), and the cultural and symbolic meanings embodied in water, which are prominent in sociological and anthropological studies (Baviskar, 2007; Orlove and Caton, 2010; Strang, 2004).

We propose the concept of waterscape to analyse hydro-social relations in a given context, with a view to overcoming the confines of conventional spatial scales and administrative structures, and avoiding the pitfalls of 'problem-sheds' and 'policy-sheds' (Cohen and Davidson, 2011). First, the concept emphasises the idea that water and waterscapes are co-produced, which avoids the limitation of thinking about water as a purely material resource that is the object of human actions. Second, it incorporates the assumption that waterscapes are shaped by a range of socio-ecological processes occurring over multiple spatial and temporal scales, and which are not necessarily evident at the local scale or the present time. Third, waterscapes comprise the assemblage of a wide range of water flows, technologies, issues, institutions, discourses and meanings that characterise waterscapes, and that produce, and are produced by, power relations. In the next section, we use this approach to examine the reconfiguration of water use, institutions and discourses, and the rescaling of governance structures, in relation to mining in Peru.

3. MINING AND THE CO-PRODUCTION OF WATERSCAPES IN PERU

In this section, we draw on empirical research into the relationship between mining and water in Peru, including a case study in the south of the country, to consider what an examination of processes of mineral extraction might bring to an analysis of water governance. We aim to show how the growth of mining and its need to secure water in the face of natural and produced scarcity has shaped multiple moments in the waterscape, including the restructuring and rescaling of water governance. We start by presenting the evolution of water governance in Peru, and then consider how mining has reshaped waterscapes. The last part analyses the politics of the changing nature and scale of water governance, and its implications for power relations.

3.1 The evolution of water governance in Peru

The legal and institutional framework for water governance in Peru has evolved over the last 40 years. Until 2009, Peru's framework was sectoral and administratively hierarchical. The former 1969 General Water Law (*Ley General de Aguas*) was passed alongside agrarian reform, implying that water allocation was strongly directed towards agriculture, Peru's principal water user. Under this framework, water was managed by different ministries: the Ministry of Agriculture managed water allocation and use for irrigation, the Ministry of Housing administered drinking water and wastewater, the Ministry of Health oversaw water quality, and the Ministry of Energy and Mines regulated water contamination in relation to extractive industries. At the local level, allocation of water rights⁵ and water resource management were organised by irrigation district

⁵ Water rights are state-granted administrative concessions (*licencias*) that are required for all uses and sources. They are allocated to land, and are not transferrable or tradable. Water users are required to pay fees according to the flow consumed, type of use and source of water. Although

(*distrito de riego*), a relatively small administrative area that corresponded minimally with watershed boundaries. Water management within an irrigation district was the responsibility of a local 'technical administrator' (*administrador técnico*). Technical administrators were responsible for allocating and administering water across all uses within their jurisdiction, although irrigation was the dominant use. Due to their relatively limited scope, capacity and resources, more complex issues, such as groundwater allocation, were usually passed to the former National Institute of Natural Resources (*Instituto Nacional de Recursos Naturales*) in Lima (Technical Administrator, 2006).

Alongside this formal state apparatus, a number of user-based water organisations managed and governed water locally. These comprised water user associations (*juntas de usuarios*), defined by the General Water Law, irrigation committees (*comités de regantes*), and highland community water systems. The latter comprise traditional systems that are managed by *campesino* village irrigation committees on a communal basis and according to customary rules and practices. As such, these highland systems are multiple, diverse and dispersed (e.g. Boelens, 2008; Gelles, 2000). All these water user organisations were predominantly agricultural, with little, if any, participation from other sectors. They also had relatively little voice at the national level, despite the representation of water user associations by the National Board of Water User Associations (*Junta Nacional de Usuarios de los Distritos de Riego*). However, the 1969 framework included no formal role for the participation of these local water user organisations in water allocation, management or regulation.

In 2009, a new Water Resources Law (*Ley de Recursos Hídricos*) was passed, building on a strategy that promoted integrated water resources management. A revision to the existing law was needed for two key reasons. First, the nature and structure of the Peruvian state had changed following processes of decentralisation from Lima to the sub-national administrative units (regions, provinces and districts) in the late 1980s. Second, the scale and nature of water use in Peru had significantly changed from the 1990s, following growth in water-related industries including export-oriented agriculture, urban development and drinking water coverage, extractive industries, and hydroelectric power production, which were promoted by successive governments and supported by a liberalised economic framework and governance structure. The resulting increase in demand for water, the exploitation of new sources (especially groundwater), and the development of new infrastructure (especially hydraulic works) that these sectors required, presented new challenges for water governance that were not well accommodated within the existing framework (del Castillo, 2010).

The new legal and institutional framework was proposed in 2004⁶ and developed by a National Water Commission (*Comisión Nacional del Agua*), comprising a 'consultation commission' (*comisión consultiva*) made up of relevant government agencies and prominent independent institutes, and a 'review committee' (*comisión revisora*) comprising the consultation commission plus key sectoral stakeholders, including the National Mining, Petroleum and Energy Association (*Sociedad Nacional de Minería, Petróleo e Energía*). The draft framework was debated and amended in Congress from 2006, and passed in 2009 (del Castillo, 2010). Alongside the new law, a state water institution, the National Water Authority (*Autoridad Nacional del Agua*), was created in 2008, which was intended to be cross-sectoral,⁷ autonomous,⁸ and decentralised.⁹ The

traditional water entitlements are valid, and should be respected, many are not registered, especially in the highlands (del Castillo, 2006).

