Beveridge, R.; Moss, T. and Naumann, M. 2017. A socio-spatial understanding of water politics: Tracing topologies of water reuse. Water Alternatives 10(1): 22-40

Sociospatial Understanding of Water Politics: Tracing the Multidimensionality of Water Reuse

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ABSTRACT: Much social science literature on water reuse focuses on problems of acceptance and economic problems, while the spatial and political dimensions remain under-researched. This paper addresses this deficit by reformulating the issue in terms of sociospatial politics of water reuse. It does this by drawing on the work of Mollinga (2008) and the Territory Place Scale Network (TPSN) framework (Jessop et al., 2008) to develop an analytical approach to the sociospatial politics of water in general, and water reuse in particular. The paper argues that Mollinga's understanding of water politics as contested technical/physical, organisational/managerial and regulatory/socioeconomic planes of human interventions can be deepened through further reflection on their implications for the four sociospatial dimensions of the TPSN framework. Such a comprehensive, multidimensional approach re-imagines the politics of water reuse, providing researchers with a heuristic device to trace the interventions through which water reuse plans disrupt existing arrangements, and avoid a concern for individual preferences and simplified notions of barriers and enablers. The potential of the analytical framework is explored using an empirical illustration of water reuse politics in the Berlin-Brandenburg region in Germany.

KEYWORDS: Water reuse, TPSN, governance, sociospatial politics of water, Germany

INTRODUCTION

Interest in, and technical capacity to, reuse water have grown in response to the challenge of increasing water and resource scarcity. According to a report for the European Union in 2013, worldwide there exist more than 3300 water recycling projects for non-potable end uses (Raso, 2013). Nonetheless water reuse remains limited outside areas of water scarcity. The main obstacles to wider implementation identified in the literature are: acceptance problems (especially regarding health), institutional and political issues and economic concerns (Angelakis and Bontoux, 2001; Bixio et al., 2006; Hamilton et al., 2007; van der Bruggen, 2010; Garcia and Pargament, 2015; Moss et al., 2016). Much social science literature focuses on problems of acceptance and economic problems, while the spatial and political dimensions of water reuse remain under-researched (Ormerod, 2015: 12). This paper addresses this deficit by reformulating the issue in terms of sociospatial politics of water. It does this by drawing on the work of Mollinga (2008) and the Territory Place Scale Network (TPSN) framework of Jessop et al. (2008) to develop an analytical approach to the sociospatial politics of water reuse. The

framework is aimed primarily at analysts of water reuse but should be of interest to researchers of water governance more generally.

Mollinga (2008: 10) conceives water resources management as inherently political, centred on three planes of human intervention to control water: technical/physical, organisational/managerial and regulatory/socioeconomic. Together these provide not only a perspective on how water control is asserted but also how it is contested. Our paper argues that this understanding of water politics as contested planes of human interventions can be deepened through further reflection on their implications for the four sociospatial dimensions of the TPSN framework: territory, place, scale and network. In a bid to move away from one-dimensional analysis of spatiality, the TPSN framework foregrounds four dimensions of sociospatial relations and argues for an analysis across them. The synthesised approach aims to provide a greater sense of the disruption prompted by water reuse projects by tracing the interventions through which water reuse attempts to transform these existing arrangements through, for example, new types of territorialisation, place-making, scaling and networking. Such a thoroughgoing, multidimensional approach re-imagines the politics of water reuse, removing it from the consideration of individual preferences and simplified notions of barriers and enablers and analysing it instead along the sociospatial fault lines which emerge in these landscapes of water governance.

The paper proceeds as follows. The next section reviews the literature on water reuse governance, detailing the key 'problems' identified by researchers and the ongoing blind spots in current research. We then outline Mollinga's approach to water politics and the TPSN framework and illustrate how the two might be combined to analyse water reuse and governance more generally. We demonstrate how the framework can be used heuristically, formulating questions to guide analysis of the sociospatial politics of water reuse using the four TPSN dimensions. While the heuristic may be most suited to academic research, its distillation of the complexity of Mollinga's and especially Jessop's work may offer opportunities for more applied work on water reuse/governance. We then elucidate the potential for applying the analytical framework using an empirical illustration of water reuse politics in the Berlin-Brandenburg Region in Germany and showing how it might be understood in terms of territory, place, scale and network. Given the explorative nature of the paper the conclusion centres on issues raised and ways forward.

GOVERNANCE OF WATER REUSE: STATE OF THE ART IN THE SOCIAL SCIENCES

This section outlines the problems of water reuse identified in the social sciences literature and the associated inattention to issues of space and politics. The discussion focuses mainly on the EU and Global North, though some issues it raises (e.g. equity) are particularly relevant to other parts of the world.

An overview of water reuse

Water reuse has been defined as the direct and beneficial use of reclaimed or recycled water from domestic, municipal and industrial wastewater treatment plants that has been treated to standards that allow safe reuse (Haering and Evanylo, 2009). Interest in water reuse in policy-making, public administration and academic communities is on the rise due to increasing water scarcity and stress, growing populations and related food-security issues, increasing environmental pollution from improper wastewater disposal, an increasing recognition of the resource value of wastewater, excreta and greywater (WHO, 2006; Hamilton et al., 2007), and for sanitary and environmental reasons in 'water-rich countries' (Angelakis and Bontoux, 2001; Bixio et al., 2006; Hamilton et al., 2007; van der Bruggen, 2010). Water reuse is most frequently focused on increasing agricultural production whilst relieving pressure on groundwater and surface water resources (for an overview, see Lazarova and Bahri, 2005).

The perceived benefits of reusing water are numerous: increased water availability; substitution of drinking water (to keep drinking water for drinking only); reduced over-abstraction of surface water and groundwater; reduced energy consumption compared to using deep groundwater resources, water importation or desalination; reduced nutrient loads to receiving waters; reduced manufacturing costs of using high-quality reclaimed water; increased agricultural production; reduced application of fertilisers; enhanced environmental protection by restoration of streams, wetlands and ponds; increased employment and local economic performance (e.g. tourism, agriculture) (Sanz and Gawlik, 2014). Given the range of potential benefits of water reuse, it is easy to see why it is being prioritised by policy-makers, even in areas where water scarcity is not yet pressing. For instance, the EU (European Commission, 2012; BIO, 2015) presents water reuse as a strategic objective for the entire EU area on the grounds that it can foster greater sustainability – and efficiency – in water management.

Water reuse has been applied in multiple sectors: urban (irrigation of parks, street cleaning), agricultural (food crops, fodder), households (toilet flushing), industrial (processing and cooling water), recreational (irrigation, bathing), environmental (aquifer recharge, wetlands) and potable water (augmentation of surface drinking water supplies, drinking water) (Sanz and Gawlik, 2014). One review of water reuse projects found that the main contexts of implementation were Japan (>1,800 projects), USA (>800), Australia (>450), Europe (>200), the Mediterranean and Middle East (>100), Latin America (>50) and sub-Saharan Africa (>20) (Sanz and Gawlik, 2014: 10). It is, however, likely that there has been a rapid recent increase, especially in China, India and the Middle East. In Europe, water reuse projects have developed rapidly in the last 20 years (BIO, 2015), though at varying rates. The pressure for water reuse is far higher in some southern European countries, with numerous projects (e.g. crop and golf course irrigation) and promotion of water reuse legislation at the European level (Angelakis, 2011). In Northern Europe there exist only a very few small-scale water reuse projects, driven largely by environmental groups (van der Bruggen, 2010: 56) or industrial applications (Lautze et al., 2014: 9). The EU has noted that there is a need to develop standards and incentives for water reuse (European Commission, 2012; BIO, 2015). Elsewhere, Australia pioneered national guidelines on augmentation of drinking water with recycled effluent in 2008 (Environment Protection and Heritage Council, 2008).

