Chapter 25 – Water Resources (revised version 15/12/2017)

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Introduction

You cannot step into the same river twice said Heraclitus of Ephesus 2500 years ago. Water is changing and so are the problems and challenges water governance faces. Water, literally the resource, is indispensable and not only humans need it to survive. Yet, human relationship to and with water has been a history of use and abuse. Drinking water, river navigation, irrigation, canals, cooling water for thermal power stations, dams, desalination or recreation are only a few among the many uses of water. Some regions of this planet have too much water, others suffer from water scarcity (Lehn and Parodi, 2009). Humans divert water, they pollute water and it has been subject to war, even more so in present times (Jones, 2010; Lossow, 2016). Water is also an economic good. We trade water in reality as well as virtually (Allan, 2011), we fill it in bottles and sell it. Yet, especially in developed countries people have lost touch with it. Although we all need it, people are more aware of the price of a litre of petrol or a pint of milk than the price for a litre of drinking water from the local supplier.

Water will be the medium through which climate change impacts are being felt and will be experienced. Climate change is projected to reduce renewable surface water and groundwater resources significantly, droughts will be more frequent and there will be impacts on streamflow and water quality. All this will intensify the competition for water among agriculture, ecosystems, settlements, industry and energy production, affecting regional water, energy and food security. (Bates et al., 2008; IPCC - Intergovernmental Panel on Climate Change, 2007; Jiménez Cisneros et al., 2014). Gosling and Arnell (2016) estimate that by 2050 the effects of population increases alone mean that 3.1 to 4.3 billion people will be living in watersheds exposed to water scarcity. Rockström et al. (2009) conclude that global manipulations of the freshwater cycle affect biodiversity, food, and health security and ecological functioning, undermining the resilience of terrestrial and aquatic ecosystems. Sustainable water governance, therefore, is a key challenge of the 21st century not least expressed in the Sustainable Development Goal 6 “Clean Water and Sanitation” (United Nations, 2016). Sustainable water governance is a precondition for successful climate change adaptation. Furthermore, rapid urbanisation and population growth put pressure on water resources. Infrastructure, access and allocation hence become crucial questions regarding

water governance. Successful adaption to climate change does not only include technical aspects – upgrading and maintaining supply networks or technological developments in water (re)use, it also entails the right policies, regulations, public participation and education. And because of the many uncertainties surrounding climate change issues, actors are facing the challenge of increasing the adaptive capacity of society and to deal with future unexpected changes. The IPCC claims that an adaptive approach can address uncertainty due to climate change if it includes techniques such as scenario planning, experimental approaches or the development of flexible and low-regret solution that are resilient to uncertainty (Jiménez Cisneros et al., 2014).

As a natural resource, water is notoriously capricious and its behaviour difficult to predict (Zwarteveen et al., 2017). However, water is not just natural but also highly social. It is after all human beings who make decisions about water, i.e. who gets what and how much. Water governance is defined as "the practices of coordination and decision making between different actors around contested water distributions." (ibid., p. 3) The aim of this chapter therefore is to highlight the different actors of water governance, how they are interlinked and what this means for climate change adaptation. To start with, the chapter reflects upon adaptive water governance. This means, looking at key challenges, relations to other policy sectors, and historical legacies as well as path dependencies in water governance, which can foster or hinder adaptation. This is followed by a brief characterisation of the main actors involved in adaptive water governance. The chapter concludes with case studies exemplifying current and future water challenges under climate change. The first example discusses drought and water scarcity management in the UK and how scenario planning could pave new paths to foster the resilience of the UK water sector. It thereby also highlights the use of co-development in the creation of new knowledge. The second example, climate change adaptation in a coastal area in Germany, highlights the role of psychological barriers to climate change adaptation. A third example discusses institutional challenges in South Africa, where water governance suffers from an implementation gap despite well meaning adaptation plans.