⁶ Although it drew on earlier proposals from 1997-1998 to introduce private water rights, support for this increasingly weakened as the draft law was negotiated (del Castillo, 2006).

⁷ The Water Resources Law regulates all instances of water management and water-related issues.

National Water Authority has a regional presence through an Administrative Water Authority (*Autoridad Administrativa del Agua*) in 14 regions, and a Local Water Authority (*Autoridad Local del Agua*) in each major river basin. The new framework thus integrated water under the National Water Authority and its sub-authorities, replaced the technical administrators with the Local Water Authorities, filled the gap in water governance that previously existed between the national level and the irrigation district, and changed the unit of water governance from the irrigation district to the river basin.

Given the shift from a centralised approach to an integrated framework based on the watershed unit, the new law also mandated the establishment of river basin councils (*consejos de cuenca*), envisaged to incorporate all water user organisations and to be invested with significant decision-making powers.¹⁰ One key function of the councils is to integrate sources and water use sectors through coordination within the basin.

3.2 Mining and changing waterscapes

The connections between water and mining become embodied in, and expressed by, a range of 'moments': water flows, rights, infrastructure, institutions and discourses.¹¹ We present and analyse these in turn.

Flows

While we aim to move away from the unidirectional impacts of mining on water sources and users, the material effects of mining on water quantity and quality constitute important ways in which mineral extraction shapes waterscapes. However, it is not only the material effects that are important, but the ways in which these effects arise, and potentially reconfigure mining activities.

In Peru, water contamination through leaching (infiltration of acids and heavy metals used for ore separation) and dumping of tailings (finely ground rock from which ore has been extracted) from mines has been serious in some cases, especially in the past when environmental standards were less stringent, and has damaged the health of local ecosystems and people (Balvín, 1995; Urteaga, 2011). Although in principle standards are now higher, some stakeholders suggest that contamination still occurs due to lack of state monitoring. Moreover, it is not just physical contamination that is important, but the idea of contamination: water contamination continues to be strongly associated with *any* existing or potential mine, especially by groups opposed to mining. The strong association of mining with water contamination has been an extremely pervasive negative image that the sector has been unable to discard.

In Tacna and Moquegua, the extraction of water for mines is claimed to have depleted sources, with serious environmental and social consequences. In some highland areas (from approximately 3500 metres above sea level), *campesino* people have alleged that high Andean alpine wetlands (*bofedales*) have significantly shrunk following the extraction of surface water and groundwater for mining. The wetlands sustain

⁸ The National Water Authority was envisaged to fall under the remit of the newly-established Ministry of the Environment, but was provisionally housed within the Ministry of Agriculture.

⁹ The decentralised structure of the Water Authority institutions built on an earlier process of decentralisation of core state functions, such as infrastructure, from Lima to the regions from 2003.

¹⁰ Initially, the National Water Authority established six of these as pilot initiatives. One of these comprises the Locumba-Sama and Caplina river basins in Tacna.

¹¹ From hereon in, we have anonymised some institutions and individuals to protect identities.

biodiversity, regulate the local climate, provide pasture for livestock (especially alpaca, the principal livelihood in the highest Andean villages), and feed water courses.¹² Similarly, in the central parts of valleys (approximately 2000-3500 metres above sea level), some *campesino* communities have claimed that the flows of water into their customary irrigation systems have drastically reduced as a result of mining, restricting their ability to maintain (or expand) their traditional terraced agriculture.

Through water, the effects of mining can be experienced in locations that are distant from the mine(s) and not otherwise affected by mining. This has at least two important implications. First, in principle, sources of water extraction may not be in the same jurisdictions as mines, which presents challenges for water governance (in terms of both regulation and user participation), whether organised on a political-administrative or a watershed basis. Second, as the wider effects of mining on water quality and quantity are difficult to prove, such communities are seldom considered as 'affected communities' (*comunidades afectadas*) and do not qualify for compensation. For example, in Moquegua, the villages located in an area that supply water to some large mines (and claim that their wetlands have reduced as a result) have received very little revenue from the mining tax (*canon minero*), because they are not located in the administrative districts closest to the mine, to which the largest proportion of the revenue is paid.

Furthermore, mineral extraction is the *only* major economic activity that takes place in the headwaters of basins. However, the implications of disturbing headwaters – especially glacial headwaters such as those in some areas being mined in the Andean region – are extremely poorly understood (Bebbington and Williams, 2008). The issue of the protection of headwaters was one of the most contested aspects during the formulation of the 2009 Water Resources Law. While agricultural and environmental stakeholders strongly supported the prohibition of any development in headwaters, to avoid downstream impacts and to conserve ecosystems (and possibly also to attempt to curtail the expansion of mining), the mining sector vehemently resisted this restriction, arguing that there was no solid evidence that industrial activity in headwater areas would have adverse impacts if carried out responsibly (Urteaga, 2010). The final version of the new law did not prohibit development in headwaters, which would have greatly affected the viability of many current and future mining ventures.

