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- *Water infrastructures – Regional development – Global change – Regional adaptation*

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Managing Water Infrastructures in the Berlin-Brandenburg Region between Climate Change, Economic Restructuring and Commercialisation

Wasserinfrastrukturen in der Region Berlin-Brandenburg zwischen Klimawandel, wirtschaftlichem Strukturwandel und Kommerzialisierung

With 3 Figures

Global change is posing a major challenge to existing forms of natural resource use, socio-economic development and institutional regulation. Although trends such as climate change, socio-economic transformation and institutional change are global in their scope, they have very specific regional outcomes. Regionally distinct coping strategies are required which take into account both the diversity of regional impacts of global change and the local contexts of appropriate responses. This paper explores the impacts of global change on the management of water infrastructure systems in the Berlin-Brandenburg region in terms of three concurrent and overlapping challenges: climate change, socio-economic change and institutional change. It subsequently examines how regional actors in the water sector are addressing these three dimensions of global change.

1. Introduction

The impact of global change on cities and regions and the potential responses available to local and regional stakeholders represent core challenges for research and policy. Three issues, in particular, make this task particularly demanding: first, the uncertainty regarding the outcomes of global environmental change – especially cli-

mate change – at the regional level; second, the complexity of human-nature relations at work between the local and the global scale; third, the diversity in both problem perceptions and potential responses in different cities and regions.

This paper explores regional impacts of, and responses to, global change through the lens of a policy field deeply implicated in diverse com-

ponents of global change: the socio-technical systems of water supply and sanitation. The management of water infrastructures is affected substantially not only by climate change (in the form of shifting rainfall patterns and the increasing frequency of extreme weather events), but also by the consequences of socio-economic transformation for regional water demand and by institutional changes, such as liberalisation, privatisation and commercialisation. All three phenomena are global in origin and scope, but each has impacts which are specific to particular national, regional or local contexts. In this paper we focus on the regional – i.e. sub-national – scale of water infrastructure policy and management as the most suitable for capturing the spatial scope of socio-technical systems of water supply and wastewater disposal. The purpose of the paper is threefold. Firstly, it seeks to map out the regional impacts of these three dimensions of global change for the water infrastructure systems of one region – Berlin-Brandenburg. Whilst most studies address merely one of these phenomena in isolation, the value here lies in highlighting all three as parallel – and partially interconnected – processes. Secondly, the paper explores how water and infrastructure managers in the region are responding to these dimensions and what strategies they are developing to this end. Thirdly, conclusions are drawn on the implications of both impacts and responses for the future management of water infrastructure systems. We are particularly interested in investigating how far conventional pathways, logics and practices of infrastructure management are being challenged by the multiple impacts of global change. Before embarking on this endeavour, however, preliminary explanations are needed about the region under study, the nature of infrastructure management and the methods of analysis used.

The Berlin-Brandenburg region is particularly suited to a study of the regional impacts of global change on water infrastructure systems. Firstly, climate change is already affecting precipita-

tion patterns and average temperatures in the region. According to current forecasts, there will be an increase in the frequency and intensity of droughts as well as extreme weather events in Berlin-Brandenburg (*Gerstengarbe et al. 2003, Lotze-Campen et al. 2009, MLUV n. d.*). Secondly, since 1990 the region has been subjected to radical socio-economic change in the wake of German reunification, European integration and economic globalisation. Rapid de-industrialisation coupled with a declining population in structurally weak areas has been crucial behind the significant drop in demand for water and the under-utilisation of existing technical networks and plants (*Koziol 2004, Moss 2008, Lux 2009, Naumann 2009*). Thirdly, global trends towards the commercialisation and privatisation of water utilities have had far-reaching consequences for the organisation of water services at local and regional scales (*Wissen and Naumann 2006, Beveridge and Hüesker 2008*), including the Berlin-Brandenburg region (*Naumann 2009, Hüesker 2011, Beveridge 2011*). By selecting the region as a whole, rather than one of the two states (*Länder*) of Berlin and Brandenburg, we can draw on particularly illustrative examples of each of the three dimensions of global change addressed from within the region. The huge disparity between the metropolitan core of the German capital, the suburban belt around Berlin and Potsdam and the structurally weak periphery of Brandenburg (see *Fig. 1*) provides a rich tapestry of experiences with socio-economic, institutional and climate change relevant to water services. The purpose of the paper is not to compare the experiences of Berlin with those of Brandenburg but, rather, to shed light on the diverse – and even contradictory – impacts of global change within this one region of Germany and how they shape the context of regional action (*Wissen 2009*).

The study is conducted against the backdrop of water infrastructure systems traditionally characterised by strong path dependency and inflex-

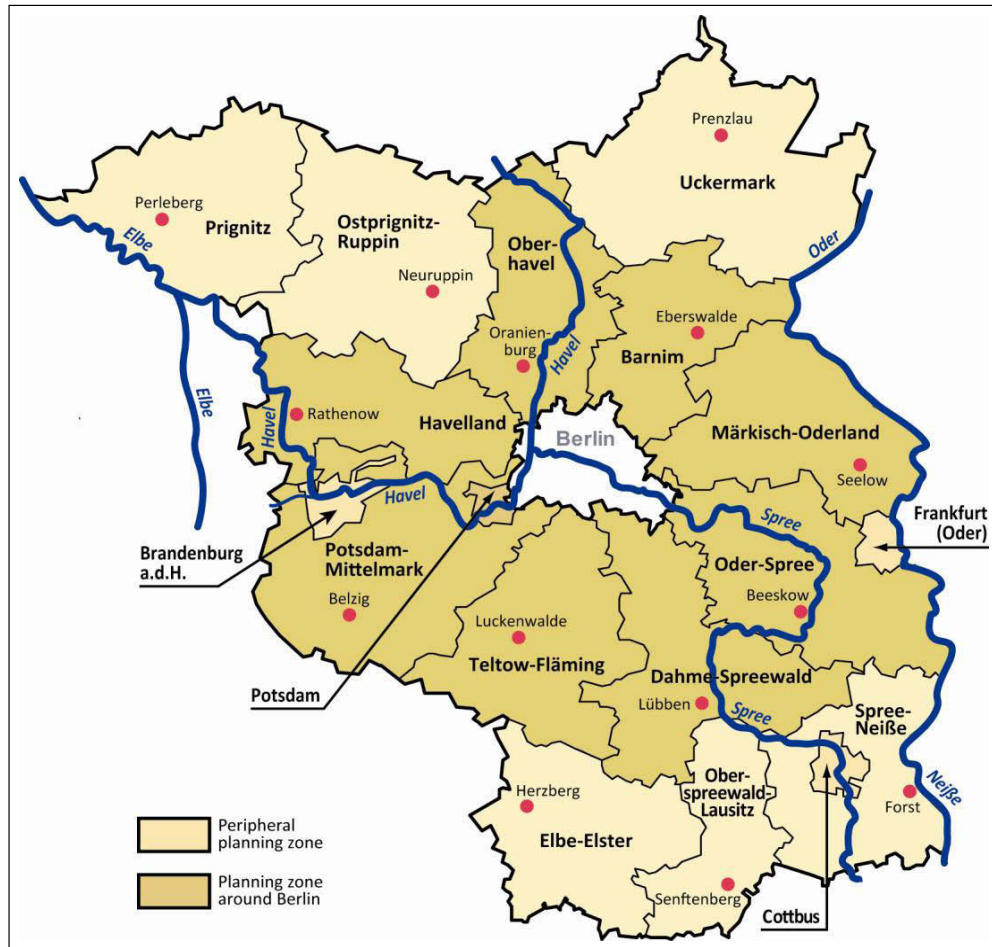


Fig. 1 Berlin and Brandenburg: districts and planning zones
 Berlin und Brandenburg: Landkreise und Planungsräume

ibility (Kluge and Scheele 2008, Bernhardt 2009). This path dependency is caused by the long life-cycle of technical structures, the high amount of “sunk costs” in networks and plants, the spatial embeddedness of water resources and infrastructure facilities as well as the persistence of a traditional logic of infrastructure supply (Tietz 2006, Gailing et al. 2009). The “modern infrastructural ideal” (Graham and Marvin