As this brief overview suggests, water reuse covers multiple purposes, socioeconomic contexts, political institutional arrangements and spatial units. It is hence particularly dependent on cooperation and complex arrangements of water governance. It should be clear, then, that the challenge of water reuse is manifold. But is this reflected in the literature on water reuse governance?

Defining the 'problem(s)' of water reuse governance

Much of the social sciences literature centres on explaining why water reuse has not developed further. Three main problems have been identified, and these problem definitions characterise not only the proposed governance/managerial interventions to overcome them, but the common approach to understanding water reuse: 1) acceptance: a socio-cultural and psychological problem (in relation to public health and safety), in which the aim is to overcome individual 'disgust' and public opposition via branding and education, 2) institutional obstacles: lack of awareness in, and cooperation between, responsible organisations and deficient regulatory guidelines, and 3) economic and financial impediments to change: in many areas water reuse is too costly and a high risk.

The acceptance problem

A recent public consultation report compiled by Deloitte for the European Commission (BIO, 2015) on "Optimising water reuse in the EU" captures something of the paradox of the water reuse debate. From a survey of around 500 individuals, private companies, public authorities and academics, around 70% of respondents thought water reuse valuable for adaptation to climate change and resource efficiency. However, only 30% were in favour of water reuse involving contact with food and people (e.g. drinking

water). Hence, appreciation of its benefits does not appear to translate into willingness to allow for greater water reuse (Garcia and Pargament, 2015: 157). Awareness and perception (as waste) are regarded as main barriers to potable uses despite evidence of relative safety. Po et al. (2004: 20) show that worries diminish when awareness and knowledge increase and residents can make an 'informed choice', with awareness campaigns and information seen as instrumental in moving away from seemingly emotional (Bixio et al., 2006) public responses. The 'yuck-factor' also emphasises the importance of promoting awareness and knowledge provision to counterbalance 'emotive' responses (Ormerod, 2015: 34), asserting control (technical, legal, social) over 'unruly', irrational publics (Meehan et al., 2013). However, there are numerous examples of the populace blocking water reuse, despite awareness campaigns and water shortages, such as in the city of Toowoomba in Australia in 2008, where residents' concerns about recycled effluent use were not only about health but also about the image of the community (Hurlimann and Dolnicar, 2010; Meehan et al., 2013: 75). Hence, there are very often limits to what governmental or managerial interventions can achieve.

Institutional obstacles

Bixio et al. (2006) identified three main obstacles to effective and safe water reuse associated with institutional contexts. First, stakeholders have little awareness of the potential of water reuse. There is often an absence of multidimensional approaches to water management, and water reuse is often marginalised. Second, there is a lack of cooperation among stakeholders, attributed mainly to a lack of institutional arrangements on water cycle management in general and water reuse in particular. Salgot (2008: 192) identifies numerous stakeholders involved in the implementation of water reuse, such as health authorities, water authorities, plant operators and end users. Third, insufficient guidelines and criteria for reclamation and reuse of water are viewed as impeding projects before they have even started. Where there are no criteria, public officials from regulatory agencies have to rely on their assumptions and are more likely to reject a water reuse project due to concern for their own position and an unwillingness to breach perceived water management norms on quality and safety (Angelakis et al., 1999: 2201). In the recent public consultation report for the European Commission cited above (BIO, 2015), of the ca. 500 respondents 85% stated that they wanted more regulation. Core demands focused on regulation: in particular, institutional capacity and cooperation to increase public confidence in water management institutions and overcome vested societal interests and the need for interdisciplinary, multisectoral water management (BIO, 2015). Other studies target the need for interdepartmental coordination to overcome fragmentation of responsibilities (Lautze et al., 2014: 11) and for "implementable guidelines" (Bahri, 2009: 48).

Economic and financial barriers

Besides an inadequate regulatory framework, economic and financial concerns are considered a major barrier to water reuse. Water reuse is still seen as costly and unpredictable (given the public controversies around them), especially for agriculture, requiring government grants to render many projects economically viable (Raso, 2013: 45). An analysis for Beijing shows that low rates charged for reused water are the main reason for reuse systems not being financially feasible (Liang and van Dijk, 2010: 1973). Garcia and Pargament (2015: 157) state that the "demand for recycled water depends on the existence of consumers who would need and be willing to use this water resource". Implementation and operation costs may vary between individual projects depending on scope, scale and local contexts. Interventions to tackle the insecurities of local actors regarding the economic efficiency of water reuse projects centre on cost-benefit analysis tools – including monetary and nonmonetary aspects – and financial support to dispel concerns and create incentives for water reuse projects (Miller, 2006; Urkiaga et al., 2008). In the EU there is evidence that stakeholders support financial incentives (e.g. public subsidies) to promote water reuse, justified because water from conventional sources is strongly subsidised in many EU areas, and hence reused water cannot compete due to its comparatively high

price (BIO, 2015). Therefore, Raso (2013: 46) pleads for an economic evaluation of water reuse projects that consider the nonmonetary benefits of their implementation.

Moving forward

These three categories of problems are undoubtedly important lines of inquiry, even if the approaches adopted by many researchers have been recently criticised for being too deterministic (Ormerod, 2015). Rather than joining in this debate about how to better understand these obstacles, this paper seeks to re-think the terms of the water reuse debate. Reused water, we argue, should be seen as a thoroughly disorderly element in water governance, challenging existing power structures, spatial relations and institutions of water governance (Meehan et al., 2013). The aim of this paper is, then, to foreground water reuse politics and its sociospatial dimensions. This is not to claim that the existing literature on water reuse fails to address these dimensions at all. References are made, for instance, to urban agriculture and the relationship between urban and rural areas (e.g. Bahri, 2009: 19). However, these issues are currently under-represented and, above all, under-conceptualised in the literature due to the predominant focus on social, economic and cultural aspects of water reuse. Because of the importance of water reuse for the sustainable development and governance of cities and regions there is a need to ask different questions about water reuse governance, exploring its politics and spatiality, and to employ the right concepts to research them.

REFRAMING THE DEBATE: A SOCIOSPATIAL UNDERSTANDING OF WATER REUSE POLITICS

Water resources management is, as we outlined above, not merely a question of dealing with 'natural' or 'technical' issues but also a challenge of governance (Molle et al., 2008: 4). This makes it inherently social and political (Mollinga, 2008). Contesting viewpoints, power asymmetries, winners and losers are all fundamental to water resources management (Zeitoun and Allan, 2008). As Mosse (2003: 1) has stated, "the relationship between water and society is as complex a historical, sociological, and regional problem as any that can be imagined". Water-society relations are complex and multidimensional. Politics emerge from competitive or cooperative interactions across institutional, ecological and economic systems, between sectors (e.g. energy, land use, urban planning), and over time and space.

To identify better the sociospatial politics of water, this section brings two analytical approaches into conversation with each other: Mollinga's (2008) Political Sociology of Water Resources Management and Jessop et al.'s (2008) Territory, Place, Space and Network Framework. While the work of Mollinga has been highly influential for water research, the TPSN framework has made an important conceptual contribution to Urban Studies, Human Geography and other social sciences concerned with spatial development and its governance.