Rights

Many locations in which mineral extraction is possible - especially in southern Peru – are characterised by water scarcity due to arid conditions, location in headwaters and/or the presence of existing water users. In contexts where little or no water is available, mining companies have sought to acquire water rights by various means. First, one strategy has entailed acquiring land from *campesino* people (not always through ethical means) (e.g. Bury, 2005; Urteaga, 2011).¹³ For instance, in Moquegua, one mine is alleged to have bought an extensive area of pastureland containing wetlands from almost an entire *campesino* village.¹⁴ Although water rights can neither be bought nor transferred with land, it appears that, when land was sold, Technical Administrators simply used to

¹² While parts of these wetlands are dead, there is no data available to attribute this to water use for mining.

¹³ At widely diverging prices, with some sales at far below market value reported (Labor, 2006).

¹⁴ Reported by two Aymara *campesina* (female) landowners of a highland village near Moquegua (*Campesina A*, 2010; *Campesina B*, 2010). Although water would have sustained pasture, it is unlikely that water rights would have existed. It is unclear whether a mining company would be able to acquire water rights from wetlands; although, in this case, it is claimed that the land was required for a reservoir rather than for water extraction (Labor, 2011).

reallocate the same water rights to the new owner.¹⁵ Second, some mining companies have approached government agencies to discuss solutions. For instance, in Tacna, mining company representatives liaised with the Technical Administrator, looking to facilitate the process of determining water availability by commissioning studies and/or by providing the logistics for field inspections (Technical Administrator, 2006; Mining Company 1-B, 2006). Similarly, a company aiming to establish a new mine in the region approached the National Institute of Natural Resources in Lima to negotiate acquisition of the necessary water rights, offering to contribute to studies and infrastructure (National Institute of Natural Resources, 2006). A third strategy has entailed the revision by mining parties of existing water allocation to identify any unassigned resources. For example, a company in Moquegua observed that the infiltration of water from a reservoir floor into the aquifer had been overlooked, and requested the rights to this flow (Labor, 2011). The use of such strategies shows that water allocations and decisions can take place outside formal structures, and be influenced by social relations and vested interests.

Infrastructure

An important way of potentially fulfilling mines' demand for water is to 'produce' water through hydraulic infrastructure. Infrastructure that has been constructed or proposed in southern Peru includes large boreholes to extract groundwater, hydraulic works to enable inter-basin transfers, dams and reservoirs to produce water and energy, and desalination plants, whereby either desalinated water would be pumped to mines or supplied on the coast in return for the use of highland water at source (thereby saving the energy costs of pumping). These supply-led technical solutions, proposed and constructed for mining, can significantly modify hydrological regimes and thus patterns and rules of access.

Infrastructure solutions, however, are more complex than some of the above strategies, not only because they require government authorisation, but also because they are seldom cost-effective for the operational life of one mine. In one case in Moquegua, where the new infrastructure was not economically viable for the mine alone, the company sought co-financing from the state, on the basis that the proposed dam and reservoir would also provide water and energy to other sectors (agriculture, urban centres), and would outlast the mining project (Mining Company 2, 2006). In another instance, a mine sought to access water from a state irrigation project (State irrigation project, 2010a, 2010b), and subsequently offered a water swap, whereby it would draw water from the irrigation system in the highlands, and replace it with desalinated water on the coast. This proposal was extremely contentious, due to the perception that the mining sector was diverting water from the agriculture sector, and also because state irrigation projects are fully financed by public investment due to their social functions (expanding the agricultural frontier and supplying drinking water). In this way, mining also influences the type and organisation of infrastructure that is constructed.

Institutions

Through the National Mining, Energy and Petroleum Association, the mining sector actively participated in debates over, and the formulation of, the 2009 Water Resources Law in Congress (del Castillo, 2010; Oré, 2011). The final version of the law reflected its influence, through the authorisation of economic activities in headwaters, and the prominence of the concepts of efficiency in water use and equity in access, which had been strongly emphasised by mining sector to signal that new entrants (i.e. mining) should have the same opportunities to access water as existing users (i.e. agriculture).

¹⁵ Sosa (2010) reported that some *campesino* communities in Cajamarca (northern Peru) were persuaded by a mining company to relinquish their water rights on the basis that they no longer required them, so that the company could apply for them.

This illustrates how the influence of the mining sector became reflected in the very architecture of Peru's new water governance framework.

One effect of the revised Water Resources Law was increased state control over water user organisations. Whilst this intervention has established more formal links between state agencies and local water user associations, in particular on Peru's coast where water user organisations have more easily adapted to the legal framework (due to larger agricultural units and/or the nature of their organisational culture), it has presented challenges in relation to water management in other areas, especially the highlands. Given that the state has historically had very little, if any, presence in highland communities, *campesino* water systems were barely considered in the formulation of the new legal and administrative framework. This means that the formal organisational arrangements for water user associations and river basin councils are not easily adapted to highland community water systems. In principle, highland systems are expected to comply with the national legal framework, for instance by formalising unregistered water rights and incorporating village irrigation committees into water user associations. However, *campesino* communities' customary norms and rules for water allocation, and their own systems for governance, not only differ among themselves, but are also very distinct from those defined by, and operating under, the formal framework (see also Boelens et al., 2010; Gelles, 1998; Trawick, 2003). Nevertheless, in practice, the small scale of highland irrigation systems, the isolation and lack of state presence in the highlands, and the wider cultural and economic marginalisation of Andean *campesino* people, has permitted communities to ignore, or at least delay, changes to their water governance structures and practices.