2001), which guided the planning and politics of networked infrastructures in industrialised countries during the 20th century, established universal access to standardised services provided by (public) monopolies as the accepted norm. In Germany water services are part of municipal public services and the responsibility of local authorities. Characteristics of German water management are: supply areas served by mono-

polies, mandatory supply contracts and the obligation to use local systems, full cost-recovery water tariffs and the fair distribution of costs between all users of one supply/disposal unit (Kluge and Libbe 2006, Bernhardt 2009). These traditional arrangements for the organisation of water infrastructures are usually perceived to have worked well in Germany. In general, drinking water supply is of a high quality, reasonably priced, near-universal in terms of coverage, and reliable. Furthermore, the improvement and extension of wastewater disposal has contributed significantly to human health and the protection of water resources.

However, the traditional technical and political model of water management has been increasingly contested since the late 1980s (Araral 2009, Conca 2006, Castro and Heller 2009, P  rard 2009). Criticisms have come from various commentators, addressing the inefficiency of monopoly structures, the obsession with technology and the dominance of a supply-side logic of infrastructure provision (Graham and Marvin 2001, Loske and Schaeffer 2005, Kluge and Scheele 2008, Moss et al. 2008). These criticisms, taken in the context of the challenges posed by global change, can be seen to be opening up a “window of opportunity” for a reconfiguration of water infrastructure systems and their institutional arrangements. In this paper we focus on three dimensions of global change – climate change, socio-economic change and institutional change – to investigate how far the challenges which they pose are challenging conventional logics and practices of water supply and wastewater disposal in the Berlin-Brandenburg region and thereby calling for a reflection on the fundamental aims and functions of the region’s water infrastructure systems.

The paper summarises a more substantive report produced (in German) for the Berlin-Brandenburg Academy of Sciences and Humanities (Moss and H  esker 2010). Like this report, the

paper is rooted conceptually in work conducted by the authors on the reconfiguration of water infrastructures in Germany, reflecting international debates on urban infrastructures in transition (see Moss et al. 2008). Empirically, the paper draws principally on three pieces of research conducted at the Leibniz Institute for Regional Development and Structural Planning (IRS) between 2005 and 2009. These comprise firstly Matthias Naumann’s doctoral thesis on the transformation of water infrastructure systems in rural and peripheral areas of Brandenburg (Naumann 2009), secondly, Frank H  esker’s doctoral thesis on the consequences of the partial privatisation of the Berlin Water Company (H  esker 2011), and, thirdly, research by Markus Wissen on parallel discourses on water resources, water infrastructures and climate change in Brandenburg (Wissen 2009). The following paper represents a secondary analysis of the rich empirical material from these three sources.

In line with the aims set out earlier, the paper is structured into three parts. The following section draws on existing literature on the transformation of water infrastructure systems to reveal how infrastructure systems in the region are being affected by the three dimensions of global change. In Section 3 we analyse current institutional strategies to cope with each of these dimensions of global change in the region. We conclude by reviewing these strategies and discussing possible consequences for infrastructure governance¹ (Section 4).

2. Challenges for Water Infrastructures in Berlin-Brandenburg

Since 1990 Berlin-Brandenburg and its water infrastructures have had to cope with the far-reaching, complex consequences of the collapse of the socialist German Democratic Republic (GDR), the fall of the Berlin Wall and German reunification. The development of the region has

been characterised not only by deep, long-term structural transformation but also by increasing disparities. As a result, processes of global change have had differentiated outcomes within the region. In what follows we provide a brief overview of the three main challenges for water infrastructures in Berlin-Brandenburg prompted by global change: climate change (Section 2.1), socio-economic change (Section 2.2) and institutional change (Section 2.3).

2.1 Climate change and its impact on water infrastructures in the Berlin-Brandenburg region

Although at present there is a lack of detailed forecasts at the scale of the region, it is clear that climate change will have significant impacts on water infrastructures (UBA 2005, Bundesregierung 2008, Europäische Kommission 2009). Preliminary research on the consequences of climate change for the Berlin-Brandenburg region has been conducted by the Potsdam Institute for Climate Impact Research (PIK) (*Gerstengarbe et al. 2003, Lotze-Campen et al. 2009*). According to their predictions, by 2055 climate change will have led to a significant rise in average temperatures, milder winters and an increase in hours of sunshine and decreasing amounts of precipitation in Berlin-Brandenburg. Even moderate forecasts predict a further decrease in rainfall and a simultaneous increase in evapotranspiration especially during summer, leading to a decline in groundwater and river water levels as well as problems of water quantity and water quality (*Gerstengarbe et al. 2003: 75*). The main consequences of climate change for drinking water supply and wastewater disposal are summarised in this section.

Lower discharge levels: Due to decreasing amounts of rainfall during the summer and increasing evapotranspiration rates (*Lotze-Campen et al. 2009: 16f.*), a reduction of the

total water volume of rivers in the Elbe river basin by 20 percent is expected between 2000 and 2050. As drinking water abstraction for the Berlin metropolitan area is to a large extent based on bank filtration, low water levels of the Spree and Havel rivers are predicted to have a significant influence on the availability of drinking water resources. Problems will arise if the demand for water cannot be covered by surface water and bank filtration, especially during the summer when demand peaks and water levels are at their lowest. In the field of wastewater disposal low water levels mean a higher concentration of pollutants from wastewater discharges. This could disturb the current configuration of drinking water abstraction points and wastewater discharge points for the Berlin metropolitan area (*Möller und Burgschweiger 2008: 58*).

Decreasing groundwater replenishment: As hotter summers coincide with less rainfall, it may be difficult to replenish groundwater resources. As a consequence of climate change, groundwater replenishment could fall by 40 percent (MLUV n. d.: 8). The moorland and wetlands of Brandenburg are particularly at risk and changes here would result in further negative impacts on groundwater levels. It is already apparent that natural groundwater replenishment through precipitation is not sufficient to cover the demand for drinking water abstraction for the region as a whole. As a result, water supply utilities in some areas have been compelled to use bank filtration. This problem is likely to be aggravated as forecasts predict an additional decrease in natural groundwater replenishment. Despite this general trend in the region, it is important to note that not all parts of the region will face this particular challenge. In those areas where water use has declined sharply since 1990 as a result of socio-economic change (see Section 2.2 below), for instance, the negative influence of climate change on groundwater levels may be more than compensated for by the positive effects of declining water abstractions (*Gerstengarbe et al. 2003: 75, Lotze-Campen et al. 2009: 31*).

