Improving the resilience of water distribution agreements

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TRANSITIONS TO THE URBAN WATER SERVICES OF TOMORROW

Improving the resilience of water distribution agreements

TRUST report
Deliverable 23.2

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1. INTRODUCTION

Previous tasks in TRUST have explored adaptive capacity and adaptive potential in the context of the water sector and have offered insight to and guidelines for resilient, adaptive water management systems. The TRUST reports emanating from Tasks 21.2 and 23.2 for instance, provide analysis and recommendations on the extent to which companies can support transitions towards more sustainable Urban Water Cycle Systems (UWCS). The TRUST report from Task 21.1 defines the concepts of risk, resilience and vulnerability in the context of the water sector, while Deliverable 12.1 defined guidelines for adaptive strategic planning. Deliverable 23.2 draws on and further develops these outputs.

The aim of Deliverable 23.2 is to develop a conceptual model of sustainable and stable water governance arrangements, allowing water service companies and regulators to improve the resilience of water distribution agreements. Stability, in terms of distributive justice, is often seen as necessary for a viable community (Rawls, 1993). There are two types of movements away from stability: (1) those relating to desertion (i.e. the free-rider problem); and (2) the pressing for renegotiation of the justice contract. Therefore, instability, in this sense, reflects a level of dissatisfaction felt by individuals regarding a previously agreed set of distributive justice principals of water allocation. Without stability in allocation outcomes, frictions can emerge, promoting conflict and influencing perceptions of justice. By analysing competing theories and drawing on relevant case studies, the aim of this task has been realised. The report is structured as follows. A formal assessment of the dynamics between (i) the stability of water governance arrangements and (ii) the procedural and distributional justice considerations that determine how water is allocated is presented in Chapter 2. In Chapter 3, we examine water allocation procedures in two countries with contrasting water availability statuses. Chapter 4 provides an analysis of how the features of water governance systems relate to adaptive management theory. Evidenced conclusions on the strengths and weaknesses of various governance models as the physical systems they govern are exposed to unstable operating conditions (climate, demand, competing uses etc.) are drawn upon in Chapter 5. Lastly, a proposed concept for water managers and regulators on how water governance arrangements can be made fit for purpose to deliver its objectives and the needs of stakeholders effectively where (i) resource availability is highly variable, and (ii) there is rapid change in the nature of demand (uses, qualities etc.) is described in Chapter 6.

2. DYNAMICS BETWEEN THE STABILITY OF WATER GOVERNANCE ARRANGEMENTS AND THE CONSIDERATIONS THAT DETERMINE HOW WATER IS ALLOCATED

2.1. Water governance arrangements

Definitions of the concept of water governance vary. The Global Water Partnership (2002) describes it as the political, social, economic and administrative systems that are in place to develop and manage water resources and the delivery of water services at different societal levels. Likewise, Rogers and Hall (2003) specify that water governance is concerned with the political, social and economic organisations and institutions that are important for water development and management, as well as the functions, balances and structures internal to the water sector (internal governance). Tropp (2007) provides a wide-ranging review of water governance definitions. These can be summarised to describe water governance as the means by which decision-makers determine and act on goals regarding water resource use and service delivery. In practical terms, this involves designing appropriate policies and organisational frameworks and ensuring resources are available in order to effectively implement these.

Water governance arrangements set out the principals, policies and organizational frameworks through which water service providers (or other governance bodies) should use water resources and deliver water services to society. More specifically, they are used as a means to account for both water resource management and how people interact with each other and with institutions such as governments in relation to water resource use. In this sense, a change in water governance arrangements expectedly results in a change in outcomes for people, ecosystems and resources (Figure 1). This emphasises the importance of societal and industrial actors, governance procedures and resource management in shaping developments in water governance arrangements towards beneficial directions.

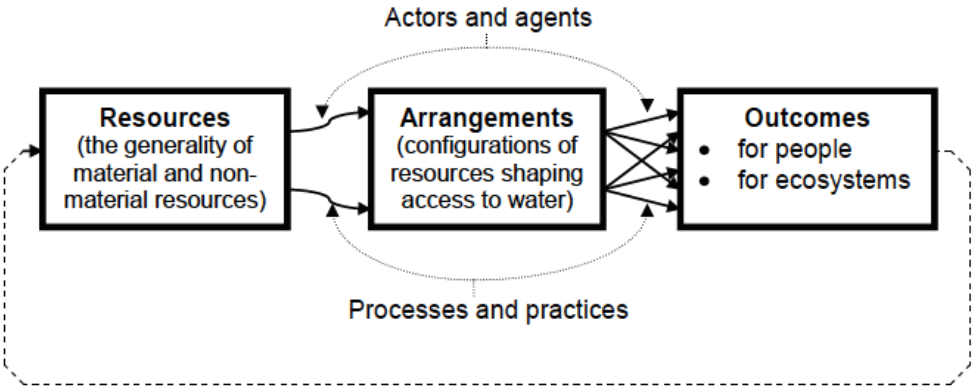

Figure 1. Changing water governance arrangements lead to changing outcomes and resources (Franks et al., 2013, p.7).

The nature of governance arrangements and their effectiveness reflects the context in which the water is being used (e.g. irrigation, drinking, industrial use) and at which scale (catchment, urban, national, cross-boundary). The resultant arrangements typically exhibit the structural characteristics of one or more modes of governance. Modes of governance are conceptualised in the governance literature on spectrums that are often described by the opposing ideal types of 'hierarchy' and 'market' (Figure 2) or 'centralised' and 'decentralised' governance structures (Figure 3). Between these types, further modes of governance have been identified, such as distributed and co-governance (Schneider and Kenis, 1996). These modes of governance are known as 'ideal types' because, in reality, only hybrid forms are likely to be found as one mode entails elements of another (Treib et al., 2005).

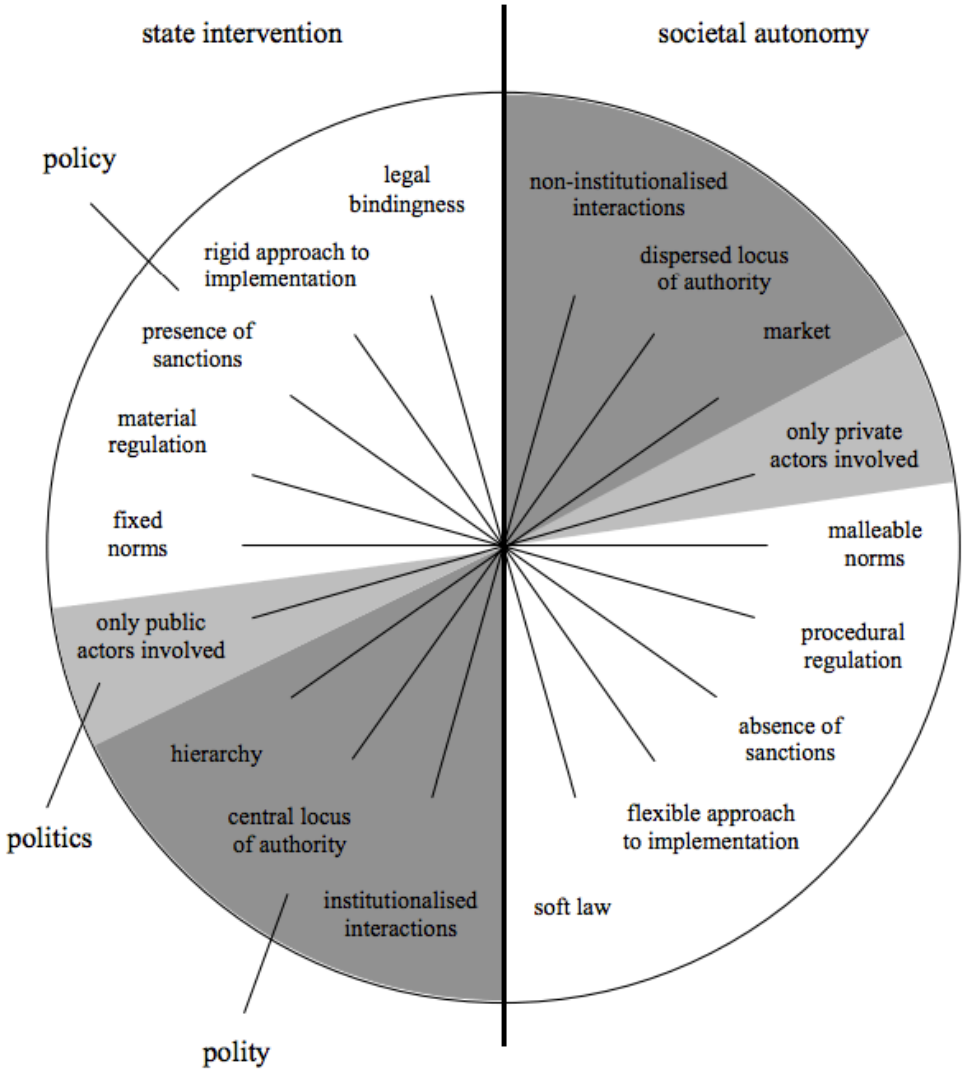

Figure 2. Conceptions of modes of governance (Treib et al., 2005, p.7).