Water politics: Control and contests in water resources management

Mollinga (2008) conceives water resources management as inherently political, centred on contested human interventions to control water. These are defined as follows: "any human intervention in the hydrological cycle that intentionally affects the time and/or spatial characteristics of water availability and/or its qualities, is a form of water control" (ibid: 10). Three planes of intervention are outlined: technical/physical, organisational/managerial and regulatory/socioeconomic (ibid). Together, these provide not only a perspective on how water control is asserted, but also how it is contested:

- Technical/physical: "the manipulation of the physical flow and quality of water" (ibid). All water reuse entails some manipulation of flow and/or quality of water – hence, contestations of existing water control arrangements are inevitable. Further, there are numerous potential technical/physical means through which water might be reused, which in themselves create the

potential for an array of conflicts: for instance, 'high' technology (micro-filtration) vs. 'low' technology (composting) or centralised vs. decentralised systems.

- Organisational/managerial: "the guiding of the human behaviour that is part of water use" (ibid). Water reuse projects are heavily dependent on the willingness and capacity of the utilities that treat wastewater to entertain alternative or supplementary approaches to the common practice of disposing of treated wastewater in local watercourses. This raises issues around whether water reuse requires new organisational structures.
- Regulatory/socioeconomic: "the socioeconomic, legal, administrative and other structures in which water management is embedded and that constitute conditions and constraints for management and regulation" (ibid). Water reuse is particularly shaped by developments in this dimension, e.g. not only the presence or absence of economic incentives or regulatory guidelines, but also attempts to inform and change (as well as control) public responses to reused water.

In political terms, the counterpart of control is contestation: the "range of interaction patterns in water management, including negotiation and struggle, and also less explicit and longer-term disputations and controversies" (ibid: 10). Introducing water-reuse measures often disturbs patterns of water control and can be seen to create contestations of existing arrangements in these three planes of control.

We would argue against criticisms that Mollinga's approach is too theoretical to help researchers studying water politics (Araral and Wang, 2013: 3948). Certainly, Mollinga does not prescribe the exact 'mechanisms' (ibid) through which water politics may emerge. But criticising a lack of specificity detracts from the extent to which Mollinga provides guiding concerns (centred on the three planes of control). However, there is certainly potential to tease out the spatiality of water politics in more concrete terms. While there is a sense of space underlying this conceptualisation of water control, particularly in Mollinga's (2008: 12) elaborations of 'everyday' and global politics, it is not the main object of Mollinga's concern, nor is it explicitly presented as a determining dimension of water politics. As Lebel et al. (2005) argue, space and politics are fundamentally entwined in water resources management. Although Mollinga does not necessarily take spatial scales as a given, the politics of scale (ibid; Norman et al., 2012; Swyngedouw and Heynen, 2003) can be more fundamental to water politics than this approach suggests. Scales can be created, constrained and shifted in the self-interest of certain actors who "can change power and authority by working at different spatial levels" (Lebel et al., 2005: 1). Scale choices can cause biases in environmental assessments and, moreover, can even be used as a means of inclusion or exclusion. But scale is only one dimension of spatial politics. Water flows through political-territorial, jurisdictional and administrative zones creating an array of places and positional advantages and disadvantages (ibid), which are fundamental to water politics. To better grasp the sociospatiality of 'waterscapes' (Loftus, 2007; Budds and Hinojosa, 2012), and how they might be disrupted by water reuse projects, we turn to the TPSN approach.

Sociospatial politics: The Territory, Place, Space and Network (TPSN) framework

As the spatial turn (Soja, 1989; Marston, 2000) in social sciences indicates, there are many potential ways of conceiving space and the spatiality of social relations. One of the most influential and comprehensive is the Territory, Place, Space and Network (TPSN) framework developed by Jessop et al. (2008). The fundamental contribution of their approach is to change the focus of the debate: away from whether one ontology of the sociospatial is 'better' than the other and on to how we can better grasp the actualities of sociospatial relations. Jessop et al. (2008: 393) argue this is to be achieved through moving from a single dimensionality to multidimensionality and adopting a more systematic and reflexive approach to the spatial dimensions of social relations (ibid). Hence, to address the "ontological

complexity of water resource management situations" (Mollinga. 2014: 193), using TPSN entails a re-framing of the complexity in terms of multiple and overlapping sociospatial dimensions.

In simple terms, the TPSN framework provides a range of complementary entry points to analyse sociospatial systems. A definition and analytical foci are provided for each dimension (ibid: 393). The authors state that sociospatial relations should be understood as messy, volatile and prone to contradictions, conflicts and dilemmas and hence they emphasise tensions, patterns of division, marginalisation and exclusion (ibid: 394). Arguably, the framework is particularly suitable to capture who wins and who loses, where and in what sociospatial forms of water governance.

- *Territory* is conceived in terms of processes of bordering, bounding, parcelisation and enclosure resulting in inside-outside divides, e.g. through the institutionalisation of river-basin management or water-protection zones as units of regulation.
- *Place* is understood in terms of proximity, identity and local differentiation and resulting spatial identities and horizontal relations, e.g. linking local identities to water reuse.
- *Scale* refers to the construction of (socio)scalar connections and divisions, resulting in hierarchisation and vertical differentiation between dominant and marginal scales in policy-making, e.g. the EU 'Water Blueprint' attempting to upscale decision-making on water reuse to the EU level.
- *Network* means the establishment of, or exclusion from, nodal connectivity and the interdependencies which thereby emerge, e.g. a collaborative stakeholder initiative to promote water reuse.

Jessop et al. (2008) stress that these spatial dimensions of social relations should be researched in combinations and not, for instance, just as networks or scales. No one spatial dimension should be accorded *a priori* preference; equally, not every dimension may be relevant to a particular empirical phenomenon. The researcher should be open to different kinds of sociospatial relations and their interdependencies. Thus, for example, a study of water governance in the wake of the Water Framework Directive following the TPSN approach would involve looking for evidence of re-territorialisation (e.g. around river basins), of place-making (e.g. around model projects of river restoration), of rescaling (e.g. between the EU, national and sub-national governments) and of networks (e.g. of environmental NGOs across Member States), paying particular attention to how these sociospatial relations influence one another. Following the authors' reasoning (Jessop et al., 2008: 392) we understand TPSN as a heuristic, an organising framework, one setting coordinates rather than diktats for research on sociospatial dimensions of water reuse politics. The four dimensions themselves are not defined in a very detailed fashion by the authors and Paasi (2008: 408) argues we might see these categories as ideal types "that do not depict 'reality as it is' but rather emphasise significant elements and omit less significant ones". The conceptual ambition is thus comparable to Mollinga's (2008) three planes of water control, in that both aim, in their different ways, to provide a heuristic for exploring multidimensionality. As Jessop et al. (2008: 392) suggest there may be other dimensions or ideal types more salient to research outside of their chosen field of political-economic restructuring. Other researchers have noted omissions from, or weaknesses in, the TPSN framework: it may underplay the importance of actors and interests (Mayer, 2008: 418), as well as ideology more generally (Paasi, 2008: 408).

Given that the TPSN framework should be used in an exploratory fashion, benefits are to be had from attuning it to the specificities of water (reuse) governance. Here, we do this by bringing TPSN into conversation with Mollinga's understanding of water control/contestation. TPSN brings extra layers of conceptualisation, adding topological 'depth', and thereby a stronger sense of sociospatial politics along the four TPSN dimensions. Whereas Mollinga's conceptualisation of water politics takes as its starting point the field of water management and focuses on the dimensions therein, TPSN is concerned with

the spectrum of sociospatial relations and examines their multidimensionality. Hence, through combining the two we can gain insights into the sociospatial dimensions of human interventions in the field of water governance. The three planes of human interventions aimed at control/contestation of water (technical/physical, organisational/managerial, regulatory/socioeconomic) can, we argue, be usefully mapped across the four sociospatial dimensions of territory, place, scale and network.