Decreasing rainfall and an increasing intensity of rainfall: Forecasts predict a decrease in rainfall during the summer and an increase in rainfall during the winter. According to one prediction, by 2055 average rainfall will have decreased by 17 percent, compared to the years 1951-2006 (*Lotze-Campen et al. 2009: 18*). However, alongside this decrease in the total amount of rainfall, there are forecasts of an increase in temporal and regional concentrations of rainfall within the Berlin-Brandenburg region (*Lotze-Campen et al. 2009: 21*). Sudden, heavy rainfall events are currently the main cause of pollution to the river Spree, because the sewer network is unable to retain excessive stormwater, which is then discharged untreated into the watercourses. To minimise these problems it is necessary to increase the capacities of sewerage networks or allow for greater water retention.

Increasing demand for water: As temperatures increase the demand for water is likely to rise too, especially during the summer (*Lotze-Campen et al. 2009: 37f.*). Agriculture, manufacturing and private households will use more water during the hotter summers and more frequent heat waves. According to the Berlin Water Company (BWB), infrastructure capacities will have to be extended if the increase in demand is not compensated for by the continuing decline in water use (see Section 2.2, below). Currently, however, BWB is assuming that water demand will not decrease further and will in fact stay at the level of 2005 (*Möller und Burgschweiger 2008*).

This example illustrates the multi-faceted and often contradictory challenges posed by global change in the region. On the one hand climate change forecasts are generating debates about water scarcity and the need for infrastructural adaptation to cope with severe precipitation and drought events. Here, considerable spatial and temporal differentiation is required (*Lotze-Campen et al. 2009: 37f.*). The consequences of heavy rain in large cities, where there is a need

for extended sewer capacities to avoid overflows (*SENGUV 2009: 14*), differ greatly from the consequences of climate change in rural areas, where there is a need for higher natural water retention. On the other hand concerns regarding the consequences of climate change often contradict those emerging over insufficient through-flow of water and infrastructural over-capacity resulting from socio-economic restructuring – the second challenge of global change addressed in this paper (*Wissen 2009*).

2.2 *Socio-economic change and its impact on water infrastructures in the Berlin-Brandenburg region*

Since the 1980s the globalisation of economic activities has been the main driver for socio-economic and spatial change all over the world (cf. *Harvey 2006*). In Europe this process has been reinforced by the concurrent Europeanisation of economic and political structures and activities and the transition from state-planned to market-based economies in Central and Eastern European countries. These transformation countries have, in particular, experienced a loss of former markets and a decline of industrial locations. The consequences of global structural change for them are far-reaching and include job losses in manufacturing, agriculture and the public sector, as well as a long-term decline in population due to the migration of young people and broader demographic change. In the Berlin-Brandenburg region industrial production has decreased dramatically since the collapse of the GDR and some parts of the region have experienced considerable population loss. Such demographic change has especially affected medium-sized towns and peripheral rural areas. Again, however, there are contradictory trends apparent within the region. In contrast to the overall trend in the region, there are municipalities in the suburban belt around Berlin with growing population numbers. Whilst districts

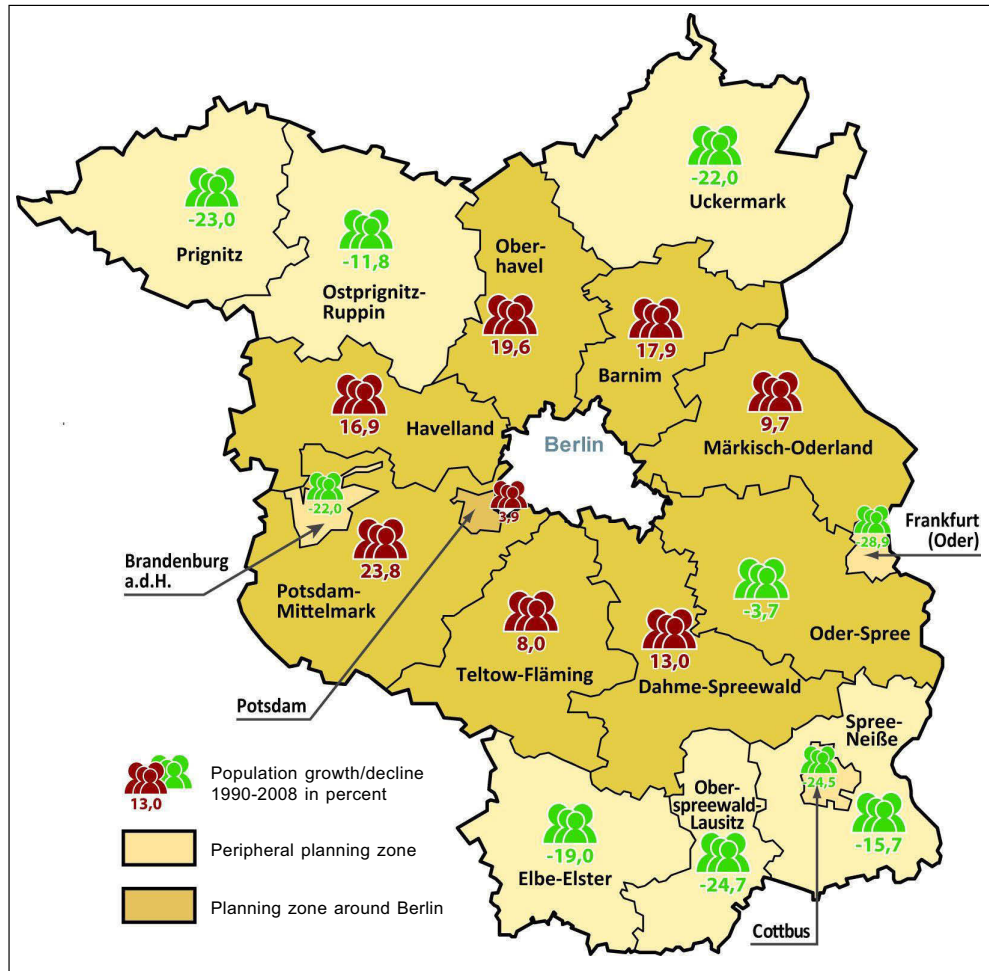


Fig. 2 Population change in administrative units of Brandenburg, 1990-2008 (Amt für Statistik Berlin-Brandenburg 2009a) / *Bevölkerungsentwicklung in den einzelnen Landkreisen Brandenburgs* (Amt für Statistik Berlin-Brandenburg 2009a)

(*Landkreise* and *kreisfreie Städte*) surrounding the capital have witnessed population growth between 1990 and 2008 of 11.8 percent on average and as much as 23.8 percent in one instance, those in the peripheral planning zone of Brandenburg have seen their population decline by an average 21 percent

(see Fig. 2). In addition to this polarisation between the suburban belt around Berlin and peripheral rural districts in Brandenburg, a wide range of small-scale differences within regions can also be observed. Economic and demographic change is therefore characterised by new inter- and intraregional disparities.