Adaptive Water Governance

Water is a global issue that needs to be tackled at regional or local level (Gupta and Pahl-Wostl, 2013). The same authors also conclude that the water crisis is foremost a crisis of

governance and they argue "that water governance is complex because it takes place against the background of changing governance trends and global change, and because it is simultaneously both a high-politics issue and a low-politics issue, a source of direct profit and indirect ecosystem services, and an economic, social, and political good" (Gupta and Pahl-Wostl, 2013). The differentiation between water governance as high-politics issue and low-politics issue takes us back to the initial statement in this section. Water is a high-politics issue because it is dealt with at global or rather international level. Many of the world's larger river basins are shared by more than one country and hence require political coordination at the highest level. In many cases this has been institutionalised in formal agreements such as the International Commission for the Protection of the Rhine or the Nile Water Agreement dating back to 1959. Yet, these agreements are contested with projects like the Great Ethiopian Renaissance Dam (Gascon, 2015). At the same time water is a low-politics issue. Water supply and waste water treatment are usually dealt with at a regional or local level. Water suppliers, private or public, provide water to a geographical confined area. A leaking or bursting supply pipeline is a local not a national matter. Furthermore, water is source of direct profits. Public or private water suppliers charge for water supply and waste water treatment. The food and beverage industry bottles water of different qualities and sells it on the market. Water is also a source of indirect ecosystem services. We do not only drink water but we swim in water, we sail on water, we walk along rivers or lakes for recreational purposes and we use water for fishing. Therefore, water is indeed an economic, social and political good or as Krueger et al. (2016) put it: "(…) water is at the same time a material, political, economic, and cultural entity (…)".

As mentioned in the introduction water governance faces challenges such as population growth and rapid urbanisation. This is exacerbated by the projected effects of climate change. As it is the case with the distribution of water on the planet, the projected effects of climate change differ from region to region (Jiménez Cisneros et al., 2014). Some regions will experience more water others less. Besides dealing with water quantity issues, water quality issues such as salt water intrusion will also become problematic. And if more people need to share the same resource issues of distribution, access and equity arise. Especially the latter should be recognised as distinct and central concern of water governance analyses (Zwarteveen et al., 2017). Another key issue is uncertainty, i.e. we do not know if the projected effects of climate change will happen and to what extent.

Three things follow from that. First, adaptive water governance needs to be flexible to take uncertainties into account. This may require paradigm shifts that can only be achieved through social and organisational learning (Warmink et al., 2017). Policies and measures must be flexible enough to be changed should it become necessary (Huntjens et al., 2012). Second, adaptive water governance means tailor made approaches. No two regions are alike and local or regional characteristics and contexts need to be taken into account (Gupta et al., 2013). Hence, policies should be based on the vulnerability and adaptive capacity of a region (Grecksch, 2015, 2013). Third, adaptive water governance relies on public participation and the involvement of all affected stakeholders during the planning and implementation phase of climate change adaptation measures. However, this also presents one of the fundamental challenges not just in water governance but in climate policy in general (Few et al., 2007). Often, we find a silo mentality and little if none collaboration with neighbouring policy fields (Grecksch, 2013).

Recently, the so-called nexus approach has gained prominence. Often referred to as the Water-Energy-Food nexus (WEF), it describes the relationship and interdependence between land, water, food and energy production. Water is not seen as a sector or issue area but as a cross-cutting issue, which requires changes in governance in all relevant sectors. “This is on the basis of the argument that water governance cannot itself regulate land, agriculture or other issues in society but that water issues need to be taken into account in each of these governance processes” (Gupta et al., 2013).

Water is different from other utilities such as electricity or gas. Water infrastructure is costly and investments are usually made for decades ahead. One the other hand the often quasi-monopolistic structure of water supply, i.e. in most countries people can only choose the water supplier that supplies the geographic area they live in, generates steady revenues for water companies. However, the UK for example is introducing competition in the water sector for business customers in April 2017 (DEFRA, n.d.). “Open Water” as the project is called enables businesses and organisations in England to choose which company will supply their retail water services similar to the competition customers are used to in for example the electricity sector.