Towards a sociospatial analysis of water reuse politics

How might we then begin to relate these two approaches to each other? Given that this is a rather complex endeavour we proceed methodically, considering the general analytical concerns and particular questions that a synthesis generates. This has the additional benefit of detailing the broader analytical benefits the heuristic framework can have for researching sociospatial landscapes of water politics. Following water reuse projects as attempts to alter sociospatial landscapes is to read such projects as interventions to control water in different ways and identify the politics they generate along the four dimensions of TPSN. The four sociospatial dimensions are, then, the means (or vocabulary) through which the manifestations of politics resulting from the three forms of interventions can be described and analysed; for instance, the implications of organisational/managerial interventions of water reuse for the dimensions of territory, place, scale and networks.

Sociospatial politics of technical/physical interventions

To begin relating the two approaches to each other, the researcher might take Mollinga's (2008: 10) first plane of human intervention to control water, the technical/physical ("the manipulation of the physical flow and quality of water"), and consider the sociospatial dimensions in which politics plays out.

Territory refers here to the technical and physical interventions that contribute to territorialisation, processes of bordering, bounding and enclosure. Such human interventions often take the form of infrastructure (non)coverage, for instance, but might also pertain to the designation of water protection zones or territorial claims to water sources. Here sociospatial politics centres on the contestation of inside-outside divides and, given the enmeshing of the state with territorial claims, this dimension might, often, be seen to involve formal (inter)state politics. The following questions could guide research across the four sociospatial dimensions of water reuse politics. How are technical/physical aspects of water reuse shaping territorialisation? For instance, how are water reuse technologies, such as 'high-tech' micro-filtration or 'low-tech' composting, shaping new patterns of enclosure or bounding? Are existing inside-outside divides being contested? Are new ones emerging as a result of these technical interventions?

Place means in this context the technical and physical interventions that contribute to place-making. Here the interest is in how water technologies, infrastructures and landscape manipulation contribute to relations of proximity (core-periphery), local differentiation and identity construction. Examples would be instances where dams become sites of localised protest or – alternatively – symbols of modernity for a region. Sociospatial politics is defined by areal divisions emerging from water control, such as core-periphery relations in terms of the concentration of water resources or services in main cities. Research questions might include the following: How are the technical/physical aspects of water reuse influencing processes of local differentiation and identity construction? How are unruly nutrients or pollutants being 'enrolled' (Callon, 1986) in place-making processes? In what ways does the place-based physicality of new water reuse infrastructure challenge local power relations?

Scale here encompasses the technical and physical interventions that shape scalar connection and differentiation. This would apply, for instance, to the diversion of local water resources (e.g. from a lake) for regional and national supply (e.g. New York City vs. New York State) and the sociospatial hierarchies that are established through the technical and physical control of water. Politics is found in

the contestation of these scalar connections and divisions. Hence we might ask: In what ways are technical/physical aspects of water reuse shaping scalar relations and differentiation (and vice versa)? At what scale are water reuse projects, like Indirect Potable Reuse (IPR), being implemented? How are new sociospatial hierarchies being established through such water reuse projects?

Networks relates here to the technical and physical interventions that shape sociospatial linkages/exclusions. Irrigation systems connecting certain farmers to regulated water resources, whilst at the same time excluding others, would be a good example. It is about the making and breaking of interconnectivity, interdependencies and the politics of horizontal inclusion/exclusion in the control and distribution of water resources. On these grounds, researchers could ask: Are technical/physical aspects of water reuse enabling or hindering particular sociospatial linkages? For example, is the implementation of water reuse in agriculture facilitating interdependencies to other areas already reusing water? What are the politics of inclusion/exclusion from water reuse in agriculture? Where and with whom do the benefits lie in this reorganisation of water resources and their distribution?

Sociospatial politics of organisational/managerial interventions

Mollinga's (2008: 10) second plane of human intervention to control water is the organisational/ managerial, "the guiding of the human behaviour that is part of water use".

Territory here refers to the organisational and managerial interventions that contribute to patterns of territorialisation; i.e. processes of bordering, bounding and enclosure via the organisational restructuring of water management entities. Examples include the creation of water use associations or water utilities around local, municipal or inter-municipal territories and the politics of inside-outside divides which these restructurings entail. Research questions arising from this analytical concern include: How do organisational structures and managerial practices enable or limit attempts to define water reuse projects territorially? For example, does a (de)centralised systems approach to water reuse alter patterns of bordering, bounding and enclosure? Are the existing organisational structures of water management, such as the territorial competence of an urban municipal water utility, being challenged by a decentralised systems approach?

Place addresses the organisational and managerial interventions which play a role in processes of place-making. These might involve place-based initiatives to designate local responsibility and accountability for water resources management – for instance a public campaign to re-municipalise a privatised water utility – that constitute social relations of proximity, identity and local differentiation. The politics here rests in the areal divisions arising in the organisation and management of water. We might, then, ask: In what ways are organisational/managerial aspects influential in generating or obstructing place-based solutions for water reuse and relations between places? Are centres of utility excellence or competence facilitating new patterns of proximity, identity and local differentiation?

Scale relates here to the organisational and managerial interventions shaping hierarchisation and inter-scalar action, and the politics emanating from vertical differentiation. These are the inter-scalar practices and procedures of water protection, provision and use. Examples could range from a national funding scheme for river restoration framing activities at a local level to catchment-based water associations enrolling the support of their umbrella organisation at EU level. Researchers should ask: How are organisational procedures and managerial practices shaping inter-scalar relations around water reuse (and vice versa)? At what scale are water reuse projects being implemented? How, for example, are the EU's recent attempts to promote water reuse re-shaping vertical differentiation? What changes in local, regional and national guidelines will emanate from EU initiatives for water reuse? What scalar contestations are emerging?

Networks refer here to the organisational and managerial interventions that prompt processes and nodes of collaboration (and contestation) in terms of water resources and across spatial entities. Here the concern is with the politics of inclusion/exclusion emerging from organisational/managerial

attempts to facilitate interconnectivity and interdependence. An example would be programmes to promote the creation of pilot projects for participatory catchment management planning and issues around access and accountability that this would raise. The following concerns could guide research on this plane: How are organisational/managerial aspects enrolled in devising new sociospatial networks around water reuse and how are they contested? What new sociospatial linkages/exclusions emerge through new institutional arrangements of water reuse? How do public consultations regarding water reuse exercises connect or divide groups of water users? What patterns of protest and compliance emerge?

Sociospatial politics of regulatory and socioeconomic interventions

The third plane identified by Mollinga (2008: 10) is the regulatory and socioeconomic, the "structures in which water management is embedded".

Territory addresses the regulatory and socioeconomic interventions and broader structural processes through which territorial processes of bordering, bounding and enclosure occur. Examples are processes of territorialisation through institutional reform of water resources management around nation states, river basins, irrigation systems, etc. and the politics of inside-outside divides prompted by these regulatory and socioeconomic interventions. Research questions might include: How do regulatory and socioeconomic interventions shape the territorial reach of water reuse projects and how far are such inside-outside divides contested? How important are, for example, the varying levels of prices of water within or between countries to the development of water reuse projects? Are water reuse projects challenging this?

Place refers here also to the regulatory prescriptions and socioeconomic processes through which place-making occurs and the relations of proximity, identity and local differentiation. These might, for instance, comprise impacts of institutional reforms or fiscal instruments (e.g. over water pricing) on the local specifics and spatial differentiation of access to, and use of, water resources. Analytical concerns may centre on: How do institutional arrangements and socioeconomic conditions influence the prospects for, and impacts of, water reuse projects in particular locales and their relation to other places? For instance, how does the classification of 'degraded' or 'contaminated' areas influence, and become influenced by, water reuse projects? How does deindustrialisation and declining water use affect the opportunities for implementation of water reuse? What new politics of areal division (core-periphery) emerge from these processes?

