
1. Water security: a popular but contested concept

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1. INTRODUCTION

1.1. The Enhanced Interest in the ‘Water Security’ Concept

The academic and political interest in the concept of water security has increased considerably over the past decade as reflected in numerous publications (Bakker, 2012), research and funding initiatives, and conferences. This growing interest may reflect the explosive rise in concern of scientific and policy communities about the state of freshwater resources and the urgent need for sustainable water and land management in an era of rapid change and persistent water and food challenges including access issues. Economic development, population increase, climate change, and other global to local drivers alter water resource availability and use, resulting in increased risk of extreme low and high flows, variously altered flow regimes, and water demands surpassing renewable supply. These have also affected the ability of water-dependent ecosystems to provide ecosystem services. Satisfying human demands is often achieved in the short term at the expense of the environment (Palmer et al., 2008; Vörösmarty et al., 2010) with harmful implications in the long run for socio-ecological systems as a whole. Many, but not all, water problems can be attributed to governance failures rather than the condition of the resource base itself. Governance failures occur at local through to global level, are manifold and affect both developing and industrialized countries albeit in different ways. They are also affected by drivers that operate simultaneously at multiple levels of governance (Gupta et al., 2013). In many developing countries, poor governance, including a lack of efficiency and effectiveness of existing resource-constrained governance structures compounded by allegations of corruption and the absence of civil society, poses problems for any kind of development (Pahl-Wostl et al., 2012; Pahl-Wostl and Knieper, 2014). The developing countries face challenges of resource shortages regardless of economic, institutional or infrastructural characteristics. Some are even seen as failed states. Most of these countries have not met basic human needs, nor have they been able to meet health and educational requirements for their own societies. In contrast, many industrialized countries suffer from over-regulation by rigid bureaucracies, sectoral fragmentation, unsustainable consumption patterns and a prevailing dominance of economic over environmental considerations. Some are increasingly facing the challenge of social inequality and live beyond their own environmental means – through importing resources from other parts of the world. Virtual water trade data shows how water moves from water stressed countries to countries with abundant water supplies (Orlowsky et al., 2014). To improve policy and scholarly capacity in dealing with such problems, demands are made for changes in both science and policy to overcome evident gaps that include more interdisciplinary and comparative studies, for an improved understanding of factors that shape water governance and cause governance failures, for the bridging of levels from

local to global, for more sectoral integration to get out of the water box and for closing the policy implementation gap (Pahl-Wostl et al., 2013b; Vörösmarty et al., 2013). This raises the question: is a new concept required to improve our analytical capabilities and provide an imperative for policy to deal with these challenges? Does the concept of water security hold promise in this respect?

Looking at the current state of the academic debate one may have some doubts. A wide range of framings and often incompatible approaches can be found in the literature (Cook and Bakker, 2012). One can note some tensions in the debate between support for a broad concept versus a narrow operational framing (Lautze and Manthritilake, 2012), developed versus developing country perspectives (Grey and Connors, 2009), engineering/natural science versus social science framings and corresponding preferred solutions to dealing with water security challenges (Bakker, 2012; Pahl-Wostl et al., 2011).

A bewildering complexity and diversity characterizes the academic and political debate. However, this diversity can also be perceived as the strength of the concept since it is an indication that water security has meaning to a wide range of different communities. Such multiple interpretations can reduce the danger of falling into the simplistic panacea trap. Idealized and generalized design principles based on institutional and technological panaceas have been applied to water issues without taking into account the socio-economic and environmental context and historical developments (Ingram, 2011; Meinzen-Dick, 2007; Pahl-Wostl et al., 2012). To capitalize on this diversity of approaches to water security it is important to build on pluralistic discourse where exchange and learning may lead to some shared understanding.

Hence a handbook is timely. It is important to provide an overview and shape the quite fragmented landscape of contributions and approaches to water security. To make some progress in identifying synergies and in paving the way to a synthesis, the authors in this *Handbook* have been asked to grapple with the following issues:

- (a) What is their theoretical understanding of the water security concept, what is its potential and limits? And does it provide a better framework for dealing with water governance challenges?
- (b) How can the concept be elaborated at a thematic level, and does such elaboration add to existing thematic discussions of the water governance challenge?
- (c) What are the water 'security' challenges at regional and/or national level?