Economic and spatial structural change has had major consequences for water infrastructures in the region (on the following *Koziol 2004, Moss 2008, Naumann 2009*). As a result of their spatial embeddedness and their high share of fixed costs, drinking water supply and wastewater disposal systems are far more affected by demographic and structural change than electricity supply and telecommunication infrastructures. The decline of traditional industries, the decrease in population levels and more efficient water use in the agricultural sector have contributed to a decline in water demand of more than 40 percent since 1990. This is almost twice as high as the national average. In Berlin the demand for drinking water dropped by 45 percent between 1989 and 2007 (SENGUV and *Berliner Wasserbetriebe 2008*). Water demand in Brandenburg fell by 42 percent between 1991 and 2007 and a further decrease by four percent is anticipated by 2015 (LDS 2006). However, as with the other outcomes of global change, decline in water demand is spatially varied. Between 1995 and 2007 water demand grew slightly – by 3.5 percent – in the districts around Berlin, while it declined by 23.1 percent in peripheral districts (see *Fig. 3*). As with population levels, huge differences exist even within the two planning zones. In the districts surrounding Berlin changes in water demand between 1995 and 2007 range from -22.9 percent (Potsdam) to +41.5 percent (Teltow-Fläming). In the peripheral districts the range is from -41.2 percent (Brandenburg an der Havel) to -2.3 percent (Ostprignitz-Ruppin).

Other developments in the management of water infrastructures have led to further tensions. Whilst demand for water has decreased significantly overall, the capacities of water supply and wastewater disposal systems have been extended. In Brandenburg, in particular, huge investments have been made to meet national and European health and environmental standards. Supported by massive public subsidies, the length of public sewers in Brandenburg increased by

59 percent and in Berlin by 5.9 percent between 1998 and 2004 (*Moss 2008*). On the one hand, infrastructural extension has helped increase connection rates to public systems and has improved the quality of surface and groundwater in the region. On the other hand, the combination of infrastructure extension and decrease in demand has led to new problems of under-utilisation and infrastructural over-capacity. Sewage works in Brandenburg's towns often work at less than 50 percent of their capacity (*Koziol 2007: 46*). Existing networks and plants cannot be easily adapted to such low levels of usage, leaving operators confronted with huge technical and financial problems, but also a fundamental challenge to the supply-oriented logic of conventional infrastructure management. The technical problems encountered include an increased risk of bacterial growth and microbial contamination in drinking water systems and sediments, and blockages in sewers, with accompanying problems of increased corrosion and odour. The technical responses, such as flushing, reducing the diameter of sewer pipes etc. (see Section 3.2, below) require additional financial and environmental resources, creating new problems for the utilities involved. Since they generally pass these costs on to their customers, the principal burden of over-capacity is borne by the consumer in the form of higher fees. In response, consumers have organised protests against rising fees, especially those for wastewater services in Brandenburg.

2.3 Institutional change and its impact on water infrastructures in Germany and the Berlin-Brandenburg region

In the mid-1990s a controversial debate began in Germany about the liberalisation, privatisation and commercialisation of water services (*Scheele 2004; Deutscher Bundestag 2006; Kluge and Libbe 2006; Wasserkolloquium 2008*). This debate was framed by a global discourse about state failure and the promises of liberalised

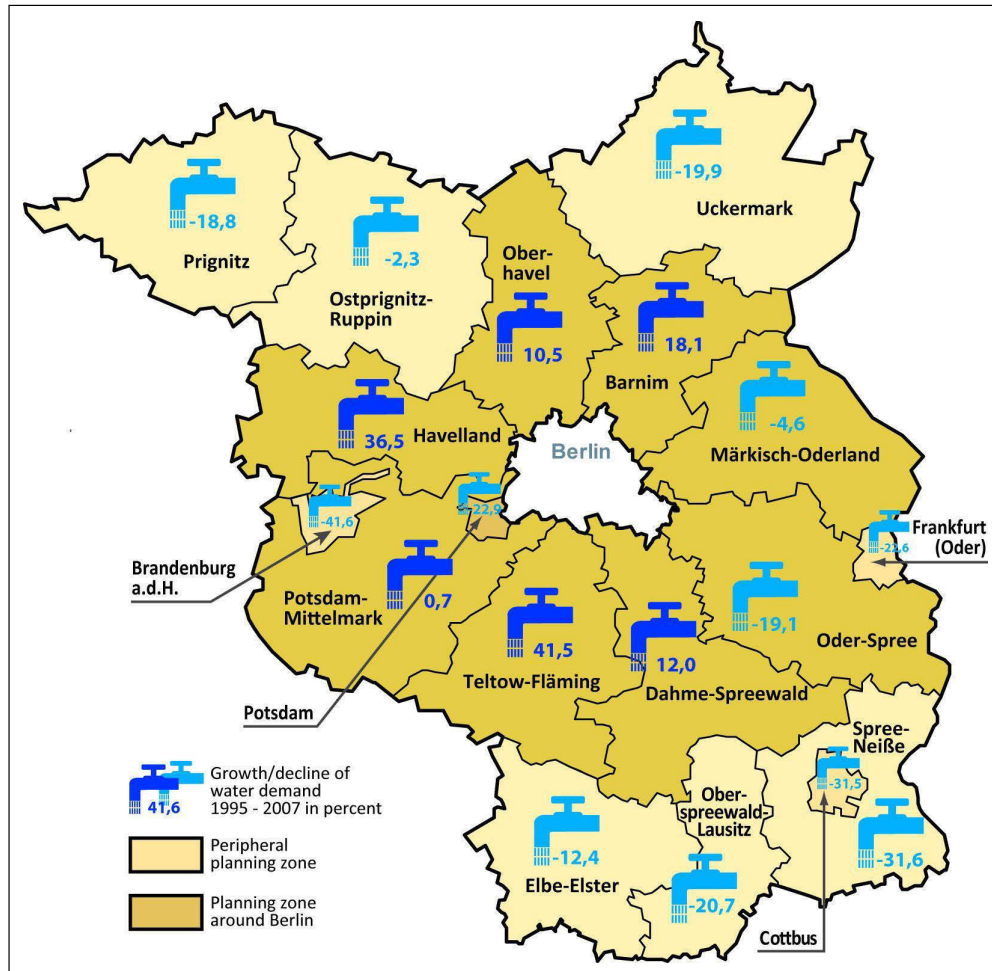


Fig. 3 Change of water demand by districts of Brandenburg, 1995-2007 (Source: Amt für Statistik Berlin-Brandenburg 2009b) / *Entwicklung des Wasserverbrauchs in den Landkreisen Brandenburgs 1995-2007 (Quelle: Amt für Statistik Berlin-Brandenburg 2009b)*

markets and private investors. Following the hegemonic “lean state” paradigm, public service provision shifted globally towards market-based provision and private sector involvement (Conca 2006; Castro 2009). The Dublin Conference on Water and the Environment was a milestone in the implementation of this policy model.

Agreement was reached on the following guiding principle: “Water has an economic value in all its competing uses and should be recognised as an economic good” (cited in Conca 2006: 219). Since then, international organisations such as the International Monetary Fund and the World Bank have supported liberalisation and privatisation, par-

ticularly in developing and transformation countries (*Conca* 2006: 221f.). The General Agreement on Trade in Services (GATS) of the World Trade Organisation (WTO) aims to implement market liberalisation in different sectors including water supply and wastewater disposal (*Libbe* and *Moss* 2007: 386f.).

These processes of liberalisation (generally understood as encouragement of competition by adequate regulation, e.g. *Sack* 2009) and privatisation (generally understood as transfer of public resources to private actors, cf. also *Sack* 2009) have been heavily criticised and contested. There are numerous studies on failed privatisations (TNI and CEO 2005, *Conca* 2006) and critiques of the impact of commodifying water (*Swyngedouw* et al. 2002, *Wasserkolloquium* 2008) and the increasing economic concentration of the water market (*Swyngedouw* 2009). Urban geographers see new spatial disparities arising from commercialised water utilities (*Graham* and *Marvin* 2001). In recent years water utilities themselves have begun to question neoliberal policy models. Currently there are signs of a movement towards the re-municipalisation of water utilities, and even the World Bank today takes a more differentiated position on the organisation of water services.