Scale targets here the regulatory and socioeconomic interventions and processes through which hierarchies and inter-scalar action are constituted. This encompasses the scalar ordering of water governance through legal frameworks, economic conditions and social structures. A national water law decentralising responsibility for water supply and sanitation to local authorities – and the impact this would likely have on sociospatial disparities of service quality – would be a typical example. As such, researchers could ask: In what ways are legal frameworks and socioeconomic conditions structuring the scalar configuration and relations of water reuse? What is the role of political (de)centralisation or uneven economic development in shaping water reuse? What new scalar politics are emerging from water reuse projects? Are particular scales promoting new legislation on water reuse at the expense of others?

Networks address the regulatory and socioeconomic interventions through which interconnectivity and interdependence are achieved. Analysis focuses here on the processes of configuring sociospatial relations around water through regulation, economic incentives and social movements, etc. Further interest should lie in the politics of inclusion/exclusion emerging from these processes. Lines of research could include: How do regulatory and socioeconomic structures enable or hinder sociospatial relations (and conflicts) around water reuse? Do sociospatial linkages or exclusions emerge through

new water reuse regulation? What trans-municipal collaborative ventures and global initiatives emerge for water reuse? What is the politics of inclusion/exclusion underpinning these processes?

Table 1. Sociospatial dimensions of water reuse politics (adapted from Jessop et al., 2008, and Mollinga, 2008).

	Sociospatial dimensions of water reuse politics			
Interventions to control water Adapted from Mollinga, 2008	Territory *Bordering, bounding, enclosure*	Place *Proximity, identity, local differentiation*	Scale *Hierarchisation, vertical differentiation, inter-scalar action*	Networks *Interconnectivity, interdependence, inclusion/exclusion*
Technical / physical *"the manipulation of the physical flow and quality of water"*	How do technical/physical aspects of water reuse shape territorialisation?	In what ways do technical/physical aspects of water reuse influence processes of place-making?	How do technical/physical aspects of water reuse shape scalar relations and differentiation (and vice versa)?	How do technical/physical aspects of water reuse enable or hinder particular sociospatial linkages?
Organisational / managerial *"the guiding of the human behaviour that is part of water use"*	In what ways do organisational structures and managerial practices enable or limit attempts to define water reuse projects territorially?	How do organisational / managerial aspects influence in generating or obstructing place-based solutions for water reuse and relations between places?	To what extent do organisational procedures and managerial practices shape inter-scalar relations around water reuse (and vice versa)?	How are organisational/managerial aspects enrolled in devising new sociospatial networks around water reuse and how are they contested?
Regulatory/ socioeconomic *"structures in which water management is embedded"*	How do regulatory and socioeconomic interventions shape the territorial reach of water reuse projects and how far are such inside-outside divides contested?	How do institutional arrangements and socioeconomic conditions influence the prospects for, and impacts of, water reuse projects in particular locales and their relation to other places?	In what ways do legal frameworks and socioeconomic conditions structure the scalar configuration and relations of water reuse?	How do regulatory and socioeconomic structures enable or hinder sociospatial relations (and conflicts) around water reuse?

Having considered how the two approaches might be synthesised (see Table 1), two observations need to be made at this point. Firstly, there are similarities between the four sociospatial dimensions, resulting in a degree of overlap between the examples given. This is to be expected, since the four analytical dimensions are different ways of looking at the same object: the sociospatial politics of water reuse. Moreover, they represent ideal types, abstractions, which may help provide coordinates for analysis and heuristics to develop understanding, but cannot hope to capture the full complexity of any given situation. Secondly, a TPSN-oriented study would, as indicated above, explore the linkages between two or more of the four sociospatial dimensions. For the sake of simplicity – and to direct attention to linkage between TPSN and Mollinga's three planes of water politics – we have desisted

from elaborating what combinations of territory, place, scale and network might mean for each plane of human intervention.

The intersections between human interventions to achieve water control and sociospatial relations can be seen as 'fault lines' in the landscapes of water politics; that is, the potential points of sociospatial rupture that trigger new political contestations. Hence, in this conception of sociospatial water politics existing landscapes are not stable but have built-in tensions that are the result of prior and ongoing contestations of water control. How the conceptual approaches of landscapes of sociospatial water politics and the sociospatial dimensions of water reuse politics can be linked to empirical observations is the main aim of the following section, where we apply them, by way of illustration, to a water reuse project in North-East Germany.

RE-IMAGINING WATER REUSE GOVERNANCE PROBLEMS IN NORTH-EAST GERMANY

In this exploratory section we engage with a completed research project on water reuse to illustrate how this approach might be used and what its particular benefits are: the 'ELaN' project on the "Development of integrated land management through sustainable water and resource use in North-East Germany". This project analysed the potential of recent initiatives to reuse water in the Berlin-Brandenburg Region (Lischeid et al., 2015). The primary concern was the use of treated wastewater for producing energy crops but the opportunities to reconfigure regional infrastructures around water reuse in general were also considered (Naumann and Moss, 2012). The case has been chosen for three reasons. First, the authors are familiar with it, having been research partners within the ELaN consortium. Second, it is representative of many of the problems encountered in promoting and implementing water reuse in Germany. Third, the explanations given for these implementation problems by most observers in the region to date resonate powerfully with the three problem definitions in the literature summarised above: lack of public acceptance, institutional obstacles and economic impediments. By exploring the case as a sociospatial intervention with political effect, our objective is to show whether the approach developed in this paper can reveal additional dimensions not accounted for in conventional analyses of the case. The aim here is not to provide a full presentation of the findings of the ELaN project but rather to suggest ways in which researchers might look at them from this perspective. The purpose is solely to provide an illustration of how interpreting water reuse projects in terms of sociospatial politics can, through a range of entry points, provide new descriptive value and analytical insights on the dynamic politics and complex geographies of such ventures.

Our approach, being sensitive to the multiple geographies of water reuse, calls for a brief introduction to the context of the case. The Berlin-Brandenburg Region is not under pressure of diminishing water resources. Securing drinking water supply and agricultural irrigation are currently not a major problem for water management. As such, hydrological circumstances do not generally favour the rapid uptake of water reuse technologies and practices. Nevertheless, the region faces several water-related challenges (Hüesker et al., 2011), which could be addressed by water reuse. The impact of climate change – involving a combination of extreme rainfall mainly during the winter and dry summers – requires local communities to develop coping strategies for both. Water and wastewater utilities across the region are considering extending their sewer systems to accommodate severe events of stormwater, whilst retaining water for times of drought (ibid: 191). At the same time, they are confronted with challenges posed by demographic change in the Berlin-Brandenburg Region. Sharp decreases in population, especially in the rural periphery of Brandenburg, are posing severe problems of underutilised wastewater infrastructures, whilst a growing population in and around Berlin is putting additional pressure on existing water and wastewater infrastructures. Furthermore, pressure to develop renewable energy as a key pillar of Germany's energy transition is directing attention to

contaminated land – such as on former irrigation fields – as potential sites for windfarms and solar parks, thus saving on agriculturally productive land.