At the time of writing, the participation of local stakeholders in the allocation of water rights by the Local Water Authorities, as prescribed by the new framework, had not happened, and decisions were being made by the regional Administrative Water Authorities and the National Water Authority in Lima. However, in practice, civil society organisations and community groups have influenced some decisions through informal spaces for dialogue and advocacy, and also through contestation and protest. For instance, immediately after the Water Resources Law was enacted, a respected independent research institute, the Peruvian Centre for Social Studies (*Centro Peruano de Estudios Sociales*), raised concerns about the potential effectiveness of the proposed channels for participatory decision-making in relation to water issues, and disseminated these through publications and radio broadcasts. This led to some national, regional and local government agencies and users to participate in decisions, and some instances of contestation regarding water allocation to the mining sector.

Discourses

In Peru, the relationship between mining and water is not just material, but also discursive. Some of the examples above have already shown how water has featured in debates about mining (e.g. inevitability of contamination, contestation over headwaters and state irrigation infrastructure). Discourses that emerge about water in relation to mining affect how water becomes viewed and represented, and these framings can, in turn, have entirely material effects, especially when they disrupt mining activities.

One way in which changing discourses are expressed is through the tension between the agriculture and the mining sectors over water. In general, the agriculture sector, the longest-standing and the most voluminous water user in Peru, and with aspirations to further expand into export production, regards itself as threatened by increased competition over water from mining; while the mining sector considers that it is unable to acquire the necessary water rights due to existing allocation of water to irrigators, which have forced it to look to other ways of accessing water. The mining sector thus

frequently contrasts its own estimated *national* use of water – two per cent¹⁶ – with that of the agriculture sector – approximately 80 per cent – to both trivialise its own water use (which can be significant at the local level), and frame the agricultural sector as an inherently inefficient water user. The agriculture sector, in turn, emphasises the real and potential contamination of the mining sector, and represents itself as a more traditional, responsible and sustainable water user. Similar discourses between communities and mining companies. In Tacna and Moquegua, *campesino* representatives have used the alleged impacts of mining on their water resources to promote customary access to natural resources, to strongly oppose mining, and, arguably, to reinforce claims for assistance and/or compensation. Some mining company representatives have responded to these narratives by framing peasant irrigation as inefficient both technically (i.e. water consumption) and economically (i.e. value of produce), and by suggesting alternative explanations for the alleged effects on wetlands and terraces, such as poor agricultural practices and climate change (e.g. Mining Company 1-A, 2006).

Some of these discourses embed specific meanings of water, sometimes drawing on Andean indigenous meanings of water (e.g. Gelles, 2000). For example, in Moquegua, groundwater extraction by a mine was *specifically* opposed by local *campesinos*, as they claimed that it would desiccate their pasture (*Campesina A*, 2006). They remained unconvinced by a technical study that indicated that the water was not connected with their land; either because they did not trust the company, because they could not physically observe groundwater flows, and/or possibly because their preferred solution was a reservoir in which they hoped to be able to raise trout. Nevertheless, local opposition was one factor in the company having to abandon plans to extract groundwater and seek alternative sources (Mining Company 2, 2006; Labor, 2006).

3.3 Restructuring and rescaling water governance

In Peru, the relationship between mining and water entails multiple artefacts, practices and discourses occurring in different places, at specific moments and with multiple connections. Yet, many of the diverse 'moments' outlined above coincide poorly with both the spatial scale and the administrative structure of formal water governance. Furthermore, the ways in which water flows and issues become shaped in relation to mining occur not in synergy, but in parallel, with other processes, such as administrative decentralisation, distribution of the mining tax, allocation of mineral concessions and livelihood strategies. We would contend that this is because social processes occur within, across and beyond watersheds, in complex and dynamic ways. This is illustrated by the pilot river basin council established in Tacna.¹⁷ Although the council was established for the Locumba-Sama and the Caplina basins, the former of which extends into Moquegua, to date the council has become organised on an *administrative*, rather than a *watershed*, basis: the two basins cover much of the territory of Tacna, and stakeholders from the part of the Locumba-Sama basin located in Moquegua have as yet not been included. This illustrates that, in practice, regional governance is not easily replaced, and watershed organisations are not always readily established.

This raises two points. First, due to the wide-ranging implications that mining has for water use and regulation, the watershed unit has little significance for governing water in relation to mineral extraction. Inter-basin transfers and desalination, for instance, can

¹⁶ This figure is highly debatable, since the only published data on sectoral water use are from the 1980s, before the expansion of mining. Furthermore, water use is mainly measured and reported by the mining industry, with little state monitoring.

¹⁷ See note 10.

render the logic of the watershed as the unit of water governance futile, since they can modify its processes, resources and limits. Although not the case in Tacna and Moquegua, in principle a mining venture could draw water from different watersheds, thus complicating governance structures and processes. Indeed, in the Apurimac basin (central-southern Peru), one part of the watershed boundary was redefined for *administrative* purposes following the diversion of water to flow westwards towards the (arid) Pacific, rather than eastwards towards the (humid) Amazon basin (Vargas, 2010).