Accordingly, we have three parts to this book. Part I examines the theoretical and conceptual underpinnings of the concept; Part II examines water security from a thematic perspective; and Part III examines water security from a regional perspective. The following three sections of this chapter synthesize the analyses that emerge from each of these three parts. Finally, we build on the discussions in the book to assess the usefulness and limits of the water security concept in uniting the water community and to analyse whether and under what conditions the conceptualization of water security will enhance our understanding of water governance and requirements for successful water governance reform.

2. CONCEPTUAL AND THEORETICAL DISCUSSIONS ON WATER SECURITY

2.1. Introduction

In international relations and at national level the term security has traditionally been used to determine issues of importance to the survival of the state. In the domestic context, the term security has often been used to refer to the ability of humans, households, communities and regions to meet their own survival needs. Increasingly at global level, we are now talking about planetary boundaries and global security. Globalization and integration of disciplines, sectors and approaches has brought the term security as a unifying term that can include different people and different concerns and at different levels. But in doing so, do we empty out the different meanings of security or do we enrich the concept? Are the different meanings incompatible?

Part I of this book has seven chapters. Cook and Bakker (Chapter 2) examine the treatment of water security in the scholarly literature. Bogardi et al. (Chapter 3) provide an overview of the policy evolution of the water security concept and its links to other concepts and other levels. Allouche et al. (Chapter 4) explain the advantages of expanding the concept to include its interpretation at other levels of governance. Fischhendler and Nathan (Chapter 5) discuss how water is securitized through the use of language in an interactive manner between actors and their audience. Pahl-Wostl (Chapter 6) explores the links between water security and adaptive risk management. Bhaduri (Chapter 7) focuses on water security in a transboundary setting and shows how changes in trade policy in a bilateral context may rebalance the production pattern of goods according to a country's inherent comparative advantage and lead to win-win situations. Gupta et al. (Chapter 8) conclude the section by warning of the political dangers of using a discourse which speaks to nationalist and defence interests especially in the context of resource shortages. The following sections integrate the discussion that emerges from these seven chapters.

2.2. Evolution in Scholarly Literature

In the academic literature (Cook and Bakker, Chapter 2) the term water security has been used since the 1990s. This would indicate that the scholarly use of 'water security' preceded its adoption into policy circles. What is interesting to note is that initially the term was used more by natural scientists and engineers and not by social scientists. Increasingly water and environmental scientists have been using it. These studies have focused on how scale can affect the classification of water security, and most papers focus on empirical, modelling and lab-based analysis with a minority focusing on conceptual issues. In terms of scale, while hydrologists focus on the watershed scale, and geographers at the local level, most other social scientists focus at the national level with only a few examining the global level.

2.2.1. Definitions of water security and expansion ad infinitum

One of the most cited definitions of water security is that of Grey and Sadoff (2007: 545): 'the availability of an acceptable quantity and quality of water for health, livelihoods,

ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies.’ This definition embraces both the productive potential of water and its destructive impact. It highlights economic, social and environmental trade-offs as a matter of concern. By using the attribute ‘acceptable’ Grey and Sadoff make explicit that any operationalization of water security must be negotiated in a societal discourse. Hence, governance and the respect of contextually relevant good governance principles are central to implementing a sustainable approach to water security (Pahl-Wostl and Knüppe, Chapter 14).

However, there is a huge diversity in the definition of water security (Cook and Bakker, Chapter 2). Four themes can be differentiated: water availability, human vulnerability to hazards, human needs (particularly development-related needs, with an emphasis on food security), and sustainability. In policy contexts a water security definition can range from minimal access issues for meeting basic needs (Cook and Bakker, Chapter 2; Obani and Gupta, Chapter 12) to meeting ecosystem needs as well. In fact Table 2.2 in Chapter 2 lists a range of water security definitions which include agricultural productivity; protection from floods, droughts, contamination and terrorism; security of the hydrological cycles; infrastructural security; and interdisciplinary and nexus linkages. These definitions are so all encompassing that the actual content of water security is not at all clear. The question is: is water security a normative goal to be achieved as suggested by Cook and Bakker (2012)? This leads to questions regarding how specific, measurable and attainable this goal is so that it is understandable for all actors and implementable. Do we need a concept that evolves with societal needs and encompasses several objectives in a holistic frame? Although Cook and Bakker argue that scholars have more or less stopped making the link to defence (a preoccupation in the 1990s), in the policy world there is continued emphasis paid to the 3 D approach and geopolitical concerns dominate.