It is against this backdrop of geographically uneven and unpredictable challenges that a growing interest in locally adapted infrastructure solutions, for instance for wastewater disposal, is currently emerging. A variety of actors in the region – including water managers, environmentalists and researchers – are looking to water reuse as a means of addressing these various water-related problems in a novel way. According to their aspirations, recycled treated wastewater can potentially make a valuable contribution to stabilising the region's water balance, meeting the growing demand for irrigated biomass crops, improving the water balance on degraded fenlands and former irrigation fields, and raising the recreational quality and biodiversity of nonagricultural land. In addition, recycling nutrients from wastewater and using them to produce fertilisers are considered a means of establishing new regional material cycles and enhancing regional economic development. The task of the ELaN project was to study the value and viability of water reuse as a means of providing these functions from a variety of disciplinary perspectives and to explore the opportunities and restrictions to implementing water reuse in the region. The results of the project, including recommendations for policy implementation, are summarised in several reports (e.g. Lischeid et al., 2015; Nölting et al., 2015; see also www.elan-bb.de). In this paper we focus exclusively on how interventions aimed at encouraging water reuse are shaped by (and may ultimately reshape) landscapes of sociospatial water politics in the Berlin-Brandenburg Region. Drawing on the questions formulated in the previous section we illustrate possible responses with examples drawn from our research in the ELaN project.

Technical/physical: Interventions to foster water reuse in the Berlin-Brandenburg Region are fundamentally centred on, and shaped by, the *territorial* reach of the wastewater treatment systems. Technical restrictions, such as the distance between existing wastewater treatment plants and land suitable for irrigation with treated wastewater, allow only a limited and uneven geography of water reuse in the region. Where the levels of wastewater production and infrastructure are high – such as in and around Berlin – land suitable for water reuse is barely available. The only major exceptions are former irrigation fields located just outside the city, at Hobrechtsfelde, Wansdorf and Waßmannsdorf. Conversely, in areas where there are large tracts of degraded land that could benefit from treated wastewater irrigation – as in rural, north-eastern Brandenburg – the available wastewater and infrastructure are inadequate. There is not enough wastewater produced locally to make water reuse worthwhile and the alternative of transporting treated wastewater from sewage plants further afield by tanker is prohibitively expensive, as well as environmentally problematic. Manipulating water flows with technologies of water reuse to create new territories of recycled wastewater is, thus, proving extremely costly given the path dependency of existing infrastructures and the wastewater they transport and treat.

In terms of *place-making*, we could observe how the experimental sites used to study interactions between treated wastewater, land use and groundwater resources were presented to the public as places of innovation. Locations which otherwise attract little attention – such as a former irrigation farm in Wansdorf to the West of Berlin or degraded moorland in the Uckermark Region of northeast Brandenburg – have been branded as pioneers of integrated land and water management. The ELaN project provided the opportunity to develop new technological solutions which are adapted to local conditions in these places. More than this, it enabled these sites to become places of educational recreation, where the potential of water reuse for growing energy crops on contaminated land could be brought closer to the general public. These attempts to create a distinctive identity around water reuse are, however, currently limited in their public reception and appeal.

Potentially, however, incorporating small and localised water reuse solutions within centralised regional wastewater infrastructures might lead to new forms of *scalar* politics. Decentralised, small-scale water reuse technologies could in part be substituted for centralised wastewater systems, particularly in sparsely populated areas of Brandenburg where infrastructure coverage is poor. They

could, then, ultimately challenge, and even invert, existing hierarchies of water governance, creating in the process new sociospatial politics. This may be a far-fetched imaginary for the region as a whole; however, in the locality of Biesenbrow, in northeast Brandenburg, the head of the local water board is promoting water reuse as a means of generating a local *network* sympathetic to sustainable land and water management. By enrolling local farmers and water managers around water reuse technologies and practices he is making headway in challenging existing patterns of water use in agriculture and advancing more environmentally sensitive practices. This, however, is proving highly contested on a wider scale. Furthermore, little to no progress has been made in developing a network that spans both wastewater and energy infrastructure systems; an organisational innovation that would appear to be essential if water reuse technologies are to be used to produce energy crops in a commercially viable way.

Organisational/management: The *territoriality* of wastewater collection and treatment in the region – as in Germany as a whole – is organised around municipalities and their utilities. This can prove advantageous for water reuse in those localities where the technology has long played an integral part of wastewater treatment. This is the case in the cities of Brunswick and Wolfsburg, which have operated water reuse technologies since the 1950s. Here, the boundary of water reuse is clearly delineated by the municipal territory served by the respective wastewater utilities. The disadvantage of the municipal structure of wastewater management is that it is difficult to reshape the territoriality of existing systems to accommodate water reuse that stretches beyond the jurisdiction of a municipality. A further organisational constraint was revealed by our analysis in the Berlin-Brandenburg Region: in areas with rapidly declining populations wastewater utilities are sceptical about initiatives favouring decentralisation for fear that new, local technologies could lead to a further underutilisation of their existing infrastructures. There are efforts to use certain organisational structures to initiate *place*-based solutions around water reuse, such as Berlin's public agencies responsible for urban agriculture (*Berliner Stadtgüter*) and forestry (*Berliner Forsten*), but these are tentative and limited. By contrast, the recent interest in water reuse in the EU is providing the cities of Brunswick and Wolfsburg with the opportunity to brand themselves as pioneers of the technology in Germany and thereby enhance their sustainability profile.

The *scalar* dimension of organisational interventions of water reuse in Berlin-Brandenburg can be illustrated by two factors: the strictly local orientation of the water reuse debate and the growing interest in regional utilities. The ELaN project was devised and conducted prior to the European Commission's recent interest in developing an EU-wide strategy on water reuse. Consequently, it was only in the final stages of the project that attention began to be paid to how the Berlin-Brandenburg case could be informed by, or contribute to, EU policy and Germany's (sceptical) position on the subject. In the future, the role of *Regionalwerke* may be significant for water reuse. These multi-utilities, providing a variety of services on a regional scale, could potentially rescale management arrangements of infrastructure supply between cities and their rural hinterlands as well as integrate wastewater disposal and energy supply services. In terms of *networked* sociospatial relations, the consortium of the ELaN project can itself be interpreted as an inter- and transdisciplinary network set up to advance new forms of water reuse in the Berlin-Brandenburg Region. It exposed and challenged some of the difficulties involved in attempting to alter existing organisational and management networks geared to maintaining conventional modes of agricultural production and wastewater disposal and created a fledgling network of stakeholders working at this interface.

Regulatory/socioeconomic: Groundwater protection is particularly strict in Germany and is the principle argument used to block water reuse projects. The *territories* of groundwater aquifers are effectively out of bounds for any kind of water reuse, which severely limits the spatial scope of such technologies. Since water protection is a state responsibility, the water regulators of each state administration determine whether exceptions to the general prohibition of water reuse may be tolerated or not. Thus the federal structure of Germany represents a second territorial dimension to

water reuse, creating openings for state-specific regulatory practices, yet complicating any efforts to standardise regulations across the country. The prospects for developing *place*-specific experiments in water reuse under these conditions are generally poor. Efforts to create new urban-rural relations around wastewater treatment and use in particular locales within the region are confronted by a state regulatory system geared to extensive and strict groundwater protection. Furthermore, the development of local water reuse solutions is still dependent on subsidies, for instance research grants, from the regional or national authorities. Without the funding from the German Federal Ministry of Education and Research none of the water reuse projects in the region could have been realised.

Germany's long-standing resistance to water reuse as part of its strict groundwater protection regime is, however, coming under threat from plans of the European Commission to promote better regulated water reuse across the EU. This recent policy initiative is *rescaling* the issue in a major way. If the Commission succeeds in its ambition to create new, harmonised standards for water reuse in the EU, the German federal and state governments will have to seek ways of accommodating the new regulations. This might well create openings for new networks to emerge around water reuse in the Berlin-Brandenburg Region and for existing regulatory norms and practices to be adapted. The exceptional and temporary permissions granted by the state government of Brandenburg for water reuse during the ELaN project helped foster such *networks* around local water reuse experiments upon which future projects could be built. However, the persistent separation of institutional responsibility for wastewater disposal and energy supply is, based on past experience, likely to impede the establishment of inter-sectoral networks. By contrast, the recycling of nutrients from wastewater by the Berlin water utility and their subsequent use as fertiliser is an interesting example of how a locally rooted technology can succeed if it does not raise issues of groundwater protection. Here, a network of actors interested in recycling and using nutrients has been initiated for largely economic reasons: to save money on conventional fertilisers (the farmers) and on nutrient removal from wastewater (the utility). The marketing of the new product – called 'Berliner Pflanze' – is proving tricky, but the commercial viability appears proven.