The nature of water supply brings with it its own legacies and path dependencies that partially help to explain the slow changes in the sector. The history of public water supply is a history of changing regulations and ownership. Often starting as private businesses, many water companies were brought into public hands in the late 19th and early 20th century. From 1980 onwards we saw a privatisation wave that either resulted in full privatisation as for example in the UK or in a mixture of public, private or even public-private companies such as for example in Germany. In any case, privatisation is contested and has been critically reviewed (Bakker, 2014, 2007, 2005; Swyngedouw, 2005). These days we observe a shift again towards 're-municipalisation', i.e. bringing back water back into public hands (Pigeon et al., 2012; Robinson, 2013). A prime example is the city of Paris (Barraqué, 2012). But while ownership changed the infrastructure remained the same and with it the need for maintenance and continuing deterioration. For example in the UK, the water infrastructure in a number of urban areas is around 150 years old and in dire need of repair or replacement (Plimmer, 2017). Yet, building and maintaining water infrastructure, supply pipelines, dams, reservoirs is complex. Repairing or updating a supply pipeline for example requires closing off whole streets and causes disruptions to traffic and businesses. Planning and building new reservoirs takes years and involves complex regulations. While this may sound cumbersome it is actually a further indicator for the needs of adaptive water governance. Because water infrastructure is built for decades ahead and because it has wide reaching implications once given the go-ahead, adaptive governance measures such as collaboration across sectors and public participation are important.

In summary, water governance, the coordination, steering and managing of water across multiple levels is vital for each country, region or to be more precise, for each river basin. Better coordination and information across sectors and policy fields, improved participation of civil society groups and water users are two important pillars of water governance these days.

Actors

A crucial element, as emphasised before, is the involvement of non-state stakeholders in adaptive water governance processes. Public participation can also help to co-produce knowledge and to tap into knowledge beyond that of experts and researchers (Krueger et al., 2016). Yet, who is involved and who should be involved in adaptive water governance? Does

it vary depending on the level or the issue at stake? Governance opened up the space for more and new actors beyond the state. However, the question must be raised how those non-state actors are selected, if all actors have the same chances to participate and what factors are applied when choosing actors (Knill and Liefferink, 2007; Walk, 2008). Actors from the state are not the main actors within a governance process. They are one among others. Still, they enjoy a special status because they still possess two important things: sovereignty and legitimacy (Bache and Flinders, 2004). State and non-state actors are interdependent, which means they are part of a dense network.

Policy-makers

Although governance (see also chapter 10) implies turning away from the traditional top-down model of governing, it is still the state and its political institutions, which set the framework conditions in the form of laws and directives. What has changed though is the framework where these processes are embedded. While it used to be the domain of the state to pass laws and make policies, we can observe the tendency that more levels of decision making above and below the national state and more actors became important for rule making processes and rule implementation. (for a good overview over the development of the term and its implications: Bache and Flinders, 2004) Therefore, depending on a state's political system we find responsibilities for water at national level, federal level, local level and in various institutions such as water authorities, water agencies or water boards. Actors from the state are not the main actors within a governance process. They are one among others: "States are still among the main players on the global stages, but they are no longer the only main players." (Rosenau, 2004). Yet, they enjoy a special status because they still possess two important things: sovereignty and legitimacy. Even in the case of the European Union (EU), which has wide reaching powers in environmental issues, legislation often takes the form of framework directives. As the name implies this allows member states to adjust a directive into their political systems. For example, the European Union Water Framework Directive (EC, 2000), a milestone in European water politics according to Evers & Newig (2014). The directive tries to set a new standard, that of a good water status, and to harmonise water management and governance across a large region of the world thereby leaving enough room for country and region specific implementation. The directive emphasises the river basin approach, public participation and integrated water management. Take for example the German case where water management or water governance is highly embedded and

fractured into organisational hierarchies from the federal down to the local level. Even a wide-ranging legislation such as the EU-Water Framework Directive (WFD) is implemented in Germany within the existing water governing structures though the directive and its river basin approach call for a realignment of water authorities (Grecksch, 2007; Grünewald, 2008; Moss, 2003; Theesfeld and Schleyer, 2013; von Keitz and Kessler, 2008). Hence, due to the fact that environmental issues are dealt with at the level of the 16 federal states, there are 16 'interpretations' and subsequently different models of implementation of the EU Water Framework Directive alone in Germany. In each case they reflect path dependencies and administrative structures and hence responsibilities and the level of public participation vary. This example shows that the state is a main player and that it sets the scene for subsequent processes.