Institutional change within the German water services sector differs to a large degree from the characteristic global model. The transformation of the German water market is not state-driven, universal and sudden (as in the UK), but a more self-contained, selective and gradual process (*Libbe* and *Moss* 2007: 381f.). Liberalisation has been less pronounced in the German water sector. Indeed, in the late 1990s an attempt by the German Federal Ministry of Economics to initiate greater liberalisation failed. Instead, new strategies to modernise the German water market put an emphasis on instruments aimed at greater efficiency and transparency (*Deutscher Bundestag* 2006). Debates

continue about an introduction of competition “for the market” (instead of competition “within the market”), e.g. competitive bidding for operational management or supply areas (*Europäische Kommission* 2004). European internal laws and competition laws compel those German utilities which are not completely publicly owned to allow open competitive biddings for contracts (*Libbe* and *Moss* 2007).

If the effects of liberalisation have been limited, it is fair to say that privatisation has led to greater changes in the German water markets. Although the majority of the 6,400 German water supply and 6,900 wastewater disposal companies are still publicly owned, private companies have a comparatively high share of the market (*Arbeitsgemeinschaft Trinkwassertalsperren* et al. 2008: 11). Furthermore, many municipalities see the privatisation of water companies or outsourcing of operational management as a means of dealing with high indebtedness and meeting demand for heavy investments in water infrastructure.

Commercialisation of services is the most advanced trend of institutional change in the German water sector. Commercialisation, understood as the introduction of “commercial principles (such as efficiency), methods (such as cost-benefit assessment), and objectives (such as profit maximisation)” (*Bakker* 2005: 542), increasingly shapes the strategies of water companies throughout the country. Even publicly-owned utilities prioritise cost efficiency, cut jobs and outsource services (*Moss* and *Naumann* 2007: 142). It should be noted that economic efficiency is not an entirely new principle of water management in Germany, having long been a legal requirement by German law which has acquired new importance under the EU Water Framework Directive (§ 5).

Turning our attention to the Berlin-Brandenburg region, the most prominent case of privatisation

is that of the Berlin Water Company (BWB), treated in detail in Section 3.3, below. In Brandenburg some water companies have been privatised, for example in Potsdam² and Cottbus, but there is no evidence of a strong trend towards privatisation in Germany as a whole. The vast majority of water utilities in Brandenburg are still 100 percent publicly owned. A trend towards commercialisation, however, is apparent. Many municipalities and companies are trying to increase efficiency by adopting the instruments and strategies of the private sector (*Naumann* 2009: 152f.). Such institutional changes have taken a variety of forms with a range of often controversial outcomes. Key features of this process include the introduction of benchmarking but also major job cuts in both the companies and the public authorities responsible for water management (*Naumann* 2009: 154).

Overall, then, it can be said that limited liberalisation, selective privatisation and far-reaching commercialisation have increased the organisational heterogeneity of German water supply and wastewater disposal systems. Although they represent distinct trends, we should note that, in practice, liberalisation, privatisation and commercialisation are often interconnected, having an amplifying effect on each other. As with the two other dimensions of global change, institutional changes to water infrastructure systems are not straightforward, but spatially differentiated and complex, generating a patchwork of diverse organisational models in which new logics of management are complementing and contesting the more traditional structures and procedures of the German water services sector.

Taken together, the three dimensions of global change described here represent major new challenges to conventional patterns of infrastructure management. Although concurrent, they can also pull in different directions, as we have noted, making adaptation to them all the more difficult. Thus, for instance, responses are needed which take into

consideration both the likely increase in water demand as a result of climate change and the recent legacy of declining water demand and problems of over-capacity resulting from socio-economic restructuring. How responses in the Berlin-Brandenburg region have attempted to deal with these challenges and their inner contradictions is the subject of the next section.

3. Regional Responses to Global Change

Following from the above analysis, the consequences of climate change, socio-economic and institutional change are such that a single universal strategy is not capable of addressing the range of problems arising at the regional level. Instead, it is necessary to develop a 'case-by-case' approach to a region's problems to appreciate the context-specific nature of these dynamics. The following sections reveal some of the responses of water infrastructure planners and operators in the Berlin-Brandenburg region, whilst discussing key issues for the further development of coping strategies for key actors affected by the impacts of global change. In the context of this paper the key actors addressed comprise local politicians, decision-makers in the region's water and wastewater utilities and planners and regulators in the Berlin and Brandenburg state agencies responsible for water protection and water services.

3.1 *Reactions to the impacts of climate change*

In Section 2.1 we identified four major problems which – according to climate change forecasts – could affect water infrastructure in the region: lower discharge rates; decreasing groundwater replenishment; decreasing rainfall and an increasing intensity of rainfall; increasing demand for water. Institutional reactions to the impacts of climate change are beset by divergent perceptions of the problem and by the lack of data on the regional impact of climate

change. Currently a number of different research projects, including the Innovation Network of Climate Change Adaptation in the Brandenburg-Berlin Region (INKA-BB), are addressing climate change impacts at the local and regional scale. The states of Berlin and Brandenburg are both working on their agendas for climate change adaptation (MLUV 2008; SENGUV 2009). The implementation of both the EU Water Framework Directive and the EU Floods Directive is currently providing new impetus to water and flood protection in the region, providing opportunities for taking a more integrated approach oriented around river basins. The consequences of climate change – in particular regarding flood events of increased intensity and frequency – are central to the management plans and programmes of measures of these two directives. Because the political debates on appropriate responses to climate change and climate change research in the region are ongoing we can only briefly outline some preliminary examples of institutional responses to climate change.

The Brandenburg state government is currently addressing problems of low water levels in its lakes and rivers in the implementation process of the EU WFD. For the Oder and Elbe rivers, for instance, the thresholds for low water will be identified with the aim of developing instruments to address low water issues and to provide a forum for discussion with all water users. The development of this dialogue is designed to increase the acceptance of future measures of low water adaptation (MLUV 2008: 18f.). For smaller rivers, integrated development concepts (*Gewässerentwicklungskonzepte*) are being implemented which include measures to secure adequate water levels in times of drought. Looking beyond the rivers to water availability in general, the state government of Brandenburg is running a programme to protect water and watercourses in the landscape (*Landschaftswasserhaushalt*), which is geared to securing adequate

water resources – especially for agricultural production and biodiversity – in the face of the effects of climate change (see *Germer et al.* 2011 and *Lischeid and Natkhin* 2011 in this issue).

One means of countering diminishing groundwater replenishment is to retain purified wastewater locally instead of discharging it into neighbouring watercourses. This would allow for the increased recharging of groundwater systems. In the city of Berlin public subsidies are available and initiatives in place for artificial groundwater recharge, rainwater treatment and infiltration with a view to replenishing local groundwater reserves (*Möller and Burgschweiger* 2008: 60). As early as 2001 the city government of Berlin and the Berlin Water Company agreed on measures to adapt Berlin's sewer network to cope with heavy rainfall. Recently, the Berlin Water Company has created additional retention capacity in the city's combined wastewater system in order to avoid overflows following heavy rainfall events (*Pawłowsky-Reusing* 2010). Additionally, research on adapting combined sewer systems to climate change is currently being conducted by the Berlin Centre of Competence for Water, a public-private partnership comprising Veolia, BWB, the Berlin State, the city's universities and business groups.