Below we describe the governance modes that are of most prevalence in and relevance to the water sector. Note that this is not an exhaustive list and some governance modes have been grouped due to the encompassment of similar attributes and overlapping semantics (e.g. centralized, hierarchical, bureaucratic and top-down governance). There are also similar modes that have deliberately not been grouped in order to emphasise the inherent differences in their outcomes. For example, although bottom-up governance may be described as a polycentric mode of governance, it is a more specifically decentralised form (and therefore moves to the right on the centralisation-decentralisation continuum – Figure 3).

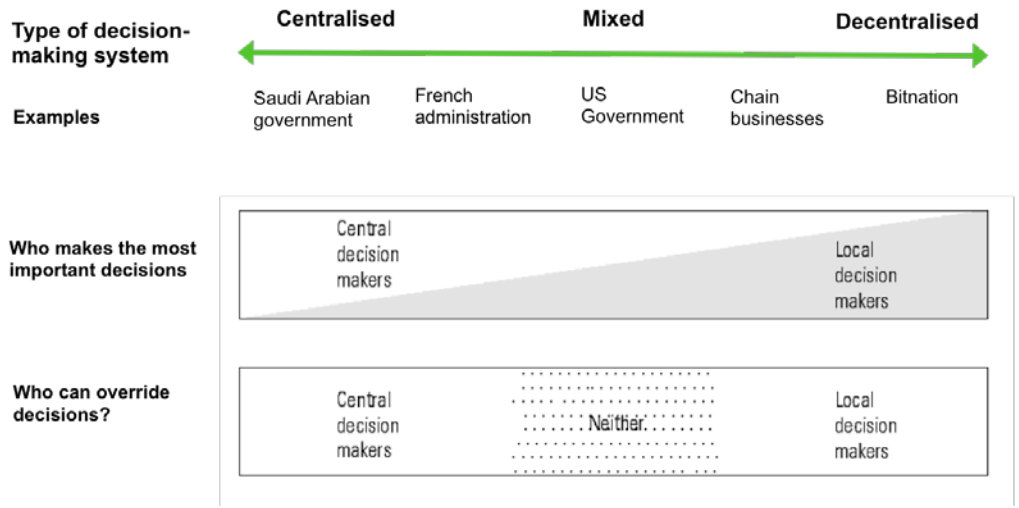

Figure 3. Centralisation-decentralisation continuum (modified from Malone, 1997, Figure 3).

- **Polycentric governance**

In polycentric governance regimes, authority and functions are distributed among several centres that relate with one another mutually under a general system of rules (Ostrom 1996). In this sense, it is a decentralized mode of governance. The process involves negotiations among stakeholders competing for resources and finding ways of providing services at different scales. The academic literature often views water governance arrangements as polycentric (McGinnis, 2011). For example, Thailand's 1997 Constitution gave authorisation for community involvement in managing local natural resources, which brought about the emergence of polycentric water governance in northern Thailand (Tan-Kim-Yong et al., 2002). This process included common property organisations that held resource rights based on local and state law.

- **Distributed and network governance**

Distributed governance (also termed network governance) is a form of polycentric governance that involves interdependent actors working together to deliver a public service. Decision-making is based on negotiations rather than the all-embracing rationality that governs hierarchical or centralised systems or the procedural reasoning involved in market-centric governance (Wang, 2013). Compliance is ensured through regulations and, gradually, behavioural norms.

- **Bottom-up governance**

Bottom-up governance arrangements allow stakeholders to provide input to negotiating, formulating and implementing policy (e.g. by ensuring public participation). This requires cooperation among multiple public and private sector actors in order to prevent the interactive and inclusive process from becoming meaningless in decision making (Edelenbos, 2005). In Europe, for example, the Water Framework Directive (WFD) advocates bottom-up governance as a model for a single system of water management by encouraging a focus on management by river basin geography, rather than according to political or administrative boundaries (EC, 2014). This approach fosters participation at the local level (Lockie & Higgins, 2007).

- **Co-governance**

Co-governance encompasses a participatory management process in which the decisions of stakeholders are recognised equitably. It therefore necessitates the development of non-centralized rules affecting the use and management of resources (Quilligan, 2013). In New Zealand, for instance, a co-governance agreement between the Te Waihora/Lake Ellesmere Management Board and Environment Canterbury was established in 2012 for both parties to share commitment to the restoration and management of Te Waihora and its catchment (Te Rūnanga o Ngāi Tahu and Environment Canterbury, 2012).

- **Self-governance**

Self-governance describes a community of stakeholders who can exercise power without intervention from any authority. It emerges (or is sought) in cases where geographic, religious or ethnic groups perceive that a national government does not represent them or where a monarch or colonial rule ceases. It also arises where land and water rights in terms of ownership and property rights are in dispute and, in terms of international law, the concept of national sovereignty (i.e. the self-governance of nation-states) is commonly observed and discussed (Rogers and Hall, 2003).

- **Centralized, hierarchical, bureaucratic and top-down governance**

Centralized, hierarchical, bureaucratic and top-down governance approaches take the form that each actor or entity involved in implementing a governance regime, with the exception of one, is inferior to another actor or entity. In other words, water resources are broadly

managed from a central bureaucracy. In comparison to polycentric governance, centralized governance (and similar) regimes can appear ordered and more comprehensive. Its structure can be observed in, for example, the hierarchical or vertical control of a state or government. This has been described as an increasingly out-dated form of governance (Kooiman, 2003); however, its fundamentals can be observed in bureaucratic governance regimes – i.e. the structures and formal contractual relationships within organisations.

- **Market-centric governance**

Where the focus is to maintain and promote market expansion and technological innovation, water governance arrangements can be classified as market-centric. This approach can result in growth in a defined water sector; yet, it can also lead to a rise in pockets of inequality and social opposition. Furthermore, market-centric governance can be high risk as failures in technology and the economy, along with environmental degradation become internalised and impact the system (Stephan, 2012). In the past two decades, private sector management, and commercial principles and practices have been instilled in the water sector in many countries (Bakker, 2010a). However, the existence of functioning water markets (where water is actually traded) has been dismissed, particularly for urban uses (Bauer, 2004; Castro, 2011).

The arrangements that are operationalised from these ideal-type modes of governance differ from one another in terms of the type and roles of actors, scope and levels of authority, legal basis, policy preferences and organizational elements (Menard & Saleth, 2012). In turn, the interactions of such specific components within arrangements affects institutional performance in the water sector (Saleth & Dinar, 1999). A change in any of these factors can therefore also affect the performance of the water sector as a service provider, as explored further in Section 3.2 below.

2.2. Changes to water governance arrangements

Research has discussed shifts in modes of environmental governance (Greenhalgh and Zaapagic, 2009) or recommended such shifts in order to achieve sustainable societal transformations (Van Zeijl-Rozema et al., 2008). For example, Driessen et al. (2012) set out to analyse and explain stability and dynamics in water governance in The Netherlands for the purpose of deriving recommendations for policy design. Based on influential bodies of literature for explaining policy change, these authors offer five key factors to explain shifts in modes of governance: a) physical circumstances (i.e. the environment, including population); b) infrastructure; (c) structural factors (i.e. rules and resources); (d) characteristics of agency (i.e. the capacity in the governing body); and (e) shock events (i.e. natural disasters, economic crises). Similarly, Rogers and Halls (2002) describe the forces that appoint changes in urban water governance as: (1) political shifts; (2) accessibility problems; (3) leakages/disruptions; (4) inequitable prices; (5) inflation; and (6) public debt. The relative stability of these forces determines expectations regarding accessibility, affordability, safety and sustainability of adequate water services.

In this section, we explore these drivers of change, but rather than prescriptively follow factors identified by Driessen (2012) and/or Rogers and Hall (2002), we incorporate aspects of their analysis that are most applicable to the European water sector and the subsequent analysis of water allocation that follows this section. We specifically explore four factors that drive changes in water governance arrangements, and can subsequently form the basis for evaluating the dynamics between the stability of such arrangements, water allocation, and varying levels of water availability. The four factors, (1) physical environment and infrastructure; (2) characteristics of agency; (3) socio-political and regulatory trends; and (4) rules (i.e. governing principles such as laws and/or traditional standards), are mutually dependent and internally related in the sense that the operation of water governance arrangements is driven by legal, social, environmental, physical and political mechanisms. Facilitating or constraining change in any of these factors can lead, in turn, to instability in water governance arrangements. How these factors can drive change in water governance arrangements is specifically outlined below.

Physical environment and infrastructure

Increasing urbanisation necessitates new and/or revised flood protection strategies and, typically coupled with this is, rising urban populations, which calls for spatial planning. Rather than a state centralized/decentralized mode of governance encompassing, perhaps, traditional water management actors (e.g. those in charge of water treatment), such changes to the physical environment require a form of distributed governance (i.e. to allow for the involvement of planning and project developers, regional water authorities, local and regional governments etc.). Likewise, the strengthening of infrastructure is frequently part of regional and national climate change adaption strategies, which can entail similar amendments to water governance arrangements (Dupuis and Biesbroek 2013).