Utilities

Water companies, no matter if they are private, public or public-private, represent a crucial link in water governance. While policy-makers set the framework in the form of legislation, water companies actually provide water and treat waste water. Often they own or they hold a licence for the supply network, groundwater sources and water treatment works. They charge customers for water and they maintain the supply network. Due to the nature of water supply and its costly infrastructure, water companies have a quasi-monopole.

A subgroup within utilities, if they are private companies and listed at stock markets, are its shareholders. For example, Thames Water, one of the world's largest water suppliers serving almost 15 million customers in London and the south-east of England is currently owned by a number of different shareholders including Australian based Macquarie Group, the BT Pension Scheme and the Abu Dhabi Investment Authority. Shareholders have an interest in a profitable business although this may sometimes contradict water companies' responsibilities to provide public water supply to everyone bestowed upon water companies by the authorities. Yet, for investors water companies are a lucrative investment because after all everyone needs water.

Independent of its organisational structure, water companies face a series of challenges. A major challenge is rapid urbanisation and population growth. More people settling in cities mean more water demand in cities. This is both a water quantity and a water quality issue. It

increases pressure on water supply and waste water treatment. New ideas such as decentralised water management areas could be one solution. The system would be easily adaptable if people migrate to a certain area and it takes stress away from large centralised water management systems in urban areas. Another issue are urban flash floods, which easily overstretch the capacity of sewers and in a worst case scenario enable the spread of bacteria and diseases. Heavy rainfall events as a result of climatic changes fall into the same category as they are difficult to predict and quickly overburden the supply network. At the other end of the spectrum, i.e. scarcely populated rural areas due to people moving to cities water companies face challenges because the supply network was once built for a larger population. A problem that becomes evident in ageing societies of the west. This means more maintenance and regularly flushing supply pipes to maintain a healthy water quality and maintain drinking water standards. These problems exemplify a dilemma water companies face. In case of too much water due to heavy rain the answer could be to enlarge the diameter of the mains supply network. In the case of less water demand water companies could reduce the diameter of supply pipes. Yet, both solutions would come with trade-offs. Increasing the diameter would incur increasing costs for maintenance, decreasing the diameter comes with heavy costs for replacing the network in rural areas. At least in reaction to urban flash flooding innovative solutions are available. So called sustainable urban drainage systems offer a variety of innovations to prevent and alleviate urban flooding. A good example are 'waterpleins' in the Netherlands. These water plazas are designed as playgrounds yet act as temporary retention areas during or after heavy rain events. They are shaped like a cascading basin and water can gradually drain over the course of a few days after an extreme weather event (Biesbroek et al., 2014; Boer, 2010; Kleerekoper et al., 2012). Another issue water companies have to deal with is an ageing infrastructure. At least in industrialised countries the majority of water infrastructure dates back to the second half on the 19th century and the early 20th century. While this enabled better living conditions in rapidly growing cities, it is now a major challenge for water utilities to maintain, repair or replace an ageing infrastructure.

In the future, water companies could become leaders in sustainability by reducing energy consumption for water purification and waste water treatment. In Germany, where more than 6000 water suppliers deliver drinking water and treat waste water, the leverage of "greening the supply process" should not be underestimated according to Arnold and Pieper (2014).

Some water companies have even begun to install solar panels on reservoirs (BBC, 2016). This not only generates electricity that can be used for water treatment but it also reduces evapotranspiration and is an efficient use of space.