Another strategy available for dealing with the most threatening consequence of climate change for water infrastructures in the region – the simultaneous rise in demand for water and diminishing water resources – would be to save more water. However, at present there are few if any campaigns to encourage water saving due to the problems arising from under-utilisation of the networks. Existing economic instruments for water saving are at present limited to groundwater abstraction and wastewater discharge fees in Berlin and water consumption fees and sewage charges in Brandenburg. These fees have to be paid by the utility companies who then pass on the costs to water consumers.

3.2 Reactions to the impacts of socio-economic change

Under-utilisation of water supply and wastewater disposal systems as a consequence of decreased water demand leads – as we have noted – to technical, economic and institutional problems. Water companies have developed different strategies to cope with decreasing water use, elaborated in the following section.

Firstly, water and wastewater utilities are altering their tariffs to make them less vulnerable to a sharp drop in revenue precipitated by declining water use. The Berlin Water Company, having introduced consumption-based water rates several years ago to encourage water saving, has recently reverted to a basic charge to cover part of the costs of water services. This measure provides the company with a more secure source of revenue, being less dependent on water demand, but acts as a disincentive for customers to conserve water. Here, a further contradiction becomes apparent. What is good for the efficient and effective operation of the water infrastructure network is bad for protecting the region's long-term water resources from the negative effects of climate change.

Secondly, water utilities in Berlin and Brandenburg have adapted their networks to match the decline in water use. One option is the downsizing of networks and pipes. Pipes of smaller diameter can be inserted into existing water and sewer systems to minimise the negative effects of over-capacity described in Section 2.2, above. This option is very costly, however, and rarely adopted by companies operating in structurally weak areas characterised by a declining population and generally low incomes. Decentralised networks or semi-centralised systems provide new technological options for maintaining services under conditions of declining demand (Bieker et al. 2010, Felmeden et al. 2010, Kluge and Libbe 2010). However,

these are often only valid as an alternative, rather than a complement, to existing infrastructure systems. Where investments have already been made in centralised systems any additional system components tend to exacerbate the problem of over-capacity. Another – radical – option is the complete abandonment of parts of a network. This is a highly complex task, requiring an integrated approach with other organisations responsible for urban planning, in particular those involved with the urban renewal programme “*Stadtumbau Ost*” (urban transformation in east Germany). The cases of Cottbus and Eisenhüttenstadt, two “shrinking cities” of Brandenburg, show that close collaboration between urban and infrastructure planners can save substantial costs in situations of over-capacity water and sewer networks (Kozioł 2007).

Thirdly, waterworks, sewage treatment plants and other facilities have been closed to reduce over-capacities. The Berlin Water Company has closed five waterworks and three sewage plants since 1992. Waterworks have also been closed in Brandenburg. These closures have led to the respective drinking water protection zones losing their statutory status. By 2005, 40 percent of all drinking water protection zones in Brandenburg had been declassified and the new water law there foresees further deregulation.

Fourthly, water companies try to enlarge their supply areas in order to increase use of their available infrastructure. Most notably, wastewater companies have sought to connect households in rural areas still reliant on small-scale technologies to the public sewage system. These connections are often contested because house owners oppose the payment of excessively high connection fees and sewage disposal tariffs levied by wastewater utilities keen to recoup the costs of past over-investment in their sewers and sewage treatment plant. Protests against connection to public wastewater disposal systems have taken the form of rallies, blockades and even hunger strikes (Naumann 2009: 159).

Fifthly, groundwater management is another way water utilities cope with decreasing water use. As a consequence of reduced water demand, groundwater levels are rising and causing problems of damp and even flooded buildings in Berlin. In response, BWB operates a number of wells in the city abstracting groundwater as a means to artificially lower groundwater levels and thereby protect surrounding residential areas (e.g. in Johannisthal and Jungfernheide) from damp or groundwater flooding.

Finally, water infrastructure planning is increasingly dependent on the detailed forecasting of future demand for water services. To this end, Berlin Water Company has developed a "Strategy for Drinking Water Supply 2040" as a basis for long-term infrastructure planning. The Brandenburg Ministry of Environment, Health and Consumer Protection is to establish a "demographic check" in order to ensure that demographic trends of depopulation and ageing are considered when planning investment in water infrastructures. Given the huge spatial disparities within the region (see Section 2.2, above) such "demographic checks" and forecasts need to be finely tuned to the specifics of individual sub-regions, communities and even neighbourhoods.

3.3 Institutional change and shifts in infrastructure governance

An emblematic example of responses to the third dimension of global change – liberalisation, privatisation and commercialisation – is the way the partial privatisation of the Berlin Water Company (BWB) in 1999 has affected infrastructure governance in the city. Private investors – the French multi-utility enterprise Vivendi (since 2003: Veolia) and the German energy supplier RWE – together own 49.9 percent of the company's shares, with the State of Berlin retaining the remaining share. The partial privatisation has had significant implications for the management

of the company and water supply and sanitation services in the city. This is apparent in new decision-making structures, greater profit orientation, new regulatory instruments and a reformed corporate philosophy (cf. Beveridge 2011, Hüesker 2011, Oelmann et al. 2010).

Decision-making in the restructured BWB is convoluted and based on agreements set out in contracts withheld from the public until recently (cf. Beveridge 2011, Hüesker 2011)³. It rests on the complex structures of the privatisation model implemented, in particular the principle that no major decision can be made without the agreement of both the private investors (Veolia/RWE) and the State of Berlin. Informal arrangements involving representatives of the private investors and the Berlin government were established to enable the shareholders to reach a consensus prior to the involvement of democratic bodies in the more official decision-making procedures. These secretive informal institutions have reduced the democratic legitimacy of Berlin's water policy despite the city-state still retaining a majority shareholding.

BWB's privatisation has led to a stronger profit orientation of the company and has been followed by substantial increases in water tariffs in Berlin which many attribute to the secret contractual arrangements concluded to secure a high selling price (cf. Hüesker 2011). Indeed, this profit orientation is built into the privatisation law and the secret contractual agreements between the public and private partners. In 1999 the privatisation law (§ 3) implemented a new system of water-tariff calculation based not only on total costs but also according to a specific calculative revenue. § 23.7 of the consortium contract (*Konsortialvertrag*), supplementing the privatisation law, guarantees the private investors a certain annual profit rate. Berlin's constitutional court, however, ruled in 1999 that such specific revenue could not be part of the partial privatisation law. The State of Berlin, as one of the own-

ers, has also sought to maximise the potential of the water company to make profits and has encouraged the commercialisation of BWB. Water consumers in Berlin today have to pay for this added calculative revenue, which amounts to about 25 percent of total water fees in the city.

Alongside the developments emerging from the privatisation of BWB, the State of Berlin has sought to tighten up the regulatory structure of the water sector (cf. *Hüesker* 2011). It has, for example, established new rules for government and parliamentary control of public companies, including the publication of managerial salaries, an annual administrative decision on water tariffs and the statutory implementation of a wastewater disposal concept now implemented in Berlin's new water law and public company law. It could, indeed, be argued that the State of Berlin needed the partial privatisation to strengthen instruments for regulating public companies. A growth of regulation in the wake of privatisation has been witnessed in other cases of water privatisation around the world, most notably in England and Wales (cf. *Bakker* 2005). There is a sense then that privatisation, through the tensions it exacerbates between notions of public and private, as well as between the economic, environmental and social values attached to water, has inaugurated a phase of re-regulation, which itself represents a form of institutional change.