Characteristics of agency

Water service providers (and other governance bodies) can strive to either instil or resist change (e.g. through provision or isolation of resources, skill sets and knowledge levels and encouragement to change), which may ultimately impact on stability. Change, in this sense, may be brought about by, for instance, resource allocation (marketization), measures to enhance user participation (decentralisation) and/or performance incentives/sanctions (commercialisation) (Furlong, 2010). Examples of such practices are illustrated in Table 1. The change can be related to a desire for improved corporate performance, due to the recognition of a strong causal relationship between overseeing the direction and management of a business (corporate governance) and corporate performance (Scottish Government, 2014). Furthermore, the policy literature often attributes the accomplishments of robust organisations in the water sector to 'good' governance and describes changes that can be made in order to attain this goal (Grindle, 2007). It is notable that good governance in itself is inherently normatively driven, for example, the good governance agenda in response to the Washington Consensus (Santiso, 2001), which focuses on 'getting institutions right' for market-based (water) systems and shows that 'agency' is not value-free, but occurs in an ideological framework (whether market-based, government-led, or otherwise).

Table 1: Examples of water sector governance reforms relating to the characteristics of agency (Bakker, 2014)

GOAL OF REFORM	TYPE OF REFORM	EXAMPLE FROM THE WATER SECTOR
Resource allocation	Marketization	Introduction of a water market in Chile (Bauer, 1998).
Performance incentives/sanctions	Commercialisation	Commercial principals introduced (e.g. full cost recovery) in water management in South Africa (McDonald & Ruiters, 2005).
User participation	Decentralisation or devolution	Devolving water quality monitoring to lower orders of government or individual water users in Babon River, Indonesia (Susilowati and Budiati, 2003; Bakker, 2012).

Socio-political and regulatory trends

As mentioned previously, national sovereignty, political ideology, and social values all have a role to play in the shaping of water governance arrangements; as is also the case for instance with property rights, economic crises, or corruption (Rogers and Hall, 2003). There may be socio-political pressures or aspirations to improve the effectiveness of water management, and therefore stakeholders, bodies or countries lobby for high-level institutional changes to governance arrangements. For example, at the 2001 International Freshwater Conference in Bonn, water governance was identified as the most important area for action (UN, 2001). State representatives in attendance at the Bonn conference also proposed that countries should have appropriate water governance arrangements in place for managing affairs at all levels and, where feasible, to accelerate water sector reforms (Rogers et al., 2005). Tropp (2007) points out that such changes have tended to lead to either basin-based decentralization (e.g. in the case of countries prioritising their obligations to fulfil the objectives of the European Water Framework Directive), or more market-based governance arrangements with increased cost recovery and user and private sector participation. Important or proposed changes in water governance may be observed when an authority perceives water sector reform will bring political and social benefits, which may occur after political change or to influence votes before an election (Menard and Saleth, 2012). However, the process of reversing, for instance, market-based policies on a large-scale, is a difficult feat and may be undesired by stakeholders.

Rules

Due to the relationship between water governance arrangements and other institutional arrangements, Saleth and Dinar (2006) suggest that no particular arrangement is effective in all contexts regarding urban water governance. This raises difficulties for decision makers and, whether their goals are financial, political, equity, sustainability, the stability of governance arrangements are likely to be impacted. In some cases the law reinforces or retracts from this stability. For example, in the Netherlands, the Dutch Water Law reinforces the precise responsibilities of Rijkswaterstaat and regional water authorities (Van Rijswick and Havekes, 2012; Driessen et al., 2012).

2.3. The procedural and distributional justice considerations that determine how water is allocated

Water allocation refers to the rules and availability considerations through which access to water is decided for individual or communal use. In making allocation decisions, governance bodies apply procedural (whether formal or informal) rules. With regards to why decisions are made, Vermunt and Tornblom (2006) identify the following three dimensions to procedural rules that affect whether or not justice is deemed to be realised:

(1) **Structural** – pertaining to whether the procedures through which decisions are made form part of a nation's, organisation's or other entity's legal framework.

(2) **Cultural** – a water service provider (or other governance body) may have a culture of working with local governments or other stakeholders to exploit opportunities and work together or they may have a closed off system whereby stakeholders cannot participate. 'Culture' can also refer to the way in which management views evidence and makes subsequent decisions – for instance, decisions could reflect proprieties based on profit, the environment, political reasons etc.

(3) **Personal** – this includes the ways decisions are communicated to the people affected by the procedure, which may or may not do justice to these people.

One of the earliest studies that sought to relate procedures to justice evaluations was conducted by Thibaut and Walker (1975). They observed that stakeholders were more satisfied in an adversarial legal system (i.e. involving a jury) than the stakeholders in a continental legal system (i.e. relying on one or more judges to investigate a case). Thibaut and Walker suggested that the adversarial system appeared to allow both parties in a dispute to have some control over the outcome – and thus stakeholders perceived that this increased their likelihood of receiving a positive outcome. More recently, Tyler and Lind (1992) studied the role of procedures in group behaviour. They hypothesized that being able to raise an opinion within a group or society is viewed as an indicator of self worth within that group and that it partially reflects the rewards that that member will gain from group decisions that are made.

Distributive justice refers to the fairness of an allocation outcome. What is perceived by a customer or consumer as being a just allocation or route to access can depend a number of factors, including:

(1) **Need** – those who need more water, from a distributive justice perspective, should be allocated more than those who already have a sufficient supply.

(2) **Expectations** – whether the outcome is perceived by the receiver as a gain or a loss (i.e. unbiased division is likely to be seen as fair by beneficiaries who view what they receive as a gain).

(3) **Reputation of supplier/governance body** – if there is a good relationship between the giver and receiver and the supplier is viewed positively, then the level of equity is likely to be viewed as fairer (and vice versa).

(4) **Supply** – depending on how water is managed and how much is available, the justness of the allocation outcome may be thought of differently.

(5) **Stability** – without stability in allocation outcomes, frictions emerge, promoting conflict and influencing perceptions of justice.

Of the dimensions listed above, stability renders further comment, as it is a key thematic component of the prescriptive literature on distributive justice because its achievement is widely seen as a prerequisite for a viable community (Rawls, 1971, 1993). Within a distributional justice context, movements away from stability have been characterised as being either: (a) those resulting in a tendency to defect (e.g. the free-rider problem); or (b) those resulting in a tendency to press for renegotiation of the justice contract. Therefore, instability is a reflection of the level of satisfaction felt by individuals with regard to a previously agreed set of justice principles. The ramifications of these two types of instability impact upon contrasting areas of society. Instabilities related to the free-rider problem are evident primarily in social and economic settings where individuals seek to reap the benefits of a just distribution arrangement without fulfilling the agreed duties. Contrastingly, instabilities of the second type (a tendency to press for renegotiation) constitute a prime stimulus for political activity. Indeed, changes of policy or government in democratic settings and revolutions in totalitarian settings can be viewed as the process of such renegotiation. It is interesting to note that within the descriptive literature, these two problems are often referenced but rarely discussed, although the former does receive expansive attention from other research fields such as game theory and micro-economics (see, for example; Dawes & Thaler, 1998; Andreoni, 1988; Kim & Walker, 1984). A challenge here for water service providers is to promote greater stability by exposing a framework within which instability in water allocation mechanisms can be reconciled.

In terms of combined procedural and distributive justice considerations in water allocation mechanisms (referred here forth as 'allocation criteria'), these vary depending on the complexity of the allocation task (location, government interventions) and pressures (demand, availability, financial, environmental) on the resource (Roa-García, 2014).

Greenberg and Colquitt (2005) provide an overview of the theoretical models that have been developed to explain distributive and procedural justice evaluations. The following paragraphs examine three factors that strongly influence the dynamics of how water is allocated in the water sector.

Stakeholder priorities

The criteria for distributing water resources for drinking may differ vastly depending on stakeholder priorities. This means that a period of water scarcity could be matched with an allocation criterion based on priorities. For instance, in the case of irrigation versus domestic use - in Southern Spain, the agricultural sector is the biggest water resources consumer (Reca et al., 2001). According to Reca et al. (2001), the hydraulic policy measure taken to help with this is the construction of hydraulic regulation works (i.e. dams) in order to increase water resources (i.e. supply development). In this case, water is distributed to stakeholders according to their rights – and not according to economic efficiency in water use. In other cases, for example in market-centric (or similar profit driven) governance arrangements, a higher economic profitability of the water may result in greater allocation to a specific group of users.

Reliability of supply

Distribution criteria may undergo modification dependent upon the amount and quality of water available, with a distinction being made between conditions of surplus, sufficiency, quality fit for purpose and scarcity. For instance, access to better quality water might be judged on different grounds from access to more water. This is perhaps an obvious area where greater diversity could be built into water resource distribution policies. A suitable policy in this respect may match allocation criteria with resource availability through any one of a range of mechanisms. Periods of sufficient supply might be reflected by an allocation criterion based on equality.