Regulators

The competencies of a water regulator depend on the structure of the water governance system. Generally speaking, regulatory bodies can for example oversee water pricing and water abstraction. With regard to water pricing they are a safeguard mechanism and have to balance the need for water companies to be profitable, if water companies are private, and water prices to be affordable for customers. This is due to the nature of the before mentioned quasi-monopole of water suppliers. Customers have no option but to choose the water supplier in the geographical area they are living in.

Regulating abstraction, i.e. how much water is abstracted from groundwater aquifers or rivers is another task for regulators. Usually maintaining a sustainable level of water abstraction is in the interest of a state. This encompasses for example groundwater recharge and maintaining minimum river flows. Regulators issue abstraction licences, based on hydrological modelling, to water companies or private persons who maintain a private water supply, usually a borehole. A license enables a licence holder to abstract a certain amount of water. Other issues regulators deal with are related to biodiversity and habitats protection and are closely linked abstraction licensing.

Customers and Consumers

Water customers and consumers can broadly be split into two categories – private and business. Private water consumers form the larger part in terms of numbers. Private customers use water for a variety of purposes. They use it for drinking, cooking, personal hygiene, washing clothes, dishwashing, cleaning and watering gardens. From a wider perspective people use water for swimming, fishing or boating. People pay for water, usually be means of a water meter, and water treatment. They are both consumers and customers. The latter is important because it also entitles them to certain rights with regard to service delivery and pricing. Private customers and consumers are also the main target of water efficiency campaigns. Reducing household demand is a major aim of policy-makers and water

companies. Water efficiency campaigns reach from using water efficient household appliances, water audits, providing water saving taps to educational programmes for schools.

Business customers form another major group of water consumers (see also chapter 23). Unfortunately, they are an often forgotten group. Kurland and Zell (2010) a "paucity of water-related studies" in top journals in this regard. Yet, almost every production process requires the use of water. For example, thermal power stations require water for cooling, the brewing industry uses large quantities of water as do drink and juice producers. Paper mills and the horticultural business are other examples of large water abstractors. Water goes into food production and is needed for cleaning. Innovations in this area are grey water (re)using schemes as not every industrial process requires the use of freshwater in drinking water quality. Businesses could cooperate in this regard for example one company could provide its waste water to another company instead of feeding it to the general sewerage network. Power stations are yet again a good example for the necessity of an integral view on water issues. First of all, thermal power stations (coal, gas and nuclear) use substantial amounts of water for cooling. Rising water temperatures and low river discharges can cause close downs of stations as for example in France in 2003 and 2009 (Jones, 2010). Another issue is the effect of power stations on water quantity and quality. Power stations take more water out of a river than they are returning to a river and they return warmer water to rivers or lakes, which could have an effect on aquatic life (Jones, 2010, p. 25).

Non-governmental organisations

All the large major environmental protection organisations deal with water related issues on a global or national scale. Yet, we find a large number of regional and local water related non-governmental organisations as well as organisation for the protection of habitats or certain animal species who have a stake in water protection. Often they operate at catchment level and profit from local knowledge and expertise. They often collaborate with policy-makers and water companies on specific issues or specific sites and localities. They form the collective voice of the interested public and they also help transform policies at a local or regional level.

Agriculture and Irrigators

Agriculture is by far the largest water consumer. Some 70% of the world's available freshwater is used for agricultural purposes (Jones, 2010). Irrigation is used to support the growing of agricultural crops or maintain landscapes in areas with insufficient rainfall (Rey et al., 2016). Irrigation therefore is a central element in the water energy food nexus. Yet, even without irrigation, agriculture uses water, for example to wash harvested fruits or vegetables. The availability of water is therefore crucial to the sector that needs to address uncertainty as well (Vermeulen et al., 2013). Irrigation is also contested because it is applied in regions with water scarcity. For example, the region around Almeria, in southern Spain produces a third of the European Unions' vegetables and fruit in one of the most arid climates in Europe (Custodio et al., 2016). Irrigators and agriculture represent emphasis that water is a cross-sectoral issue and sectors such as agriculture, planning, forestry, flood protection or disaster management should be included into adaptive water governance processes. However, each of these sectors represents a complex systems itself, creating overlaps and interactions (Ernst and Preston, 2017).