Second, the principle of using the watershed as the basis of water governance suggests a unit that is both rational and coherent. Yet, many watersheds in Peru are extremely large, heterogeneous and dynamic, both physically and culturally. The watersheds that we examined in Tacna and Moquegua are highly diverse spaces with regard to contestation and conflict, as different (socio-economic and cultural) groups located in different parts of the basin struggle over water along different axes of material and symbolic differentiation: geographic areas (highlands / valley / coast), administrative regions (Tacna / Moquegua), user sectors (agriculture / mining), and socio-economic group (*campesino* / commercial).

Moreover, the rescaling of water governance to the watershed level has the potential to significantly reconfigure power relations. Whilst the strategy upon which the Water Resources Law was based suggests that the river basin was adopted as the unit of governance due to the prevailing consensus within integrated water resources management (as opposed to pressure from particular interest groups), we do note three implications of this shift in relation to the nexus between mining and water. The first is that it serves to more effectively integrate the water resources of Peru's distinct 'regions': the Pacific coast, the Andean highlands and the Amazonian lowlands. This, in turn, could eventually facilitate the justification of transfers from the (humid) lowlands or highlands to the (arid) coast. Such a view would coincide with the view held by some conservative Peruvian business and public sector groups that the poor and rural indigenous groups inhabiting the Andean highlands and Amazonian lowlands harbour valuable resources on their ancestral lands (e.g. minerals, oil) that they do not wish to be exploited, which is deemed to impede the generation of development and wealth for Peru as a nation.¹⁸

A second is that the restructuring and rescaling of the institutional framework for water governance is advantageous for the mining sector in several ways. First, it eliminated the previous agricultural bias, by formally recognising a greater plurality of water users, including the mining sector in water governance. Second, it permitted development in the headwaters of river basins, which is essential for mineral extraction to proceed and expand. Third, it established river basin councils as new institutions that will allow the mining sector – which almost *never* previously participated in water user associations – to become involved in local water governance. Depending on how the river basin councils are organised (for example, if voting rights are proportional to water rights), mining companies could acquire significant power within these institutions, especially if the participation of other stakeholders is reduced.

While the new Water Resources Law aims to promote coordination between resources and users, its legal and institutional framework only achieves this through the river basin councils. This is partly because the National Water Authority and its sub-authorities do not incorporate participation from non-state actors; the only entity that does this is the river basin council. It is also partly due to the new water framework being decentralised to the regions and the basins, yet disconnected from the regional governments and wider political-economic processes (such as economic development, investment of the mining tax and land-use planning) that also affect the mining sector. Importantly, there is as

¹⁸ This attitude was expressed by former President García (1985-1990; 2006-2011) as the 'dog in the manger syndrome' (*síndrome del perro del hortelano*) (García, 2007).

yet little evidence that these efforts at integration have reduced tensions between different uses and users, not least because they do not address the coordination of upstream-downstream water uses and impacts.

Lastly, at the time of writing, this rescaling existed in theory rather than in practice. In principle, the decentralised water framework would delegate more power from the National Water Authority to the regional Administrative Water Authorities and the basin-level Local Water Authorities, to both fill the former gap between the national level and the irrigation district, and strengthen the Local Water Authorities. Yet, to date, power and decision-making appear to be largely concentrated in the National Water Authority.

4. CONCLUSIONS

In this paper, we set out to examine the relationship between the growing mining industry and increased demand for, and competition over, water resources in Peru. In particular, we sought to demonstrate the application of the concept of waterscape, by analysing how the influence of the mining sector becomes shaped by, and embedded in, a panorama of water flows, artefacts, institutions and discourses. We suggest that this perspective avoids three particular limitations in relation to analysing water governance.

First, understanding the waterscape as a socio-natural entity, in which water and power are co-produced and expressed, enables a shift from thinking about the governance of water as a material resource towards an examination of the relationship between water and society. Our study of southern Peru shows how water and mining shape each other, both materially and discursively. Natural and produced scarcity, social relations of water use and people's attitudes towards water all challenge the mining sector's access to water, and, in turn, the mining industry's need to fulfil its thirst for water has influenced governance arrangements in particular ways, for example, through the mobilisation of a variety of strategies to acquire water for new mines, proposed co-financing arrangements for hydraulic infrastructure, and the framing of agricultural users as inherently inefficient. In this way, examining the waterscape reveals the reach of the mining sector in Peru.

Second, by looking beyond the formal institutions that govern water, to the multiple social relations through which water governance is enacted over space and time, a waterscape analysis also endeavours to transcend conventional and hierarchical administrative structures that characterise formal water governance. In Peru, an important consequence of the growth of mining has been the transfer of water traditionally used by *campesino* communities to mines, which both changes traditional livelihoods and landscapes, and enables the mining industry to expand and develop. An analysis of the formal governance structure alone would fail to fully capture the ways in which mining company representatives may negotiate water solutions directly with communities or government agencies, the mining sector's influence on the legal and administrative framework formulated to govern water, the ways in which successive governments have supported the development of the mining sector, or the framings used to justify the diversion of water to the mining sector. This illustrates how scales are framed and mobilised, and how different strategies are employed to occupy different levels. Furthermore, rather than explaining these relations in terms of 'jumping scale', we would suggest that the actors who are more effective in influencing water are better able to capture and occupy these different moments in the waterscape. For instance, mining companies operate at diverse levels: their lawyers negotiate water rights or contest government decisions; their community relations teams liaise with villages; and their technical staff produce studies to support proposals or refute claims. By doing so they are present in, and influence, multiple spaces and moments in different ways.