2.3. Evolution in Policy Circles

In political and policy circles the term water security was first used in 2001 and has since been progressively used more often (Bogardi et al., Chapter 3). Since then the term has been widened and deepened: widened to include environmental, economic and social issues, as well as security in other sectors – such as food security (in use since the 1960s), energy security (used since the 1970s) and health security (used since the 1980s), incorporated into the concept of the water, energy and food security nexus (used since 2009); and deepened to go beyond the national level to include human security (used since the 1990s by United Nations Development Programme), thereby also incorporating notions of gender and increasingly planetary security. The 3 D security approach of the UK, Canada and Netherlands governments refers to the need to integrate Development issues, Diplomacy and Defence, thereby further widening the scope of water security (Gupta et al., Chapter 8).

2.4. Why Water Security?

A key reason for using the water security jargon is to enhance the political priority given to the issue in order to raise it to the level of a high politics issue (Fischhendler and Nathan, Chapter 5; Gupta et al., Chapter 8). Such political priority is seen as needed

because there is a potential resource or identity conflict that could otherwise escalate to a violent situation – such violence could imply physical conflict or it could imply extreme human stress such as famine from drought. In other words, it is perceived that the use of the word ‘security’ conveys the urgent nature of the water crises at global through to local levels and will result also in urgent action being taken commensurate with the significance of the problem for survival.

2.5. How Is Water Securitized?

Fischhendler and Nathan (Chapter 5) argue that water is securitized through the use of language, visualizations of the issue, and institutional and infrastructural measures. Language can be used to emphasize the supply–demand gap (e.g. water deficit, water poverty index), unmet needs (access for the human right to water and sanitation), the need to safeguard humans from water-related risks (from climate change, disease, terrorism, etc.), and sustainability (which links social, ecological and economic issues). Visualizations include graphics and maps that sharpen the message of a threat. Institutional and infrastructural approaches focus on the establishment of norms and bodies, as well as actual structures to protect a resource.

2.6. Does the Use of the Term Security Achieve Its Sustainability Goals?

If the use of the term security aims to put the issue on top of the political agenda and thereby ensure that it is addressed, then the question this raises is has this happened in the past? Empirically one could argue that sixty years of food security discussions have only partially addressed food access issues at the level of humans (Bogardi et al., Chapter 3) or the sustainability dimensions (economic, social and ecological) of the food issue. However, fifty years of energy security discussions have been accompanied by a series of wars between nations to protect state access to energy resources, without adequately addressing either the human access issues or the ecological sustainability of using, for example, fossil fuels. In situations where the use of security is focused on a single issue, it is unlikely to deal systemically with sustainability goals (Pahl-Wostl, Chapter 6). Where water security discussions in water-scarce regions of the world lead to tensions between states (Fischhendler and Nathan, Chapter 5), this may not lead to sustainable solutions. However, broad concepts such as water security and water sustainability could help in providing a better systemic understanding of the issue, even though actually researching or implementing such broad terms is very difficult (Cook and Bakker, Chapter 2). Whether security adds anything more to the sustainability concept is difficult to argue: sustainability examines the ecological, economic and social aspects, it examines current needs and relates it to future needs, and it has a multi-level dimension. The term security may be expanded beyond economic and social aspects to include ecological aspects; it may be expanded beyond the state to include both global and human dimensions, and thus may go beyond present to future generations. But while it conveys the notion of urgency, can this very notion of urgency lead to solutions that are less than sustainable by sliding down the slippery slope of securitizing the concept?

2.7. Potential Benefits and Risks of the Concept

The use of the water security concept could potentially raise the profile of an issue, raise resources for an issue (Fischhendler and Nathan, Chapter 5) and could in its broadest incarnation help to create understanding of the complexity, non-linearity, teleconnections and systemic nature of the water–human system (Pahl-Wostl, Chapter 6). In doing so it could complement the integrated water resource management (IWRM) concept (Cook and Bakker, Chapter 2) and adaptive capacity (Pahl-Wostl, Chapter 6) and potentially contribute to sustainable water governance.