Examples

The aim of the following section is to exemplify some of the pressing issues in relation to water governance and climate change adaptation. The first example looks at drought and water scarcity management in England and Wales, highlighting the role of scenario planning and its emphasis on co-development of knowledge. The second example takes a closer look at a case study in Germany highlighting the role of psychological barriers to climate change adaptation. The third example reflects on implementation challenges and water governance in South Africa.

"Drought is a recurring feature of UK climate" (Marsh et al., 2007) and recent drought events were in 1975-1976, 1995-1996 or 2003-2004, 2004-2006 and 2010-2012. The main drivers are climatic changes, population growth and changing demand patterns. Further contributing factors are an aging infrastructure and high leakage levels. Within a research project that advocates a more risk-based approach to drought and water scarcity management in the UK (Link: www.mariusdroughtproject.org) drought management practice in England & Wales was reviewed and the results suggest to broaden the range of options considered, beyond those that are very directly indicated by the existing regulatory framework (e.g. such as leakage control, water supply restrictions during drought etc.). Currently employed drought

management options in the UK rely significantly on restricting water use in times of drought and are therefore, with the exception of elements of drought plans and water resources management plans, potentially too much focused on thinking about water scarcity in the context of actual drought events. (Grecksch, 2018a). In contrast, current literature on drought and water scarcity management suggests pro-active measures that focus on cross-sectoral collaboration, certain abstractor groups and option that stress the value of water (Farmer, 2012; Hanak et al., 2011; Kampragou et al., 2011; Nelson et al., 2008; Robins et al., 2017; Sayers et al., 2017; Wilhite, 2002).

Based on the review a scenario building workshop was carried out to elicit potentials for new drought and water scarcity management options in the UK (Grecksch, 2017). The IPCC highlights scenario planning as an adaptive approach to water management to reduce uncertainty (Jiménez Cisneros et al., 2014, p. 254). The workshop offered the possibility to co-develop explorative scenarios for resilient drought and water scarcity management in England and Wales in 2065 with stakeholders and the opportunity for unconstrained blue sky thinking about future drought management options based on the question 'What can happen?' This is against the background that UK Water Act 2014 introduced a so-called resilience duty to achieve long-term resilience of water and wastewater systems and service provision. Participants were drought and water scarcity stakeholders ranging from policy-makers, regulators, water companies to researchers (Grecksch, 2017, p. 4). The workshop developed four scenarios describing potential future pathways for drought and water scarcity management (see figure 3). What was interesting to note is that the list of key drivers, which subsequently form the basis for the development of the four scenarios, identified by the workshop participants reflects the deficits of UK drought and water scarcity management and also chimes with the key tendencies as identified by the literature and mentioned above. Thus, among the key drivers were items such as 'society's expectations towards water', the influence of 'extreme weather events', the 'alignment of flood and drought policy' or the 'willingness to share water (across regions)' (ibid., p. 14). However, applying such a method is not without problems and some participants struggled with the idea first of all, of blue sky thinking, i.e. not having a normative goal and second with thinking decades ahead into the future, in this case 2065 (Grecksch, 2018b, 2017). De Jouvenel (2000) identified the latter as a common problem of studies that deal with future developments though.

In the context of adaptive water governance a scenario exercise can contribute to the debate about potential future developments. It is a suitable method to integrate the views of different

stakeholders, and the development of four different scenarios could help addressing uncertainty by providing alternative pathways.