4. Conclusions: Coping with Growing Uncertainty, Complexity and Contestation

This paper set out to answer three questions: firstly, how the three dimensions of global change – climate, socio-economic and institutional change – are impinging on the management of water infrastructures in a region affected by all three: Berlin-Brandenburg; secondly, how water and infrastructure managers in the region are responding to these manifestations of global change; and thirdly,

what conclusions can be drawn from both impacts and responses for the future governance of water infrastructure systems in the region. Rather than simply summarising the earlier sections this conclusion addresses the impacts, responses and their implications in terms of coping with growing uncertainty, complexity and contestation in the management of water infrastructure systems.

Our analysis of the impacts of global change on water infrastructures in the Berlin-Brandenburg region has demonstrated how each of the three dimensions addressed – socio-economic, institutional and climate change – is substantially affecting the content and style of water infrastructure management, albeit in very different ways. The effects of global change are even challenging some conventional assumptions and practices of infrastructure planners. Thus climate change is confronting water utilities with the need to plan for likely water shortages in specific areas and during periods of drought as well as for likely extreme flooding events on the basis of great uncertainty regarding the timeline, intensity and location of such phenomena. Similarly challenging is the persistent over-capacity of water and wastewater networks in those areas affected by processes of deindustrialisation and population decline. Infrastructure managers accustomed to expanding their networks to accommodate ever-increasing demand are being confronted with the highly unfamiliar situation of having to operate their infrastructure systems under conditions of long-term structural decline. The third, institutional, dimension of global change is manifesting itself in the Berlin-Brandenburg region not as the roll-out of a standard model of privatisation or liberalisation, but as a piecemeal process of selective and partial privatisation and gradual commercialisation. This process is highly contested in some communities, giving rise to popular protests, regulatory checks and even reversals to public ownership.

The paper has addressed each of these phenomena individually, for analytical reasons, but has repeatedly referred to the tensions and contradictions emerging between the impacts of socio-economic, institutional and climate change in the Berlin-Brandenburg region. We have emphasised that global change and its impact on water infrastructures is far from homogenous. Rather, it should be perceived as being a multi-faceted, contradictory and often conflictual set of processes. Whilst climate change threatens the region's water availability, requiring measures to secure water resources in the medium to long term, the over-capacity of many of the region's water and wastewater systems resulting from socio-economic restructuring is proving a serious disincentive to conserve water in the short term. Whilst over-capacities in water infrastructures call for substantial investments for retrofitting and/or greater collaboration with urban and regional planners, the commercialisation of water and wastewater utilities is making this increasingly difficult. Whilst the impacts of climate change and socio-economic change are demonstrating the importance of water infrastructure systems in protecting environmental resources and maintaining essential services at affordable prices, instances of privatisation in the region indicate how a strong profit motive and strict efficiency drives can jeopardise the pursuit of tasks in the public interest that exceed the statutory requirements of water utilities. These problems are compounded by intra-regional disparities which characterise the Berlin-Brandenburg region and relate, interestingly, to all three dimensions of global change. Thus climate change is likely to affect the water balance negatively in some areas of the region but not in others. Socio-economic change has led to deindustrialisation and falling population levels (and declining water use) in many rural-peripheral areas and former industrial towns, but to growth (and rising water demand) in the area surrounding Berlin. Piecemeal privatisation has accentuated the patchwork nature of the organisation of

water services in the region. In sum, the wide-ranging and deep-reaching processes of global change have often manifested themselves in small-scale changes in the region; changes which have heightened differences within the region. Indeed, one major outcome of global change in the Berlin-Brandenburg region has been an increase of intraregional disparities.

Reactions by actors of water infrastructure management to these regional manifestations of global change are characterised by huge diversity, reflecting widely differing perspectives on the challenges of global change. What is particularly striking is that those responsible for water and water infrastructures in the region are currently addressing each of the three dimensions of global change in isolation, but rarely treating their interdependencies and inconsistencies. Thus measures by state water regulators to accommodate the negative effects of climate change on water availability in the region take little consideration of the disincentives to save water emanating from responses by water and wastewater utilities to the problem of over-capacity in their infrastructure networks. Similarly, attempts to enrol water/wastewater utilities in programmes to regenerate cities or to improve the quality of water courses rarely consider how the willingness of these utilities to cooperate is heavily dependent on the commercial constraints within which they operate. Overlooking such connectivity leaves the region's decision-makers unprepared not only to deal with the kinds of inconsistencies and contestations illustrated in this paper but also, notably, to reap benefit from potential synergies that can be derived from a more integrative perspective on the multiple pressures affecting water infrastructures and their governance.

Considering the implications of the paper's findings for the governance of the region's water infrastructures, we can conclude that the development of effective institutional responses to the three dimensions of global change is

confronted by the following difficulties which need to be addressed more explicitly in future infrastructure management:

- The path dependency of water infrastructures: Due to the high proportion of “sunk costs” and the persistence of institutional structures, once made decisions cannot easily be reversed. The BWB privatisation contract, for instance, covers a period of 30 years. A great number of sewage networks in Brandenburg are already under-utilised now but require amortisation payments which will continue for many years to come. This path dependency of physical structures and institutional arrangements should neither be ignored nor taken for granted, but given due consideration in all strategic decisions.
- The temporal differences between present-day decisions and future problems: Utilities have to address the fact that their decisions have long-term, often unforeseen effects, particularly in the context of global change. Infrastructure planners are faced with major uncertainties about future climate impacts, the outcomes of socio-economic change and institutional development which need to be factored into future infrastructure planning.
- Increasing diversity and complexity: The diversity of climate, socio-economic and institutional developments poses a real challenge to the traditional modern infrastructural ideal of cheap, universal and standardised supply for everyone. Infrastructure planning has to cope with a decrease in total rainfall as well as an increase in heavy rainfall events, growing as well as shrinking numbers of population and private sector involvement alongside the continuing presence of municipal companies. This requires greater flexibility in the technical solutions and organisational structures and procedures adopted.
- The deep-seated logic of water infrastructure management: Developing successful regional institutional responses to global change requires a discussion about the logics of water service provision. The supply-oriented approach of building infrastructure to meet future (growing) demand is ill-suited to today’s decline in water use and to tomorrow’s uncertain impacts of climate change. The political functions and objectives of drinking water supply and wastewater disposal have to be re-defined to accommodate the challenges of global change. The reactions of regional stakeholders to date reflect growing contestation over what functions water infrastructures should serve and who should pay for them. Whilst water regulators insist utilities should protect water resources in the long term, the utilities themselves are demanding additional funding for conducting tasks which they deem exceed their statutory obligations for providing water services. An open discussion of the societal functions of water infrastructure systems and suitable ways of providing and financing them in the context of global change is essential to overcome this impasse.
- The multi-dimensional quality of global change: As we have stressed throughout the paper, the three dimensions of global change – climate, socio-economic and institutional change – are inherently heterogeneous, sometimes contradictory but ultimately overlapping in their impacts at the regional level. It is therefore necessary to tackle these dimensions simultaneously and in an integrated manner. Measures aimed only at one dimension of global change will overlook the complex dynamics of change and, as a result, are liable to fail.

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Notes

¹ In this paper we use “governance” as a generic term for all forms of coordination of collective and interpersonal action, including government agencies.

² Potsdam’s water supplier was partly privatised in 1998 and re-municipalised in 2000. The parent company Potsdamer Stadtwerke GmbH is still partly privatised.