Equity

Periods of plenty and periods of scarcity may attract an allocation criterion based on equity. Equity theories propose that a distribution occurring within a relationship will be equitable and just when the relations between the inputs brought into the relationship and the outcomes strived for in the relationship are perceived as being equal for all participants. However, the manner in which water is used differs (in terms of quality and quantity needed). Therefore, it could be argued that the equitable amount of water given should be directly proportional to the use such that there is no wastage or undersupply of the commodity. If an equal share of water is a human right or is considered common law, anti-water privatization advocates have raised the question as to whether private, for-profit multinational water corporations running networked water supply are compatible with such principles. However, the status a human right conveys upon a resource is unclear. For example, the UN's Committee on Economic, Social and Cultural Rights define water as a commodity as well as a cultural, social and good (ECOSOC 2003). In this sense, Bakker 2007 and 2010b highlights that because human rights stem from an individualistic, libertarian

philosophy, they are compatible with capitalist political economic systems – and therefore water rights, as currently embedded in international law are, compatible with water privatization or other types of market-based management.

2.4. Dynamics between the stability of water governance arrangements and how water is allocated

By examining the dynamics between the stability of water governance arrangements and water allocation considerations, a more complete picture of the potential impacts of allocation decisions and changes to governance arrangements on subsequent attitudes and behaviour can be made. This can help water service providers to anticipate drivers for change. Table 2details associations between the factors that affect the stability of water governance arrangements and water allocation criteria, and Table 3 provides an additional analysis of the relative strength of associations between the influencers of dynamics that are detailed in Table 2.

Table 2: Associations between the factors that affect the stability of water governance arrangements (row headings) and water allocation criteria (column headings).

	PHYSICAL ENVIRONMENT AND INFRASTRUCUTRE	CHARACTERISTICS OF AGENCY	SOCIO-POLITICAL AND REGULATORY TRENDS	RULES
Stake-holder priorities	Pressure on governments to take more responsibility for flood, drought and climate change risk management has increased (Driessen et al, 2012), e.g., the 2014 financial investment into flood protection infrastructure in the UK as a result of recent rainfall events. This affects governance arrangements and has associated impacts on allocation criteria set out according to stakeholder priorities. Stakeholder views often need to be incorporated into plans and therefore the means by which decisions are made.	Having the capacity and a willingness to change governance arrangements within an organisation can in part depend on stakeholder priorities in terms of water allocation (Giddens, 1984; Furlong, 2010). The underlying governance model would also influence this – e.g. market-centric versus a bottom up governance model.	Socio-political influence to change water governance management may aim for high-level institutional change to governance arrangements (UN, 2001). This instability can be influenced by stakeholder priorities (Menard and Saleth, 2012). The change to water governance arrangements for these reasons can then have knock-on dynamics to stakeholder priorities allocation criteria.	Laws, for instance in times of economic crisis or property rights, are influenced by stakeholder priorities (Rogers and Hall, 2003), which in turn can dictate both governance arrangements and allocation criteria depending on stakeholder priorities.
Reli-ability of supply	Supply development measures have been taken to improve the reliability of water supplies in response to physical environment changes and, in some cases, aging infrastructure. For example, in southern Spain, hydraulic regulation works (e.g. dams) have been constructed to help increase water availability for domestic use (Reca et al., 2001).	Progressive strategies, according to Bakker (2010a) are those that reform state governance while fostering and sharing different models of local resource management. In The Netherlands, for instance, the report of the Second Delta Committee was released to determine how to deal with climate change consequences. A Delta Fund was subsequently established and a Delta Commissioner appointed (Delta Committee, 2008).	Distribution criteria may undergo modification dependent upon the amount and quality of water available, which is most evident during conditions of surplus, sufficiency, quality fit for purpose and scarcity (Foa & Stein, 1980).	Although stability, in terms of governance, is often referred to in the literature as 'lasting agreement', distributive justice arrangements may include a waiver to allow the alteration of previously fixed criteria under certain circumstances – e.g. under conditions where reliability of supply is threatened.
Equity	In times of flooding, or where changes to water governance arrangements are driven by the physical environment and infrastructure, allocation criteria is more likely to be seen as just based on levels of equity. The opposite would apply where governance arrangements are, for instance, heavily centralised.	The level of equity (in terms of water distribution criteria) one agency is prepared to accept or seek to implement can depend on the wider goals of an agency (and subsequently the stability of its water governance arrangements) and whether it has positive relationships with government, public and other agencies. During the 19th Century in the Netherlands, for instance, the changes made to water governance demonstrated on-going opposition between the provinces, the water boards and central government.	The role of the consumer (a customer, or a community member), the media and government entails different rights, demands, responsibilities and accountabilities (Bakker, 2010a). Therefore trends or changes in what these roles entail can place pressure on the stability of water governance arrangements and influence the equity (or perceived equity) of allocation criteria.	Equity, by its very nature, should be unaffected by law and incorporates everything with or without law (Hudson, 2009). However in practice today, this can be overwritten by rules and where conditions are bound by legal statute e.g. EU countries bound by the WFD. Procedural justice in some countries is held by cultural premises that emphasise a legal treatment, which may not hold elsewhere (Törnblom and Vermunt, 1999).

Table 3: General analysis (from the perspective of European water service providers) of the relative strength of associations between the influencers (or drivers) of dynamics in Table 2, showing high (red), medium (orange) and low (yellow).

	PHYSICAL ENVIRONMENT AND INFRASTRUCUTRE	CHARACTERISTICS OF AGENCY	SOCIO-POLITICAL AND REGULATORY TRENDS	RULES
Stakeholder priorities				
Reliability of supply				
Equity				

This Chapter has focused on exploring various water governance arrangements and assessing the factors that affect their stability and how they influence water allocation criteria. In the following Chapter 3, we introduce two case studies countries with contrasting water availability statuses and investigate how the different water governance arrangements are operationalised in these counties.

3. COMPARISON OF WATER ALLOCATION PROCEDURES IN A WATER SPARSE AND A WATER ABUNDANT COUNTRY

Challenges in water allocation that lie ahead include the provision of adequate water supplies for increasing populations and housing, ensuring water abstraction is more sustainable and compliant with legislation and international agreements, and mitigating and adapting to the potential effects of climate change (CIWEM, 2012). Below we examine two countries with contrasting water availability statuses: (1) England, which has little or no water scarcity; and (2) Yemen, which is an area of physical water scarcity (Figure 4). Table 4 provides a comparison of water allocation mechanisms and outcomes in England and Yemen. It is accompanied by Table 5, which describes various rights that are conferred as a result of water allocation procedures.

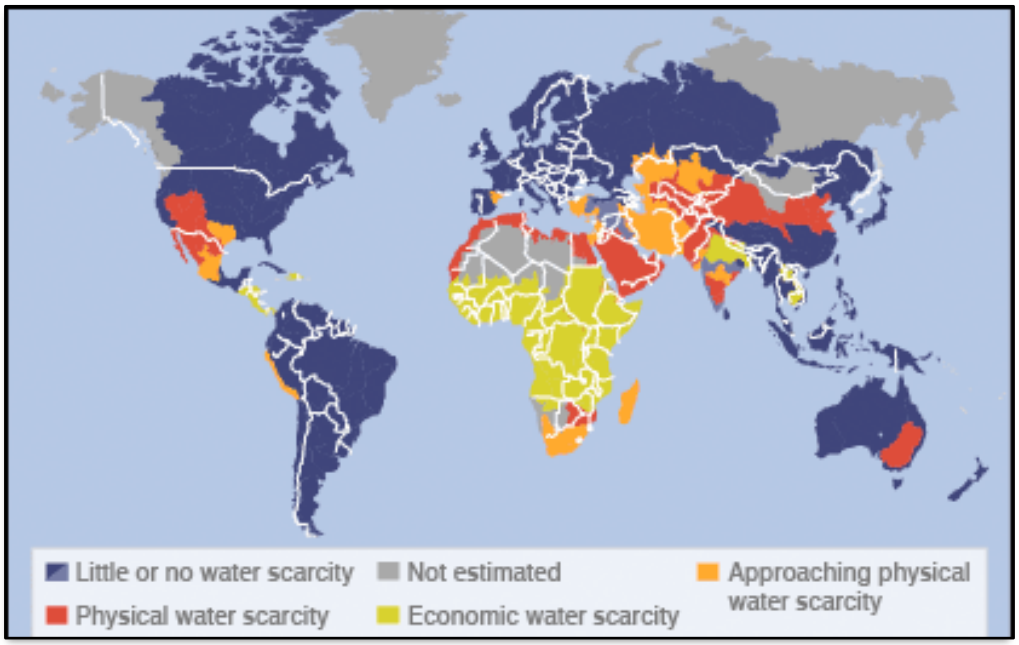

Figure 4. Global areas of physical and economic water scarcity (Comprehensive Assessment of Water Management in Agriculture, 2007).