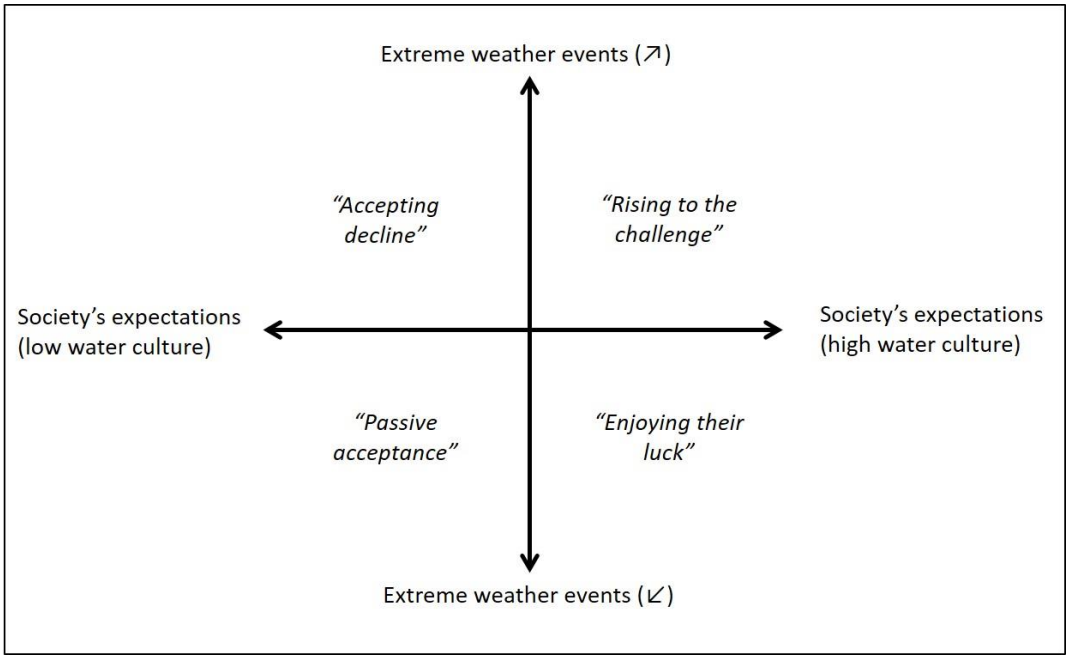


Figure 1: Resilient Drought and Water Management in England and Wales by 2065 scenarios (Source: Grecksch, 2017)

The purpose of the second example is to highlight psychological barriers to climate change. The example is part of a large scale study on the governance of adaption in a coastal region in north-western Germany (Garrelts et al., 2013). The study saw the application of the adaptive capacity wheel (ACW), an approach to assess the adaptive capacity of institutions (Gupta et al., 2010), to a variety of policy sectors – water (Grecksch, 2013), disaster management, spatial planning and coastal protection. In addition to the ACW, two new dimensions were added to the framework to reflect the perceptions and perspectives of those actors who make decisions about the realisation of adaptation measures (Grothmann et al., 2013). The first, adaptation motivation refers to the motivation of decision makers and other actors to realise, support and/or promote adaptation to climate change. The second, adaptation belief, refers to the ability of actors and decision makers to adapt to climate change. (ibid.) Both dimensions can become bottlenecks for adaptation if for example stakeholders underestimate their ability to adapt (ibid.). Only if key actors are convinced of the success of adaptation will it also be possible to activate the other elements of adaptive capacity. In the water case study, the two dimensions were rated medium and low respectively (Grecksch, 2013, pp. 808–809). For most stakeholders, climate change is on the agenda but not ranking particularly high and not

being part of the daily business. With regard to adaptation belief stakeholders stressed the difficulties they foresee when it comes to implementing adaption measures and blamed financial constraints and a lack of political will (ibid.). The example highlights that water governance is a social issue and that it takes the willingness of stakeholders to act upon climate change. If for example a stakeholder is not (yet) interested in climate change adaptation or not convinced about it, this could have implications for successful adaptation strategies.