A more in-depth discussion of the Berlin-Brandenburg case and its embeddedness in national and European water politics can be found elsewhere (see Moss et al., 2016; Naumann et al., 2016). Here, the purpose was solely to demonstrate how the water reuse project can be reinterpreted by applying the analytical perspective of sociospatial water politics developed in this paper, revealing aspects overlooked by conventional explanations of implementation problems.

CONCLUSION AND OUTLOOK

In this article, we have illustrated how the politics of water reuse might be (re)imagined in sociospatial terms. The purpose has been to expose the topologies of water governance and the multidimensionality of any attempts to reconfigure them through water reuse projects. This, we have argued, is especially necessary in the debate on water reuse in order to overcome the narrow focus of social science studies on particular problems of implementation: public acceptance, institutional obstacles and economic impediments. By contrast, the politics and geographies of water reuse are, in much current research, underrepresented and poorly theorised.The analytical approach developed here places such problems in topological relief, showing the intricate knottiness, the sinewy, enmeshed and inherent sociospatiality of water reuse practices. It is designed as a dialogue between two contributions on the politics of water (Mollinga, 2008) and the multiple dimensions of sociospatiality (Jessop et al., 2008), respectively. The paper developed a matrix to guide research at interfaces between Mollinga's three categories of political intervention (technical/physical, organisational/ managerial, regulatory/socioeconomic) on the one hand and Jessop et al.'s four dimensions of spatiality (territory, place, scale, network) on the other. We prefer to emphasise political intervention, rather

than political control (as Mollinga does), to highlight the attempt to change existing practices (whether successful or not), rather than protect or consolidate them.

Empirical data from a recent transdisciplinary project on the prospects for water reuse in the Berlin-Brandenburg Region was used to illustrate how the analytical approach might be applied and what it might be expected to reveal. Even this brief reappraisal of the case through the lens of our matrix brought to light governance aspects of water reuse reaching far beyond issues of public acceptance, institutional intransigence and financial risk. For each of Mollinga's modes of political intervention and Jessop et al.'s dimensions of spatiality examples could be identified in Berlin-Brandenburg to illustrate the sociospatiality of water reuse politics. These ranged from the territorial reach of wastewater infrastructure systems and the place-making aspirations of experimental sites to the current EU initiative to rescale the regulation of water reuse, and the role of local networks in building alliances around water reuse technologies. However, this exercise has been about more than just ticking boxes of a matrix. It has revealed how existing explanations for the low levels of implementation of water reuse miss key dimensions of sociospatial politics. Proponents of water reuse – whether from research or policy – like to present non-implementation as a product of irrationality. Against all the positives stacked up in favour of water reuse they present the inconsistencies of institutional regulations, the inadequacies of market economics and the fickleness of public opinion. This paper has argued, by contrast, that the prospects and restrictions of water reuse in North-East Germany should be understood in broader terms as outcomes of the sociospatial politics of water. This has drawn attention to the various, and sometimes conflicting, political geographies of water reuse, as represented *inter alia* by their physical form (e.g. the spatial embeddedness of regional infrastructure), their scalar relations (e.g. between local, regional, national and European agencies) and their territorial organisation (e.g. around municipally constituted utilities).

From this exploratory study into the potential for using this analytical approach we conclude that the approach is applicable and viable for investigating the sociospatiality of water politics generally, but would stress that it needs to be thought through and adapted for each empirical case. Though clear, systematic and comprehensive, the analytical matrix that brings the two approaches of Mollinga and Jessop et al., into dialogue is complex and multifaceted. Beyond the 12 possible permutations of connectivity presented in the matrix, we should note – as Jessop et al., themselves emphasise – that the four dimensions of spatiality are not distinct phenomena, but often interact with one another. Thus, we need to consider, for instance, how the ongoing rescaling of water reuse in the EU might be strengthening local networks promoting reuse whilst undermining the territorial remit of national or state governments to regulate as they have in the past. Mollinga's three categories of political intervention can similarly be conceived as internally related dimensions. In utilising our approach, therefore, we would reiterate the advice of Jessop et al. (2008: 398) with regard to their own approach: That researchers use it as a general guiding framework to encourage a multidimensional approach. The point of the exercise is, again, not to fill in every box of the matrix with an answer. The purpose of the matrix is, rather, to sensitise researchers to the various forms that sociospatial water politics can take and to enable them to select those permutations of political interventions and sociospatial arrangements which are deemed relevant to the case at hand. Furthermore, as Jessop et al. state (2008), in certain contexts it may well be necessary to draw on dimensions beyond the TPSN framework. We might, for instance, consider time/temporality as an important omission in the study of water politics, given, for example, "the (short term) yearly climatic cycle and the (long term) gradual change of the hydrosocial configuration" (Mollinga, 2014: 193).

Our approach is, of course, by no means the only way of studying the sociospatiality of water, but being grounded in advanced theoretical debates in water politics and human geography it promises, we assert, guidance for future research on water governance in general and water reuse in particular. Firstly, it can provide insights on the multiple and contested geographies of water that conventional approaches on water reuse, focussed on obstacles to implementation, cannot reveal. Secondly, it draws

attention to the interlinkages between different spatial and political dimensions to water reuse, rather than prioritising just one. Thirdly, on the basis of this deeper and more nuanced analysis, it can point us towards promising avenues of intervention and warn us against potential dead ends.

ACKNOWLEDGEMENTS

This work was supported by the German Federal Ministry of Education and Research (BMBF) under Grant No. 033L025K.

REFERENCES

Angelakis, A.N. not dated. Water recycling and reuse in EU: Necessity and perspectives for establishing EU legislation. In Fundacion Centro de las Nuevas Tecnologias del Agua (Ed.*) Book of Abstract of SmallWat11, 3rd International Congress on Wastewater in Small Communities*. p. 39. Seville: Fundacion Centro de las Nuevas Tecnologias del Agua.

Angelakis, A.N.; Marceos do Monte, M.H.F.; Bontoux, L. and Asano, T. 1999. The status of wastewater reuse practice in the Mediterranean basin: Need for guidelines. *Water Research* 33(10): 2201-2217.

Angelakis, A.N. and Bontoux, L. 2001. Wastewater reclamation and reuse in European countries. *Water Policy* 3(1): 47-59.

Araral, E. and Wang, Y. 2013. Water governance 2.0: A review and second generation research agenda. *Water Resources Management* 27(11): 3945-3957.

Bahri, A. 2009. *Managing the other side of the water cycle: Making wastewater an asset*. Stockholm: Global Water Partnership (TEC Background Papers, 13).

BIO by Deloitte. 2015. *Optimising water reuse in the EU – Final report prepared for the European Commission (DG ENV), Part I*. In collaboration with ICF and Cranfield University. Luxembourg: Publications Office of the European Union.

Bixio, D.; Thoeye, C.; de Koning, J.; Joksimovic, D.; Savic, D.; Wintgens, T. and Melin, T. 2006. Wastewater reuse in Europe. *Desalination* 187(1-3): 89-101.

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): 119-137.

Callon, M. 1986. Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St. Brieuc Bay. In Law, J. (Ed.) *Power, action and belief. A new sociology of knowledge?* pp. 196-223. London: Routledge.