England

In England, water resources management is governed mostly by the water abstraction and impoundment licensing system and public water supplies are fully privatized (Table 3). This full privatization is coupled with laws prohibiting the disconnection of residential consumers and a strong regulatory framework for price and quality controls (Bakker, 2007). The arrangements are in notable contrast to the rest of the UK, where water service providers in Northern Ireland and Scotland are not independent from the Government. Water companies

in England have a statutory duty to provide domestic and non-domestic customers with an adequate supply of water for household and business purposes – and plan to ensure that future demands can be met. Statutory provisions are laid out by the Water Act 2003, which requires providers to produce water resource management plans every 5 years.

The English population is fortunate to have extensive freshwater resources. Domestic water use is approximately 145 litres/capita/day in 2008/09 (Environment Agency, 2009) and the total water supply for all customers in England and Wales is approximately 14.5 million cubic metres per day (Water UK, 2010). The absence of temperature extremes and rainfall during much of the year, typically without long drought periods are characteristic for England. The potential effects of climate and population change need to be an integrated consideration here as it is essential to consider whether England will have an adequate water storage capacity to provide a continuous supply of drinking water for commercial and domestic premises.

Yemen

The Yemen is located on the Arabian Peninsula and is encased by the Gulf of Aden and the Red Sea with a semi-arid to arid climate. The average annual rainfall ranges from 200mm in the highlands to 50mm in the largest part of the country, which makes it the most water scarce country in the Arab Nation (Van der Gun et al., 1995). Severe water scarcity is a key challenge in water management in Yemen. It is estimated that more than 90% of water abstraction in Yemen is for agricultural use and little more than 1% for industrial use (Naji & Ahmed 2009). The population is projected to increase by 74% by 2030 (IFAD 2009).

Yemen has two major types of social and legal systems relating to water allocation: tribal 'urf (customary) and Islamic law. Islamic law rules that surface water that is not contained belongs to nobody. Because, generally, less water is contained upstream, downstream ownership not only has a greater degree of legal protection (Kohler, 2000), but also a vastly greater supply of water. However, regarding customary law, the traditional water rule Al a'la fa al a'la dictates that upstream users of irrigation systems should have priority (Lawrence & van Steenbergen 2010). This has meant that water allocation has often been controlled by elders upstream (Varisco, 1983). Both rules clearly conflict with each-other (Table 4).

In 1996, Yemen established the National Water Resources Authority (NWRA) by separating (and consolidating) the water policy and planning function from the High Water Council (which since ceased to exist), the water resources assessment function from the Ministry of Oil and Mineral Resources, and the water monitoring function from the Ministry of Agriculture. Independent agencies represent the water using sectors (i.e. the General Authority for Rural Water Supply Projects - GARWSP, Ministry of Agriculture and Irrigation - MAI and Local Corporations - LCs). However there is little collaboration among the separate bodies and the arrangements do not address the challenge of reallocating water from thousands of well-owners. Yemen's water is over-allocated and it is challenging to reallocate from agricultural uses to high-value municipal and industrial uses. The reality is that decisions about water allocation are effectively heavily decentralized to hundreds of thousands of well-owners (i.e. water users at the local level). This arrangement could

possibly be changed through market-based private sector participation, particularly because no public agency or planning structure in Yemen has succeeded in doing that thus far (Rees 1998). However, Yemen Water may not be in support of a market-based private model as, in 2010, it reported that privatization, the exclusion of marginalized groups and reallocation of water to urban areas are viewed by Yemen Water as water management flaws.

Table 4: Comparison of water allocation mechanisms and outcomes in two countries with varying degrees of water availability and water governance systems.

	FORM(S) OF WATER GOVERNANCE ARRANGEMENTS	PROCESSES OF WATER ALLOCATION AND FORM OF WATER GOVERNANCE REGIME	WATER RIGHTS GENERATED BY THE ALLOCATION PROCESS	WATER SERVICE PROVIDER(S)	REGULATORY FRAMEWORK/ DISTRIBUTIONAL JUSTICE PROTECTED BY	ALLOCATION AND DISTRIBUTIONAL JUSTICE CONFLICTS
England	Market-centric, multilevel governance	Market-based allocation, central-authorisation	Use, timing, duration and ownership, quantity, quality, assurance (Table 5)	Anglian Water; Northumbrian Water; Severn Trent Water; Southern Water; South West Water; Thames Water; United Utilities; Wessex Water Yorkshire Water; Affinity Water; Bristol Water; Cambridge Water Company; Cholderton and District Water Company; Dee Valley Water; Essex and Suffolk Water; Hartlepool Water; Portsmouth Water; Sembcorp Bournemouth Water; South Staffordshire Water; Sutton and East Surrey Water	1. Water Services Regulation Authority (Ofwat) - economic regulator 2. Drinking Water Inspectorate – quality regulator 3. Environment Agency	Social opposition can arise where personal finances inhibit adequate supply. Also because the resource is a purchased commodity, supply expectations are high and therefore so too is the feeling of injustice when system failures occur
Yemen	Centralised and self-governance	State administration (Islamic Law), traditional law (Tribal *'urf*)	Use, duration and ownership, transfer (Table 5)	National Water Resources Authority (public body), which distributes to the water using sectors (i.e. the General Authority for Rural Water Supply Projects - GARWSP, Ministry of Agriculture and Irrigation - MAI and Local Corporations - LCs)	1. Multi-layer legal system 2. Water Policy Framework	Allocation conflicts within a single catchment, i.e. in intra-catchment conflicts about irrigation-water between farmers upstream and downstream

Table 5: Descriptions of the various water rights that are conferred as a result of water allocation procedures (Table 4). These describe the extent of the use and control rights conferred to the user. Note that their nature (licenses, permits, access) varies in different jurisdictions (WWF, 2007).

ATTRIBUTE	DESCRIPTION
Quantity	The amount of water the holder of the right may abstract
Quality	The water quality to be abstracted or disposed of
Source	The specific resource and location from which the right is awarded
Timing	Restrictions on the time that the right applies, i.e. times that the volume may be abstracted
Assurance	Some rights are absolute – 100% guarantee of a certain quantity and quality, while other rights have variable assurance of supply and quality depending on the available resource. This can be based, for example, on principles of priority or proportionality
Use	The specific use for which the water is abstracted (e.g. irrigation, mining, etc.)
Duration and ownership	The duration for which the holder is entitled to the rights conferred. Some rights are permanent while other rights are authorised for a specified period of time
Transfer	Whether the right can be sold, transferred to another person, location, or inherited
Security and enforcement	Details of the administrative body that has the legal mandate to award the right, including the extent of that mandate

In this Chapter, we have investigated how water governance arrangements fit in different contexts with contrasting water availability statuses. In the following Chapter 4, we introduce adaptive management theory and investigate how this relates to stability and dynamics in water governance systems.

4. HOW FEATURES OF WATER GOVERNANCE SYSTEMS RELATE TO ADAPTIVE MANAGEMENT THEORY

4.1. Adaptive management theory

Adaptive management, and the related concept of resilience, has captured the interest of a wide range of actors in different professional fields, such as security, development and the environment. Within recent debates on environmental governance, socio-ecological resilience has attracted considerable attention. The ideal for socio-ecological systems is to become (more) resilient, i.e. being able "...to absorb disturbance and reorganise while undergoing change so as to retain essentially the same function, structure, identity and feedbacks" (Folke, 2006: 259). The resilience of socio-ecological systems is often claimed to support the goal of sustainable development (Berkes et al., 2003).

Previous system theories founded on the existence of a single equilibrium point prompted linear and rational management interventions aimed at stabilizing or 'bouncing back' an unstable system (Davoudi, 2013). The idea that systems may be in a permanent state of instability and have to be managed under inherent uncertainty concerning future conditions increasingly replaced this thinking (Pahl-Wostl et al., 2007). Socio-ecological systems, such as Urban Water Cycle Services (UWCS), came to be seen as complex, non-linear and self-organizing entities, to be sustained under continuously changing conditions (Berkes et al., 2003). Hence, norms changed from continuity to discontinuity, from being to becoming, and from seeing systems not as a fixed asset, but as a changing process (Davoudi, 2013).

The notion that being or becoming adaptive can be managed – adaptive management – is welcomed by many academics and practitioners in the water sector today (Segrave, 2014). It is defined by Pahl-Wostl et al. (2011) as "...a systematic process for improving management policies and practices by systematic learning from the outcomes of implemented management strategies and by taking into account changes in external factors in a proactive manner".

A number of elements are considered essential to an adaptive management approach. Learning is a prominent one. As our understanding of how systems behave, how physical and social systems interact, as well as of what future conditions will be is inherently limited evolve, so learning from experience becomes increasingly important. It is assumed that organisations and institutions can learn like individuals do, which in turn enables learning on a social and institutional level (Berkes et al., 2003). Learning involves the testing of hard and soft management approaches and spans different kinds of processes, from the ecological to the economic (Pahl-Wostl et al., 2007). Flexibility and experimentation are also often mentioned as central elements in adaptive management. They stress the importance of being open to multiple pathways and innovative or unproven response options if progressive insight and iterative learning suggest that the current pathway is not (entirely) suitable to adequately deal with external challenges or when opportunities arise for renewal of the system (Folke, 2006).