³ As a result of a successful referendum in February 2011, the state of Berlin is obliged to publish all the privatisation contracts concluded under the partial privatisation deal of 1999. The Senate of Berlin published some previously secret privatisation contracts in November 2010 in response to an initial plebiscite but many critics maintain that additional contractual arrangements have still not been made public.

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- Summary: Managing Water Infrastructures in the Berlin-Brandenburg Region between Climate Change, Economic Restructuring and Commercialisation*
- Global change is posing a major challenge to existing forms of natural resource use, socio-economic development and institutional regulation. Although trends

such as climate change, socio-economic transformation and institutional change are global in their scope, they have very specific regional outcomes. Regionally distinct coping strategies are required which take into account both the diversity of regional impacts of global change and the local contexts of appropriate responses. This paper explores regional impacts of, and responses to, global change through the lens of a policy field deeply implicated in diverse components of global change: the socio-technical systems of water supply and sanitation. The management of water infrastructures is affected substantially not only by climate change (in the form of shifting rainfall patterns and the increasing frequency of extreme weather events), but also by the consequences of socio-economic transformation for regional water demand and by institutional changes, such as liberalisation, privatisation and commercialisation. All three phenomena are global in origin and scope, but each has impacts which are specific to particular national, regional or local contexts. In this paper we focus on the regional – i.e. sub-national – scale of water infrastructure policy and management as the most suitable for capturing the spatial scope of socio-technical systems of water supply and wastewater disposal. The purpose of the paper is threefold. Firstly, it seeks to map out the regional impacts of these three dimensions of global change for the water infrastructure systems of one region – Berlin-Brandenburg. Whilst most studies address merely one of these phenomena in isolation, the value here lies in highlighting all three as parallel – and partially interconnected – processes. Secondly, the paper explores how water and infrastructure managers in the region are responding to these dimensions and what strategies they are developing to this end. Thirdly, conclusions are drawn on the implications of both impacts and responses for the future management of water infrastructure systems.

Zusammenfassung: Wasserinfrastrukturen in der Region Berlin-Brandenburg zwischen Klimawandel, wirtschaftlichem Strukturwandel und Kommerzialisierung

Der globale Wandel stellt bestehende Formen der Nutzung natürlicher Ressourcen, sozioökonomi-

scher Entwicklung und institutioneller Gefüge vor erhebliche Herausforderungen. Obwohl Entwicklungen wie der Klimawandel, wirtschaftlicher Strukturwandel und institutioneller Wandel eine globale Dimension besitzen, haben sie sehr spezifische regionale Auswirkungen. Unterschiedliche regionale Auswirkungen des globalen Wandels erfordern damit sehr spezifische regionale Anpassungsstrategien, die die Heterogenität sowohl der regionalen Auswirkungen globaler Veränderungen als auch der jeweiligen lokalen Kontexte entsprechender Anpassungen berücksichtigen. Dieser Beitrag untersucht die regionalen Auswirkungen des globalen Wandels und mögliche Anpassungsstrategien am Beispiel eines Politikfeldes, das in mehrfacher Hinsicht unmittelbar vom globalen Wandel betroffen ist: den soziotechnischen Systemen der Wasserver- und Abwasserentsorgung. Wasserinfrastrukturen werden nicht nur entscheidend vom Klimawandel geprägt, etwa durch eine veränderte Verteilung des Niederschlags und die zunehmende Häufigkeit von Extremwetterereignissen, sondern auch von den Folgen sozio-ökonomischer Veränderungen, etwa für den regionalen Wasserverbrauch, und durch den institutionellen Wandel (Liberalisierung, Privatisierung und Kommerzialisierung). Alle drei Phänomene haben, obgleich sie globale Entwicklungen darstellen, spezifische Auswirkungen entsprechend ihrer jeweiligen nationalen, regionalen und lokalen Kontexte. Der folgende Beitrag wählt einen regionalen, sub-nationalen, Fokus auf die Planung und Steuerung von Wasserinfrastrukturen, da dieser den räumlichen Besonderheiten soziotechnischer Systeme der Wasserver- und Abwasserentsorgung am besten gerecht wird. Dabei werden drei Fragestellungen untersucht: erstens, die Frage nach den regionalen Auswirkungen der drei Aspekte des globalen Wandels für Wasserinfrastruktursysteme in der Region Berlin-Brandenburg. Während viele Arbeiten sich auf ein Phänomen des globalen Wandels beschränken, versteht der vorliegende Beitrag die verschiedenen Aspekte globaler Veränderungen als parallele und teilweise miteinander verbundene Prozesse. Zweitens widmet sich der Beitrag den Anpassungsstrategien, die regionale Akteure hinsichtlich der Auswirkungen des globalen Wandels entwickeln. Drittens werden aus Auswirkungen und Anpassungsstrategien Schlussfolgerungen für die künftige Planung und Steuerung von Wasserinfrastruktursystemen gezogen.

Résumé: Infrastructures de distribution et de traitement de l'eau dans la région Berlin-Brandebourg entre changement climatique, mutations économiques et commercialisation

Le changement global confronte les formes existantes d'utilisation des ressources naturelles, de développement socioéconomique et de structures institutionnelles à des défis majeurs. Bien que des évolutions comme le changement climatique, les transformations structurelles de l'économie et les mutations institutionnelles aient une dimension globale, elles ont des conséquences très spécifiques à l'échelle régionale. Ces différents effets régionaux du changement global rendent nécessaire la mise en place de stratégies d'adaptation très spécifiques à l'échelle régionale, qui prennent en compte la diversité des répercussions régionales du changement global et l'hétérogénéité des contextes locaux dans lesquels s'inscrivent les réponses appropriées. Cet article étudie les répercussions régionales du changement global et des stratégies d'adaptation envisageables. Pour cela, il considère l'exemple d'un champ politique concerné à plusieurs égards par le changement global : les systèmes socio-techniques de distribution et de traitement de l'eau. La gestion de ces infrastructures n'est pas seulement influencée de manière cruciale par le changement climatique, par exemple par suite de modifications de la répartition des précipitations et d'une fréquence accrue des événements climatiques extrêmes. Elle est également concernée par les effets des évolutions socio-économiques sur la consommation d'eau et par des mutations institutionnelles, telles que libéralisation, privatisation et commercialisation. Ces trois phénomènes (changement climatique, évolutions socio-économiques, mutations structurelles), même s'ils représentent des évolu-

tions globales, ont des conséquences spécifiques en fonction de leurs contextes national, régional et local respectifs. Cet article porte un regard régional sur la planification et la gestion des infrastructures de distribution et de traitement de l'eau. C'est en effet cet angle de vue infranational qui prend le mieux en compte les particularités spatiales de ces systèmes socio-techniques. Cet article traite trois questions. Premièrement, il considère les répercussions des trois composantes du changement global sur les infrastructures de distribution et de traitement de l'eau de la région Berlin-Brandebourg. Tandis que la plupart des travaux se limitent à un seul des phénomènes du changement global, cet article conçoit les trois aspects du changement global comme des processus parallèles et, en partie, interconnectés. Deuxièmement, le document examine les stratégies d'adaptation que les acteurs locaux développent en réponse au changement global. Troisièmement, à partir de l'analyse des répercussions et des stratégies d'adaptation, des conclusions sont tirées quant à la planification et la gestion futures des infrastructures de distribution et de traitement de l'eau.

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