Third, thinking in terms of waterscapes avoids confining analyses to conventional scalar containers, and taking scale choices for granted. Analysing the production of waterscapes, rather than the spatial governance of water, captures the multi-scalar processes through which water is co-produced and embodied in a wide panorama of water flows, social relations, technologies, institutions, practices and discourses. On the one hand, this has allowed us to move beyond the material impacts of mining on water, or the water footprint of mining (e.g. Allan, 2011), by examining how, through mining, this panorama becomes configured. On the other hand, it has illustrated how the restructuring and rescaling of water governance reconfigures power, especially through the creation of the river basin councils. In this way, analysing the waterscape is inspired by the multiple forms, connections and meanings of water, rather than guided by a predetermined container of space.

Here, we add our voice to existing critiques of the use of the watershed as the basis of water governance, by asserting that it is *particularly* problematic in relation to the specific issues and challenges posed by the expansion of extractive industries. Due to the extent of mines' area of influence, their high demand for water, as well as the particular socio-ecological conditions that characterise many mining areas (such as glacial headwaters and indigenous territories in the Andes), the rationale of the watershed becomes, at best, greatly reduced, and, at worst, redundant. We suggest three reasons. First, some of the key strategies through which the mining sector captures, or 'produces', water, such as inter-basin transfers, groundwater extraction and desalination, render the watershed limits infinitely porous. Second, so many of the social and decision-making processes in relation to water and mineral extraction, such as economic development and land use planning, occur beyond the watershed. The watershed thus plays little role in organising other aspects of social and economic life that intersect with water and mining. Third, while the watershed unit may - albeit arguably - *integrate* water resources, it may also disconnect them from other instances of governance, and does not always address the important challenge of regulating upstream and downstream users and impacts.

REFERENCES

- Allan, J. A. 2011. *Virtual Water: Tackling the Threat to our Planet's Most Precious Resource*. London: I. B. Taurus.
- Bakker, K. 2003a. *An Uncooperative Commodity: Privatizing Water in England and Wales*. Oxford: Oxford University Press.
- Bakker, K. 2003b. Archipelagos and networks: Urban water privatization in the South. *Geographical Journal* 169(4): 328-341.
- Balvín, D. 1995. *Agua, Minería y Contaminación: El Caso Southern Peru*. Lima: Ediciones Labor.
- Baviskar, A. (Ed). 2007. *Waterscapes: The Cultural Politics of a Natural Resource*. Delhi: Permanent Black.
- Bebbington, A. 2009. Latin America: Contesting extraction, producing geographies. *Singapore Journal of Tropical Geography* 30(1): 7-12.
- Bebbington, A. and Williams, M. 2008. Water and mining conflicts in Peru. *Mountain Research and Development* 28(3/4): 190-5.

- Bebbington, A., Bebbington, D., Bury, J., Langan, J., Muñoz, J. and Scurrah, M. 2008. Mining and social movements: Struggles over livelihood and rural territorial development in the Andes. *World Development* 36(12): 2888-905.
- Blaikie, P. 1985. *The Political Economy of Soil Erosion in Developing Countries*. London: Longman.
- Blomquist, W. and Schlager, E. 2005. Political pitfalls of integrated watershed management. *Society and Natural Resources* 18(2): 101-117.
- Boelens, R. 2008. *The Rules of the Game and the Game of the Rules. Normalization and Resistance in Andean Water Control*, Wageningen: Wageningen University.
- Boelens, R., Getches, D. and Guevara Gil, A. Eds. 2010. *Out of the Mainstream: Water Rights, Politics and Identity*. London: Earthscan.
- Bolin, B., Collins, T. and Darby, K. 2008. Fate of the verde: Water, environmental conflict, and the politics of scale in Arizona's central highlands. *Geoforum* 39: 1494-1511.
- Brenner, N. 2001. The limits to scale? Methodological reflections on scalar structuration. *Progress in Human Geography* 25(4): 591-614.
- Bridge, G. 2004a. Contested terrain: Mining and the environment. *Annual Review of Environment and Resources* 29: 205-59.
- Bridge, G. 2004b. Mapping the bonanza: Geographies of mining investment in an era of neoliberal reform. *Professional Geographer* 56(3): 406-21.
- Bridge, G. and Perreault, T. 2009. Environmental governance. In Castree, N., Demeritt, D., Liverman, D. and Rhoads, B. (Eds) *A Companion To Environmental Geography*, pp. 474-497. London: Wiley-Blackwell.
- Budds, J. 2008. Whose scarcity? The hydrosocial cycle and the changing waterscape of La Ligua river basin, Chile. In Goodman, M., Boykoff, M. and Evered, K. (Eds) *Contentious Geographies: Environment, Meaning, Scale*, pp. 59-68. Aldershot: Ashgate.
- Brown, J. C. and Purcell, M. 2005. There's nothing inherent about scale: Political ecology, the local trap, and the politics of development in the Brazilian Amazon. *Geoforum* 36: 607-624.
- Bryant, R. and Bailey, S. 1997. *Third World Political Ecology*. London: Routledge.
- Budds, J. 2004. Power, nature and neoliberalism: The political ecology of water in Chile. *Singapore Journal of Tropical Geography* 25 (3): 322-42.
- Budds, J. 2008. Whose scarcity? The hydrosocial cycle and the changing waterscape of La Ligua river basin, Chile. In M. Goodman, Boykoff, M. and Evered, K. (Eds) *Contentious Geographies: Environment, Meaning, Scale*, pp. 59-68. Aldershot: Ashgate.
- Budds, J. 2009. Contested H₂O: Science, policy and politics in water resources management in Chile. *Geoforum* 40 (3): 418-430.
- Budds, J. and McGranahan, G. 2003. Are the debates on water privatization missing the point? Experiences from Africa, Asia and Latin America. *Environment and Urbanization* 15 (2): 87-113.