4.2. Relationship to the stability of water governance arrangements and distribution criteria

As described above, adaptive management has taken root as an ideal management approach for UWCS. However, as Smith (2012) indicates, there is a tension between the concepts and ideas proposed by adaptive management theory and some inherent inflexible characteristics of our water systems, notably their physical infrastructure. That is why Segrave (2014) holds that adaptiveness in the context of water systems is not based on investing in either extremes of flexibility (i.e. a dynamic system that can alter its course of action or structure in response to changing circumstances) or robustness (i.e. a system that can withstand change without altering its structure or activities), but ideally constitutes a balance between those opposites. In addition to these options of investing in flexibility and robustness, there are options of investing in time and knowledge to cope with uncertainty, for instance by delaying interventions and investing in research that seeks to better understand the potential consequences of particular interventions (Meijer, 2007).

In Table 3, we inferred the relationships between the stability of water governance arrangements and water allocation criteria. From this, we draw on the most prominent features of water governance systems to detail below how these work together – or misalign with relevant characteristics of adaptive management theory. Table 6 presents a summary of this analysis.

Balancing water governance stability and system flexibility

Flexibility, in terms of adaptive management theory, refers to the ability of an organization to adapt to upcoming or unforeseen circumstances and providing room for bottom-up initiatives. Ensuring the continuity of water governance arrangements under flexible conditions can therefore present conflicting strategies and modes of action – particularly where the arrangements in place follow a top-down or hierarchical structure. Visions and strategic directions from the top may not reach the lower echelons, while suggestions for improvement from operational workers may not reach the higher echelons in time for adaptive management actions to be effective (Büscher & Gormley, 2014). Furthermore, and as previously mentioned regarding water allocation criteria, having the capacity and a willingness to change governance arrangements within an organisation can in part depend on stakeholder priorities in terms of water allocation (Giddens, 1984; Furlong, 2010).

Dealing with uncertainty while ensuring supply reliability

In UWCS, there is a paradox of encouraging adaptive decision-making in an industry with infrastructure and processes in place that were intended to be stable, predictable and somewhat inflexible. Where human interaction causes a problem to water quality – the adaptive solution is to deal with the source (a catchment management solution), rather than build water treatment capacity to remove the problem. The effectiveness of a catchment

management solution will be reliant on people's behaviours now and in the future, but it can be flexible and responsive to climate change or environmental legislation etc. In the same context, supply development measures have been implemented to improve the reliability of water supplies in response to physical environment changes and, in some cases, aging infrastructure. For example, as previously described, in southern Spain, hydraulic regulation works were constructed to help increase water availability for domestic use (Reca et al., 2001). However, taking action to ensure adaptation to future unknown circumstances has an optimum point, beyond which the opportunity to ensure supply reliability may cease to become greater and investment is unjustified and/or ill-feeling is raised due to a lack of return (perceived or real) on previous investments. This could be observed, for instance, in the implementation of a new chemical treatment technology that intended to improve the reliability of water quality but, instead, required new levels of training and maintenance that over-complicated the system to the point that the technology implementation was met with resistance.

Learning, anticipating change and instilling equity

From an adaptive management perspective, it is important to know about or gain insight into external trends and developments and the behaviour and strategies of associated actors, including citizens. This is because UWCS functions and activities are carried out in the greater urban environment and are thus partially dependent on other socio-natural processes. UWCS often fulfil water cycle services on behalf of local and regional government and non-government bodies and ultimately need to receive legitimation from these broader bodies. If, for instance, an adaptive management intervention is proposed that generates an immediate detrimental effect on the environment and/or living or economic conditions (e.g. water distribution), such plans can cause civil opposition to the point that plans must change in order for any progress to be achieved. Some activities and procedures, however, are clearly "must do's" as prescribed by policy, law or (EU) directives. In this sense, an optimal solution (in terms of adaptability and water distribution) should be sought when dealing with legislation. This is particularly important in cases where distribution criteria are not health based. For instance, the United Nations Development Programme (UNDP) sets 20 litres per day as the minimum daily amount of water for basic needs. According to Hey (2009) economic and population growth will increase water consumption to the point that, by 2025, approximately 3 billion people will live in arid or semiarid countries with less than 1,700 cubic metres per person annually (the level below which water stress is considered to occur). Considering such health-based guidelines from a distributive justice perspective, the just and adaptive approach should be based on science and learning from socio-political and regulatory trends and effects. In other words, legislation should be questioned as to whether it aligns with, for example, goals pertaining to human health implications.

Table 6. How the most prominent features of water governance systems (Table 4) work together – or misalign with relevant characteristics of adaptive management theory

ESSENTIAL TO ADAPTIVE MANAGEMENT	RELATIONSHIP TO THE STABILITY OF WATER GOVERNANCE ARRANGEMENTS AND DISTRIBUTION CRITERIA
Balancing water governance stability and system flexibility	Ensuring the continuity of water governance arrangements under flexible conditions can have conflicting strategies and modes of action. Directions from high levels in governance arrangements may not reach the lower echelons, while suggestions for improvement from operational workers may not to reach the higher echelons in time for adaptive management actions to be effective (particularly in top-down regimes).
Dealing with uncertainty while ensuring supply reliability	Supply development measures have been taken to improve the reliability of water supplies in response to (uncertain) physical environment changes and, in some cases, aging infrastructure. However, taking action to ensure adaptation to future circumstances has an optimum point, beyond which the opportunity to ensure supply reliability may cease to become greater and investment is unjustified.
Learning, anticipating change and instilling equity	From a distributive justice perspective, the just approach should be not solely based on legislation – but also based on (unbiased) science (e.g. health impacts) and learning from socio-political and regulatory trends and effects (i.e. what works and will be acceptable in terms of allocation). Governance regimes should be implemented in a transparent way that is conducive to learning and adapting. Yet, UWCS typically must receive legitimation from local and regional government and non-government bodies and are partially dependent on other socio-natural processes. Adaptive management in this sense is thus not always feasible.

In this Chapter, we have drawn out common and contrasting elements of adaptive management and water governance arrangements. It has been evident that the physical systems which water governance models govern are exposed to instable operating conditions (climate, demand, competing uses etc.). Based on these insights and those in Chapters 2 and 3 (i.e. the factors affecting stability in various water governance arrangements and water allocation criteria), we will next highlight specific strengths and weaknesses of water governance models in the following Chapter.

5. STRENGTHS AND WEAKNESSES OF GOVERNANCE MODELS

Evidenced strengths and weaknesses in the variety of water governance models available are expected considering the instability of the operating conditions that the physical systems they govern are exposed to (climate, demand, competing uses etc.). Before further observation can be made, it is first important to define what is a strength and what constitutes a weakness in water governance models.

The UN (2006) identifies typical weaknesses of water governance arrangements as being institutional structures and finances that are fragmented (and unpredictable for investors), a lack of clarity of roles and responsibilities, and, in the regulatory environment, dubious water allocation criteria and low capacity and accountability of implementing organisations, politicians and policy-makers. On the other end of the spectrum, the strengths of successful water governance models were classified by the UN (2003) as in-built accountability, decentralization (in terms of delegation to the lowest feasible level), participation, transparency, as well as ensuring equity, efficiency and integration. Similarly, Marchildon (2009), notes accountability, decentralization (i.e. more user-based), participation, transparency, predictability and financial sustainability as key strengths in successful governance models.

Ideally and succinctly, water governance has a clear benefit for end-users. According to most justice systems, all individuals within a locality are entitled to water supply as a human right. If the end-user benefit is, fundamentally, a just set of water allocation rules a good water governance model will thereby ensure end-users have equitable access to a water supply. However, variations in local, regional and international water uses, availability (the natural and built environment) and user cultures (organisational attributes, along with community and individual belief systems and behaviours) mean that while weaknesses in one model can be observed from one perspective – strengths can be observed from another. The strengths and weaknesses of the governance models analysed in this report are detailed in Table 7 and described further below according to the different perspectives noted above.

Strengths and weaknesses

The manner in which water is used differs from one household to another and thus it is vital to consider such differences during water supply. For water stability to be ensured under governance arrangements, there are costs to be incurred to improve the distribution channels in terms of maintenance and enhancement for efficient services (Draper 2006). The costs of obtaining, distributing and treating water are some of the constant incurred on a regular basis. In this context, a strength may be observed by some in the market-centric, distributed governance model adopted by England (Table 4). That is, costs are accounted for and, in general, variations among household demands are met and paid for accordingly. Additionally, there is little reason why the same distribution criteria that are applied to clean drinking water should not be applied to the distribution of sub-potable water for irrigation. This is particularly important in areas where the level of water availability is scarce and it highlights a weakness in the self-governance model (Table 7), as adopted in Yemen for

instance (Table 4). The value of an identical volume and quality of water is variable across individuals within the same community – depending on what its intended purpose is and how important that purpose is to the user.