Environment Protection and Heritage Council. 2008 National water quality water strategy: Australian guidelines for water recycling. www.environment.gov.au/system/files/resources/9e4c2a10-fcee-48ab-a655-c4c045a615d0/files/water-recycling-guidelines-augmentation-drinking-22.pdf (accessed 15 March 2016)

European Commission. 2012. *Wastewater reuse in the European Union*. http://ec.europa.eu/environment/water/blueprint/pdf/Final%20Report_Water%20Reuse_April%202012.pdf (accessed 14 March 2016)

Garcia, X. and Pargament, D. 2015. Reusing wastewater to cope with water scarcity: Economic, social and environmental considerations for decision-making. *Resources, Conservation and Recycling* 101: 154-166.

Haering, K.C. and Evanylo, G.K. 2009. Water reuse: Using reclaimed water for irrigation. *Virginia Cooperative Extension*. Publication 452-014. https://pubs.ext.vt.edu/452/452-014/452-014_pdf.pdf (accessed 14 March 2016)

Hamilton, A.; Stagnitti, F.; Xiong, X.; Kreidl, S.; Benke, K. and Maher, P. 2007. Wastewater irrigation: The state of play. *Vadose Zone Journal* 6(4): 823-840.

Hüesker, F.; Moss, T. and Naumann, M. 2011. Managing water infrastructures in the Berlin-Brandenburg region between climate change, economic restructuring and commercialisation. *Die Erde* 142(1-2): 187-208.

Hurlimann, A. and Dolnicar, S. 2010. When public opposition defeats alternative water projects – The case of Toowoomba, Australia. *Water Research* 44(1): 287-297.

Jessop, B.; Brenner, N. and Jones, M. 2008. Theorizing sociospatial relations. *Environment and Planning D: Society and Space* 26(3): 389-401.

Lazarova, V. and Bahri, A. (Eds). 2005. *Water reuse for irrigation: Agriculture, landscapes, and turf grass*. Boca Raton: CRC Press.

Lautze, J.; Stander, E.; Drechsel, P.; da Silva, A.K. and Keraita, B. 2014: *Global experiences in water reuse*. Colombo: International Water Management Institute (Resource Recovery and Reuse Series, 4).

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. [online]: www.ecologyandsociety.org/vol10/iss2/art18/

Liang, X. and van Dijk, P. 2010. Financial and economic feasibility of decentralized wastewater reuse systems in Beijing. *Water Science & Technology* 61(8): 1965-1973.

Lischeid, G.; Schäfer, M.; Steinhardt, U.; Moss, T.; Nölting, B. and Koeppe, P. 2015. *Nachhaltiges Landmanagement durch integrierte Wasser- und Stoffnutzung. Kernaussagen des ELaN-Forschungsverbunds*. Müncheberg: Leibniz Centre for Agricultural Landscape Research.

Loftus, A. 2007. Working the socio-natural relations of the urban waterscape. *International Journal of Urban and Regional Research* 31(1): 41-59.

Mayer, M. 2008. To what end do we theorize sociospatial relations? *Environment and Planning D: Society and Space* 26(3): 414-419.

Marston, S.A. 2000. The social construction of scale. *Progress in Human Geography* 24(2): 219-242.

Meehan, K.; Ormerod, K.J. and Moore, S.A. 2013. Remaking waste as water: The governance of recycled effluent for potable water supply. *Water Alternatives* 6(1): 67-85.

Miller, W.G. 2006. Integrated concepts in water reuse: Managing global water needs. *Desalination* 187(1-3): 65-75.

Molle, F.; Mollinga, P.P. and Meinzen-Dick, R. 2008. Water, politics and development: Introducing Water Alternatives. *Water Alternatives* 1(1): 1-6.

Mollinga, P.P. 2008. Water, politics and development: Framing a political sociology of water resources management. *Water Alternatives* 1(1): 7-23.

Mollinga, P.P. 2014. Canal irrigation and the hydrosocial cycle. The morphogenesis of contested water control in the Tungabhadra Left Bank Canal, South India. *Geoforum* 57: 192-204.

Mosse, D. 2003. *The rule of water: Statecraft, ecology and collective action in South India*. Oxford: Oxford University Press.

Moss, T.; Naumann, M. and Krause, K. 2016. Turning wastewater into energy: Challenges of reconfiguring regional infrastructures in the Berlin-Brandenburg Region. *Local Environment*. [online]: http://dx.doi.org/10.1080/13549839.2016.1195799 (accessed 24 January 2017)

Naumann, M. and Moss, T. 2012. *Neukonfiguration regionaler Infrastrukturen. Chancen und Risiken neuer Kopplungen zwischen Energie- und Abwasserinfrastruktursystemen*. Müncheberg: Leibniz Centre for Agricultural Landscape Research.

Naumann, M.; Moss, T. and Beveridge, R. 2016. Nutzung gereinigten Abwassers zwischen globalem Anspruch und regionalen Realitäten. *Wasser und Abfall* 18(1): 55-58.

Nölting, B.; Balla, D.; Daedlow, K.; Grundmann, P.; Oehlschläger, K.; Maaß, O.; Moss, T.; Steinhardt, U. and von Bock und Polach, C. 2015. *Gereinigtes Abwasser in der Landschaft. Ein Orientierungsrahmen für strategische Entscheidungsprozesse*. Müncheberg: Leibniz Centre for Agricultural Landscape Research.

Norman, E.S.; Bakker, K. and Cook, C. 2012. Introduction to the themed section: Water governance and the politics of scale. *Water Alternatives* 5(1): 52-61.

Ormerod, K. 2015. Governing risk, reuse and reclamation: Water pollution control and new water resources in the southwestern United States. PhD thesis. Arizona, USA: University of Arizona, Arizona.

Paasi, A. 2008. Is the world more complex than our theories of it? TPSN and the perpetual challenge of conceptualization. *Environment and Planning D: Society and Space* 26(3): 405-410.

Po, M.; Kaercher, J.D. and Nancarrow, B.E. 2004. *Literature review of factors influencing public perceptions of water reuse*. www.clw.csiro.au/publications/technical2003/tr54-03.pdf (accessed 14 March 2016)

Raso, J. 2013. *Updated report on wastewater reuse in the European Union.* Madrid: Typsa Consulting Engineers & Architects.

Salgot, M. 2008. Water reclamation, recycling and reuse: Implementation issues. *Desalination* 218(1-3): 190-197.

Sanz, L. and Gawlik, B. 2014. *Water reuse in Europe. Relevant guidelines, needs for and barriers to innovation*. Publications Office of the European Union. http://publications.jrc.ec.europa.eu/repository/handle/JRC92582 (accessed 14 March 2016)

Soja, E.W. 1989. *Postmodern geographies: The reassertion of space in critical social theory*. London: Verso.

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

Urkiaga, A.; de las Fuentes, L.; Bis, B.; Chiru, E.; Balasz, B. and Hernández, F. 2008. Development of analysis tools for social, economic and ecological effects of water reuse. *Desalination* 218(1-3): 81-91.

van der Bruggen, B. 2010. The global water recycling situation. In Escobar, I. and Schäfer, A. (Eds.) *Sustainable water for the future: Water recycling versus desalination*, pp. 41-62. Amsterdam: Elsevier.

WHO (World Health Organisation). 2006. *WHO guidelines for the safe use of wastewater, excreta and greywater*. Geneva, Switzerland, WHO. www.who.int/water_sanitation_health/wastewater/gsuww/en/ (accessed 14 March 2016)

Zeitoun, M. and Allan, T. 2008. Applying hegemony and power theory to transboundary water analysis. *Water Policy* 10(2): 3-12.