- Bulkeley, H. 2005. Reconfiguring environmental governance: Towards a politics of scales and networks. *Political Geography* 24: 875-902.
- Bury, J. 2005. Mining mountains: Neoliberalism, land tenure, livelihoods and the new Peruvian mining industry in Cajamarca. *Environment and Planning A* 37: 221-39.
- Campesina A (anonymised), 2006. Personal communication, Moquegua, October.
- Campesina A (anonymised), 2010. Personal communication, Moquegua, November.
- Campesina B (anonymised), 2010. Personal communication, Moquegua, November.
- Cohen, A. and Davidson, S. 2011. The watershed approach: Challenges, antecedents, and the transition from technical tool to governance unit. *Water Alternatives* 4(1): 1-14.
- Cowell, R. 2003. Substitution and scalar politics: Negotiating environmental compensation in Cardiff Bay. *Geoforum* 34:343-358.
- Delaney, D. and Leitner, H. 1997. The political construction of scale. *Political Geography* 16(2): 93-97.
- del Castillo, L. 2006. Peruvian Centre for Social Studies (*Centro Peruano de Estudios Sociales*). Personal communication, Lima, October.
- del Castillo, L. 2009. Peruvian Centre for Social Studies (*Centro Peruano de Estudios Sociales*), Lima, recorded interview by the Institute for the Promotion of Water Management (*Instituto de Promoción para la Gestión del Agua*), Lima, 11 November (http://www.cepes.org.pe/apc-aa/archivos-aa/4528189676e60f79d36b1f4a1ca39da9/laureano_cepes_reglamento.mp3).
- del Castillo, L. 2010. Peruvian Centre for Social Studies (*Centro Peruano de Estudios Sociales*). Personal communication, Lima, August.
- Dore, J. and Lebel, L. 2010. Deliberation and scale in Mekong Region Water Governance. *Environmental Management* 46: 60-80.
- Ekers, M. and Loftus, A. 2008. The power of water: Developing dialogues between Gramsci and Foucault. *Environment and Planning D* 26(4): 698-718.
- Fall, J. 2005. *Drawing the Line: Nature, Hybridity and Politics in Transboundary Spaces*. Aldershot: Ashgate.
- Furlong, K. 2006. Hidden theories, troubled waters: International relations, the 'territorial trap', and the Southern African Development Community's transboundary waters. *Political Geography* 25: 438-458.
- García, A. 2007. El perro del hortelano. *El Comercio*, 28 October (http://www.elcomercio.pe/edicionimpresa/Html/2007-10-28/el_sindrome_del_perro_del_hort.html).
- Gelles, P. 1998. Competing cultural logics: State and 'indigenous' models in conflict. In Boelens, R. and Dávila, G. (Eds) *Searching for Equity*, pp. 256-267. Assen: Van Gorcum.
- Gelles, P. 2000. *Water and Power in Highland Peru: The Cultural Politics of Irrigation and Development*. New Brunswick: Rutgers University Press.

- Harris, L. 2006. Irrigation, gender, and social geographies of the changing waterscapes of southeastern Anatolia. *Environment and Planning D* 24: 187-213.
- Himley, M. 2008. Geographies of environmental governance: the nexus of nature and neoliberalism. *Geography Compass* 2(2): 433-451.
- Jakeman, A., Beck, M. and McAleer, M. (Eds) 1993. *Modelling Change in Environmental Systems*. Chichester: Wiley.
- Kaika, M. 2003. Constructing scarcity and sensationalising water politics: 170 days that shook Athens. *Antipode* 35(5): 919-54.
- Labor (anonymised representative) 2006. Personal communication, Moquegua, October.
- Labor (anonymised representative) 2011. Personal communication, Moquegua, November.
- Lebel, L., Garden, P. and Imamura, M. 2005. The politics of scale, position and place in the governance of water resources in the Mekong region. *Ecology and Society* 10(2): 18.
- Linton, J. 2008. Is the hydrological cycle sustainable? A historical-geographical critique of a modern concept. *Annals of the Association of American Geographers* 98(3): 630-649.
- Linton, J. 2010. *What is Water? The History of a Modern Abstraction*. Vancouver: University of British Columbia Press.
- Loftus, A. 2006. Reification and the dictatorship of the water meter. *Antipode* 38(5): 1023-1045.
- Loftus, A. 2007. Working the socio-natural relations of the urban waterscape. *International Journal of Urban and Regional Research*, 31(1): 41-59.
- Loftus, A. 2009. Rethinking political ecologies of water. *Third World Quarterly*, 30(5): 953-968.
- Loftus, A. and Lumsden, F. 2008. Reworking hegemony in the urban waterscape. *Transactions of the Institute of British Geographers*, 33(1): 109-126.
- Mansfield, B. and Haas, J. 2006. Scale framing of scientific uncertainty in controversy over the endangered Steller Sea Lion. *Environmental Politics* 15 (1): 78-94.
- Marston, S. 2000. The social construction of scale. *Progress in Human Geography* 24: 219-242.
- Marston, S. and Smith, N. 2001. States, scales and households: Limits to scale thinking? A response to Brenner. *Progress in Human Geography* 25(4): 615-619.
- Marston, S., Jones, J.P. and Woodward, K. 2005. Human geography without scale. *Transactions of the Institute of British Geographers* 30: 416-432.
- McCarthy, J. 2005. Scale, sovereignty, and strategy in environmental governance. *Antipode* 37(4): 731-753.
- Mining Company 1-A (anonymised representative A) 2006. Personal communication, Tacna, October.