In a similar context, individuals carry several competing views of justice that are applied in different contexts (Miller, 1991). A sense of justice is thereby not a simple 'one rule for all cases' phenomenon, but rather a complex, contextually sensitive set of considerations. Mitchell et al (1993) succinctly define justice as a dynamic, ever shifting equilibrium between the excesses of too little regulation on the one hand and too much on the other. Broadly stated, individuals modify their opinion of what is a just distribution criterion as the details of the situation evolve. For example, with regard to variances in resource availability, Hegtvedt (1987) found a positive correlation between reward scarcity and the type of justice criteria selected. Under conditions of resource scarcity, equality was the preferred criteria, whereas under conditions of resource abundance, equity was the preferred principle. This identifies both a strength and a weakness of polycentric governance models – depending on need and whether the outcome is perceived by the receiver as a gain or a loss (Table 7).

As described previously, ideally, elements of adaptive management should be integrated into water governance arrangements in order that water needs can be met under unstable operating conditions. This will require a degree of investment and willingness to change, learn and try out new solutions – notable strengths of bottom-up governance (Table 7) – and ultimately a weakness in top-down centralized models. Moreover, ever greater levels of global economic and political integration, and increasing pressure on both natural and other types of economic resources have created a problem for policy makers as they seek a framework within which cross-culturally just resource distributions can be derived. It is no longer sufficient to merely expose differences in cross-cultural attitudes to just resource distributions. Policy makers will require information concerning the sources or determinants of these differences. A related strength of distributed, network co-governance models is that they have an ingrained capacity to negotiate and build participative catchment management solutions in order to meet this challenge.

Table 7. Strengths and weaknesses of various water governance models.

GOVERNANCE MODEL	STRENGTHS	WEAKNESSES
Polycentric governance	• Water services can be provided at different scales based on negotiations among stakeholders. • Providing room for bottom-up initiatives – suggestions for improvement from operational workers may reach the higher echelons in time for adaptive management actions to be taken. • Ensuring the continuity of water governance arrangements under flexible conditions - visions and strategic directions from the top may reach the lower echelons.	• If water is equally divided, then in terms of equality, that may be viewed as a fair share. However, if that same share is viewed in terms of equity – it may be seen as unjust. Therefore, the party who does not benefit may see the division as unfair. • In heavily decentralised arrangements, water can be over-allocated. This creates challenges, not only in times of short supply, but also it is more difficult to reallocate (particularly from one industry to another, e.g. agriculture to municipal use) once arrangements are in place.
Distributed and network governance	• Stakeholder negotiations inform decision making and therefore support for decisions is generally high – as is the perception that allocation criteria are just. • Caters for changes to the physical environment as planning and project developers, regional water authorities, local and regional governments etc. give input to decisions. This also enables management approaches to be more adaptive.	• Compliance is enforced through regulations and the actions are therefore not necessarily supported or viewed throughout the system as just in terms of allocation criteria. • If water supply is low in one area, allocation criteria may not ensure adequate supply.
Bottom-up governance	• Allows stakeholders to provide input to negotiating, formulating and implementing policy. This gives water service providers a level of capacity to change water governance. arrangements in conditions where that is needed • Is conducive to building catchment management solutions – or instilling water management by river basin programs (as endorsed by the Water Framework Directive, for example). This eliminates administrative or political boundaries and focuses on challenges at the local level, fostering participation. • More likely to have a culture that encourages stakeholders and/or local governments to seek new opportunities to exploit together in order to overcome new challenges.	• Resource intensive as it requires cooperation among multiple public and private sector actors to ensure the process is meaningful. • Arrangements may be targeted for reform due to socio-political pressures (or higher expectations with regards water management)– and bottom up governance arrangement may be more susceptible to this. • Criteria differ vastly depending on stakeholder priorities, irrigation versus domestic use; therefore the optimal decision may be difficult to reach.

Co-governance	• As the decisions of stakeholders are recognised equitably – stakeholders support resource management decisions made under these regimes, as they generally perceive their level of control increases their chance of receiving a positive (from their perspective) outcome. • Can support adaptive management because adaptive management requires an inherent capacity and willingness to change – so because co-governance is a participatory management process, it allows for the development of non-centralised rules, which are responsive and can adapt to changing conditions (legislation, weather pressures, financial, infrastructure modifications, new technology etc.).	• From a water allocation perspective, because non-centralised rules are developed regarding the use and management of resources – it may not be the fairest of procedures – particularly if there are sectors or populations without sufficient access. It may also not be the most efficient system for resource management if priorities differ across decentralised segments.
Self-governance	• Giving stakeholders the ability to exercise power without intervention from any authority can lead to feels that ultimate stakeholder rewards are being gained – and that resources can be conserved in times of excess and used in times of need – implying a sense of self-stability and sufficiency.	• Decisions may not be just all stakeholders and subsequently disputes and unrest may arise. Those without any form of control on the arrangements can be (or perceive to be) discriminated against. • With no intervention from authority – arrangements and decisions can be easily changed and become instable, which can also promote conflict and affect perceptions of allocation justice.
Centralised, hierarchical, bureaucratic and top-down governance	• Ordered and comprehensive rationality for decision making – creating a perceived stability • If the reputation of the arrangements is good then it is likely to be viewed as a fair level of equity. • Water can be reallocated or redistributed based on a central decision making agency if needed.	• All but one entity involved in the regime is inferior to another, which is an increasingly unpopular approach to governance. • Stakeholders may have no opportunity to participate in decisions and if a governance body has a bad reputation then it is likely to be view negatively, creating conflict. • More difficult to accommodate bottom-up initiatives – thus in times of change to the physical environment (e.g. flooding) and/or infrastructure, the arrangements may not adapt easily and therefore may be seen as unjust.

Market-centric governance	• Accommodates technological innovations, research and development and can create water sector growth (due to increased cost recovery), improving the potential for greater allocation and stability in supply. • Thrives to instil change and expand according to external circumstances – creating a more adaptive (and resilient) sector.	• Failures in technology, the economy and environmental degradation become internalised and impact the system – threatening supply and stability. • Social opposition can arise where personal finances prevent equality, which raises the question whether this model is compatible with the human right to water. • Reform of arrangements under this system can be used as a political tool – where an authority believes changes to water charges would bring political and social benefits – but the reform may not benefit water supply. Note that it is possible for this to occur under the other modes of governance, however it is observed more so for market-centric governance arrangements due to their direct financial implications to society.

Thus far, we have offered insights into various forms of water governance arrangements – from the perspective of stability, water allocation, adaptive management and their effectiveness. A clear challenge for water managers and regulators in developing, implementing and transforming water governance arrangements is the high variability of water demand (e.g. uses, volumes, quality) and its availability. In the next Chapter, we will bring these insights gained together with guidance on balancing system stability and dynamics while building more adaptive governance systems (and therefore often transforming governance arrangements) to offer advice on how water governance arrangements could be made fit for purpose.

6. CAN WATER GOVERNANCE ARRANGEMENT BE MADE FIT FOR PURPOSE?

Our discussion now focuses on how water governance arrangements can be made fit for purpose for water managers and regulators where resource availability is highly variable, and there is rapid change in the nature of demand (uses, qualities etc.). Achieving this goal broadly entails both transformative and adaptive water governance arrangements (4.2) that can accommodate changes that affect stability (i.e. the physical environment and infrastructure, characteristics of agency, socio-political and regulatory trends, rules [Section 3.2]) and the factors affecting water allocation criteria (i.e. stakeholder priorities, reliability of supply, equity [Section 3.3). These vary depending on the circumstances faced and the current practices and therefore guidance must account for this, as described further in the following sections.

It should be noted that it is not the purpose or intention of this contribution to suggest specific policy options for resource distribution problems. The discussion presented in this section is therefore of an abstract nature, dealing in the conceptual rather than the functional / operational aspects of the subject matter. It should be born in mind that both this and the previous section constitute an interpreted extrapolation of the foregoing discussions and as such are intended as propositional rather than prescriptive.

Balancing the factors affecting system stability and dynamics in water allocation criteria

As noted previously, we may expect to observe variety in selected distribution criteria as the level of water availability moves from plenty, through sufficiency to scarcity. There is also little rational reason why the same distribution criteria that are applied to clean drinking water should be applied to the distribution of sub-potable water for irrigation. The water use and the circumstances of the user can be anticipated to be significant modifiers of justice sentiments. For example, with regard to variances in resource availability, Hegtvedt found that under conditions of resource scarcity, equality was the preferred criteria, whereas under conditions of resource abundance, equity was the preferred principle (Hegtvedt, 1987). It has also been found that views on entitlement are related to both gender and occupational type (Moore, 1991). Further evidence suggests that different spheres of human action are associated with variances in the preferred principles of justice (Hochschild, 1981). Other empirical research has exposed evidence that chosen criteria for resource distribution are influenced by changes in resource type (Foa & Stein, 1980), the personal relationships between the donor and recipient (Peterson, 1975; Austin, 1980), group dynamics (Brewer & Kramer, 1986), social goals (Deutsch, 1975), and internalised normative values Rasinski, 1987).