The third example reflects on institutional challenges and water governance and draws on the experiences made during a study in a small river catchment in South Africa (Grecksch, 2015). Water governance in South Africa is a good example of a well-written water policy that unfortunately does not hold up to reality. The water governance system in South Africa is aligned along the three tiers of government – national, provincial and municipal. There is national legislation, a National Water Resources Strategy and while the provincial level has no direct competence over water affairs, the local tier of government is responsible for water services provision. They can either do it themselves or contract external water services providers. Water is managed along hydrological boundaries - Water Management Areas - supported by catchment management agencies and water user associations at local level. Furthermore, a water tribunal and a scientific advisory body exist. Thus, the legislative basis is good but successful implementation requires problem awareness, skills and good coordination within municipalities but also across the three tiers of government in South Africa. Claassen (2013) also concludes that: "The challenges in implementing progressive legislation is reflected in a shortage of skilled people, weaknesses in management instruments and difficulties in finding a balance between the role of the state and institutions and the effective function of networks to achieve development outcomes." Climate change may exacerbate already existing challenges in South Africa such as high unemployment, land use change and governance failures. Droughts and floods in recent years demonstrated the weaknesses of the water resource governance system, which include a lack of awareness, coordination, cooperation, financial resources but also human resources: "(…) it is important that councillors have a clear understanding of the implications and opportunities associated with climate change. Without council support, climate change response is unlikely to be taken forward sufficiently. It is vital that a dedicated councillor awareness programme be developed." (Amathole District Municipality, 2011). Based on expert interviews and literature and document review the study applied the Adaptive Capacity Wheel (Gupta et al.,

2010) to assess the adaptive capacity of institutions in the study region (Grecksch, 2015). Based on the results, the recommendations were to improve coordination across governmental levels and sectors and within municipalities. Water is a multi-level problem and it must be clearly defined, which governmental tier in South Africa has which role and function. Second, raise awareness among decision makers and the public by informing them about possible climate change effects and possible adaptation measures. Third, reduce the lack of political will and raise the belief in successful implementation of adaptation measures. All interviewed experts complained about the lack of financial resources to implement measures and they complained about the lack of political will, corruption allegations and party politics. Fourth, overcome lack of skills and lack of capacity among decision-makers. All analysed documents and interviewees either hinted or explicitly mentioned the need for stronger institutions and better institutional governance. Lastly, regenerate and incorporate traditional water knowledge especially in former homelands (Kapfudzaruwa and Sowman, 2009), a point that also hints towards more public participation in general.

South Africa is, as mentioned before, an example of a well-intentioned water policy, yet it lacks successful implementation. This is due to staff and skill shortages and but also due to path dependencies that reflect decades of politically induced power asymmetries (Kemerink et al., 2013; Méndez-Barrientos et al., 2016).

Conclusion

This chapter recapitulated some of the major themes, issues and challenges of water governance and climate change adaptation. Adaptive water governance was defined as coordination, steering and managing of water across multiple levels against the background of climatic changes and the uncertainties attached to that. The multifaceted nature of water governance, i.e. crossing policy sectors, the various uses of water, the different interests in water and the interconnectedness to other major challenges such as food and energy make water governance a challenging task. Water affects everyone but there is no panacea, instead solutions must be local or regional and tailor made to local or region economic, ecological and social characteristics. The different roles of stakeholders – policy-makers, utilities, regulators, water consumers, irrigators and non-governmental organisations were briefly described. The three examples showcased some of the key challenges of adaptive water governance but also how to overcome them. In the case of drought and water scarcity

management in the UK, scenario planning contributed to the debate about future developments of water management that addresses uncertainty. The second example emphasised the role of those stakeholders in water governance who make actual decisions about adaption measures and that psychological factor such as the motivation or the belief to adapt to climate change can be crucial when it comes to implementation. The third example highlighted the implementation gap in South African water governance. While very good on paper, in practice water governance is met by a lack of skilled staff, lack of political will and path dependencies that hinder a successful implementation. There are of course many more water governance aspects that deserve attention such as water footprinting (Hoekstra and Mekonnen, 2012) the debate around desalination (Jones, 2010) or more water education, expressed for example through the concept of "water literacy" (Yuto et al., 2014), to name only a few. However, they could not be reflected upon within the scope of this chapter.

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