Mining Company 1-B (anonymised representative B) 2006. Personal communication, Lima, October.

Mining Company 2 (anonymised representative), 2006. Personal communication, Lima, October.

Molle, F. 2009. River basin planning and management: The social life of a concept. *Geoforum* 40(3): 484-494.

Moss, T. and Newig, J. 2010. Multilevel water governance and problems of scale: Setting the stage for a broader debate. *Environmental Management* 46: 1-6.

National Institute of Natural Resources (*Instituto Nacional de Recursos Naturales*) (anonymised representative) 2006. Personal communication, Lima, October.

Neumann, R. 2009. Political ecology: Theorizing scale. *Progress in Human Geography* 33(3): 398-406.

Norman, E. and Bakker, K. 2009. Transgressing scales: Transboundary water governance across the Canada – U.S. Border. *Annals of the Association of American Geographers* 99 (1): 99 – 117.

Ochieng G., Seanego, E. and Nkwonta, O. 2010. Impacts of mining on water resources in South Africa: A review. *Scientific Research and Essays* 5(22): 3351-3357.

Oré, M.T. 2011. Institute for the Promotion of Water Management (*Instituto de Promoción para la Gestión del Agua*). Personal communication, Lima, June.

Orlove, B. and Caton, S. 2010. Water sustainability: Anthropological approaches and prospects. *Annual Review of Anthropology* 39: 401–15.

Perreault, T. 2005. State restructuring and the scale politics of rural water governance in Bolivia. *Environment and Planning A* 37: 263-284.

Perreault, T. 2006. From the guerra del agua to the guerra del gas: Resource governance, neoliberalism and popular protest in Bolivia. *Antipode* 38(1): 150-172.

Robbins, P. 2004. *Political Ecology: A Critical Introduction*. Oxford: Blackwell.

Sosa, M. 2010. Presentation to Justicia Hídrica research workshop, Cusco, November.

State irrigation project (anonymised representative) 2010a. Personal communication, Moquegua, April.

State irrigation project (anonymised representative) 2010b. Personal communication, Moquegua, November.

Strang, V. 2004. *The Meaning of Water*. Oxford: Berg.

Swyngedouw, E. 1997. Neither global nor local: 'Glocalization' and the politics of scale. In Cox, K. (Ed) *Spaces of Globalization: Reasserting the Power of the Local*, pp. 137-166. New York: Guilford Press.

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

Swyngedouw, E. 2004. *Social Power and the Urbanization of Water: Flows of Power*. Oxford: Oxford University Press.

Swyngedouw, E. 2005. Dispossessing H₂O: The contested terrain of water privatization. *Capitalism, Nature, Socialism* 16(1): 81-98.

Swyngedouw, E. 2007. Technonatural revolutions: The scalar politics of Franco's hydro-social dream for Spain, 1939-1975. *Transactions of the Institute of British Geographers* 32(1): 9-28.

Swyngedouw, E. and Heynen, N. 2003. Urban political ecology, justice and the politics of scale. *Antipode* 35(5): 898-918.

Technical Administrator (anonymised) 2006. Personal communication, Tacna, October.

Trawick, P. 2003. Against the privatization of water: An indigenous model for improving existing laws and successfully governing the commons. *World Development* 31(6): 977-996.

Turton, A., Schultz, C., Buckle, H., Kgomongoe, M., Malungani, T. and Drackner, M. 2006. Gold, scorched earth and water: The hydropolitics of Johannesburg. *Water Resources Development* 22(2): 313-335.

Urteaga, P. 2010. Institute for the Promotion of Water Management (*Instituto de Promoción para la Gestión del Agua*). Personal communication, Lima, July.

Urteaga, P. 2011. Agua e industrias extractivas: Cambios y continuidades en los Andes, paper prepared for Justicia Hídrica research workshop, Cusco, November.

Vargas, C. 2010. University of Arequipa. Personal communication, Arequipa, April.

Younger, P. and Wolkersdorfer, C. 2004. Mining impacts on the fresh water environment: Technical and managerial guidelines for catchment-focused remediation. *Mine Water and the Environment* Supplement: s2-s80.