Allowing a single ideological framework to determine just distribution for water that has different intended uses ignores the evidence that water availability and the nature of its demand is variable. This becomes more pertinent the greater the scale of (intended) application, highlighting the need for context specific solutions. An emphasis on contextually sensitive solutions reflects comments made by Aaron Wolf when reporting on

distribution agreements for international watersheds. Wolf refers to 'a middle ground between the absolute uniqueness of each basin and the feasibility of delineating clear and guiding principles for allocations which would work like an algorithm for all the international waters of the world ' (Wolf, 1999). The application of ideas of requisite variety suggest that not only should inter-basin needs and settings influence distribution criteria, but that spatial and temporal variations in water availability, water quality, level of need etc. within the basin itself should also be allowed to influence allocations. This is an implicit recognition of the coevolutionary aspects of effective water management as it accepts that water has a fundamental role to play in supporting agriculture, leisure activities, freshwater habitats, local and regional economies, regional development and public health (an agenda reflected in the 1997 UN convention [UN, 1997]).

In systemic terms, survival is ensured through adaptive change, which in turn is promoted by the generation of diversity or variety in sub-systems. For example, the survival of communities of organisms is promoted by diversity of individuals' physical or behavioural characteristics. If we view the issue of stability as relating to 'the contract that represents the agreement entered into by the various parties rather than the particular configuration of justice criteria that has been determined', then the relevant level at which diversity is required is that of the criteria. In other terms, the resilience of the agreement will be promoted by the diversity of criteria represented in it.

Integrating adaptive and transformative governance

Traditionally, governance sets out the rules and responsibilities of involved organisations within formal institutions. The agreements can, in some cases, be long-term, binding and burdensome to change and hinder the involvement of stakeholders and decision-making. As shown, this can reduce adaptive capacity within water sector organisations. Adaptive governance deals with changing circumstances and purposes of governance by continuous learning and making timely decisions (Folke et al., 2005). At the early stages of implementing adaptive governance in urban water practitioners across three Australian cities, Rijke et al. (2012) demonstrated that a decentralized and informal governance model is most effective. An adaptive strategy as such would both ensure that sustainable water resource arrangements were negotiated rather than imposed, accommodate the need for geographical equity as recently highlighted by Haughton (1998), and provide some resilience in the face of global threats such as population growth and climate change (as noted in Miller et. al., 1997). It also has two significant corollaries; it would require implementing monitoring schemes to provide information on the current and anticipated status of waters and dependent systems, and it would involve a more intense and participatory form of water governance.

Transformative governance (also known as transitions management), according to Wiek et al. (2011) enables progress in the transition from current practices towards the goal of having fit for purpose governance arrangements under water availability and demand variability. For instance, comparing current risk management levels in an organisation with its strategic goals can highlight the need for a transition. When the need for action is identified, learning may initiate a transition management process whereby the responsible

authorities decide that policy development and implementation require structural changes and stakeholder involvement (Pahl-Wostl et al., 2008). When a transition to a new arrangement is established (completed) – it is anticipated to be the result of centralized and formal governance approaches (Rijke et al., 2013).

It is evident throughout this study that, depending on the circumstances, a variety of decentralised, centralised, informal and formal approaches can constitute a more successful model of water governance. A proposed concept for helping water managers and regulators be better prepared to adapt and transform water governance arrangements is presented in Figure 5. The initial stages of the concept incorporates elements of the adaptive strategic planning process as described in TRUST Deliverable 12.1 (Van der Zouwen et al., 2013) and the TRUST framework for understanding and improving adaptive capacity in water sector organisations as described in Deliverable 21.2 (Jeffrey et al., 2014). It can thus be seen as complementary to these TRUST frameworks. Fundamentally, Figure 5 integrates the factors presented in this report that have shown to influence stability in governance arrangements and distribution under availability and demand variability – to generic governance frameworks (i.e. plan, design, implement, operate – Hoogervorst, 2009) and governance implementation guidelines for the water sector (Pollard et al., 2013). As such, Figure 5 and its basis in this report provides an alternative starting point to generate discussion among water managers and regulators who wish to evaluate the effectiveness of established governance arrangements and estimate the chance of success of, if desired, organisational reform.

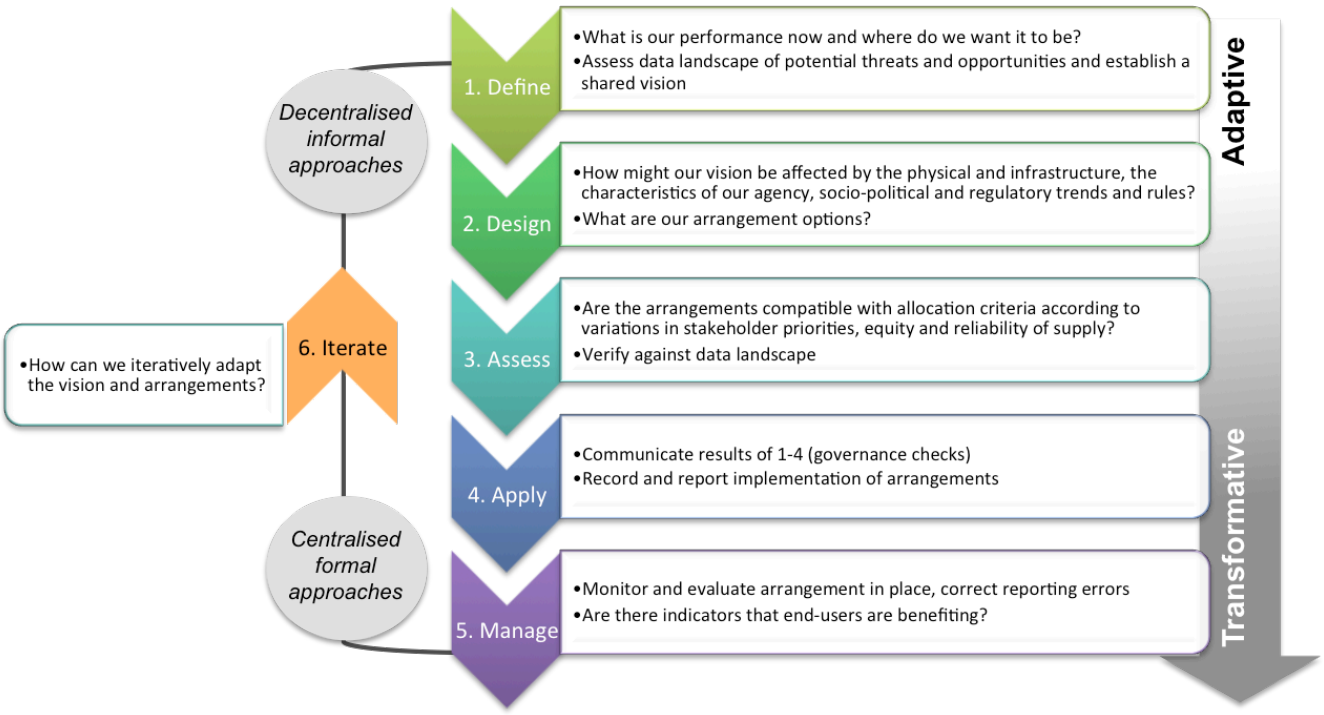

Figure 5. Proposed concept for helping water managers and regulators better prepared to adapt and transform water governance arrangements.

7. CONCLUSIONS

The research reported above highlights a stability-change paradox in water governance arrangements. Variations in factors affecting the stability of water governance arrangements (physical environment and infrastructure, characteristics of agency, socio-political and regulatory trends and rules) ideally require adaptive mechanisms built in to the system. However, with regards to allocation, to ensure stakeholder priorities, reliability of supply and equity are met – this requires a degree of stability.

We analysed co-governance, self-governance, polycentric, distributed, network, bottom-up, centralized, hierarchical, bureaucratic, top-down and market-centric modes of governance. Factors affecting their stability and how that can influence allocation decisions, along with their strengths, weaknesses and alignment with adaptive management theory were identified. Stability was most influenced by (1) physical environment and infrastructure, (2) characteristics of agency, (3) socio-political and regulatory trends and (4) rules, while dynamics stakeholder priorities, reliability of supply and equity affected allocation decision-making. No matter the mode of governance, strengths and weaknesses were evident in each due to the instability of the operating conditions that the physical systems they govern are exposed to (climate, demand, competing uses etc.). One form of governance does not fit an exact context. Rather, water governance arrangements should be made fit for purpose. This is particularly important where resource availability is highly variable, and there is rapid change in the nature of demand (uses, qualities etc.). This means that, in the majority of cases, current governance arrangement require a degree of transformation in order to adapt. As such, we have identified a pattern of governance configurations during consecutive stages of the development of arrangements that may help water managers and regulators generate discussions in order to become better prepared to adapt and transform water governance arrangements.

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