The risks of adopting the concept are that expanding the water security concept to be all inclusive of all related issues and at all levels of governance makes it so big that it says nothing. It may thereby contribute to the creation of confusion and the use of the term strategically by a variety of actors to push their own agendas. Where some actors have more power than others, it may also mean the subversion of the broad definition of water security for sectoral approaches. It may also imply that the limited definition of security will lose its meaning (Fischhendler and Nathan, Chapter 5; Gupta et al., Chapter 8) and thereby reduce the ability of the state to focus on ‘narrow security issues’ – such as the rise of the new military threats posed by cyber security, terrorism and the breakdown of civil order in countries. While in the post-Cold War period there was optimism that defence resources could be channelled into environmental security issues, terrorism post 9/11 and its new faces – Islamic State and cyber terrorism – remain key challenges for defence. Distracting attention from these issues may be problematic. At the same time, many argue that defence, development and diplomacy are so intertwined that terrorism is intricately linked to development challenges – where lack of development may feed the sources of terrorism and terrorism itself may target development (including water) infrastructure. In between these extremes, securitization of the concept may hamper cooperation and may reduce the number of players that are allowed to participate in this thinking (Fischhendler and Nathan, Chapter 5). It reinforces a conceptual return to sovereignty as a dominant characteristic of the Nation State and therefore may challenge the possibility of cooperation. Borrowing the discourses dominant in the ‘defence agenda’ may be counter-productive for those wishing to work in the sustainability field (Bogardi et al., Chapter 3; Cook and Bakker, Chapter 2).

3. WATER SECURITY – THEMATIC PERSPECTIVES

3.1. Introduction

Enhancing water security in a sustainable way which takes into account all uses and users can only be achieved if implementation of the concept is guided by an integrated approach balancing diverse risks and benefits. A narrow interpretation of water security focusing on the needs and interests of one sector or specific interest groups will increase rather than reduce trade-offs and conflicts. The diverse conceptualizations of water security suggest that a holistic and integrated approach may be an ideal often adhered to but hardly achievable in practice. Part II of the *Handbook* analyses challenges for, and interpretations of, water security in different domains.

Part II has seven chapters. Ludwig et al. (Chapter 9) elaborate on challenges for water security posed by climate change. They highlight the multifaceted nature of climate change challenges and the need to develop more adaptive approaches at different scales. Conti et al. (Chapter 10) assess what water security means for managing groundwater, a resource increasingly under pressure with increasing water demand. Ringler et al. (Chapter 11) use a modelling and global scenario exercise to analyse how water security for economic development could be achieved. Obani and Gupta (Chapter 12) focus on the social dimension of water security and discuss the nexus of water, sanitation and hygiene (WASH). Stewart-Koster and Bunn (Chapter 13) highlight the degradation of ecosystems and make suggestions about how water management could overcome the conflict between human and environmental water needs. Pahl-Wostl and Knüppe (Chapter 14) analyse the problem of fragmentation in governance in dealing with the various dimensions of water security and suggest ecosystem services as a promising concept to support integration. Meza and Scott (Chapter 15) analyse water security problems in water-scarce regions. They highlight that the shift of attention to managing demand rather than increasing supply should not detract from the potential of a number of innovative technologies to increase water use efficiency and water security in arid countries. The following sections reflect on the major insights that emerge from these seven chapters.

3.2. The Different Dimensions of Sustainability

In their definition of water security, Grey and Sadoff (2007) emphasize the need to balance the different dimensions of sustainability. Water security for humans which is achieved by creating unacceptable risks for the environment is not sustainable in the long term. Furthermore, economic considerations should not jeopardize guaranteeing water security for basic human needs. The reality of water management looks quite different. Obani and Gupta (Chapter 12) conclude that water security discussions have often not made the link to human access to WASH services. These challenges remain critical despite major efforts devoted to achieving the WASH targets set by the Millennium Development Goals (MDGs). Human water security is still achieved at the expense of the environment. In the early stages of industrial development one could have excused such trade-offs by arguing that there was a lack of knowledge about the impacts of human activities on the environment. However, nowadays there is an abundance of knowledge about human–environment interactions. A variety of planning tools exist to guide water management towards more sustainable practices (Stewart-Koster and Bunn, Chapter 13). Hence, one may wonder why they are not used more. A systemic and long-term interpretation of water security seems to be wanting; a narrow, short-term profit maximizing interpretation appears to prevail. At the same time, achieving water security for economic development in times of global change faces increasing challenges (Ringler et al., Chapter 11; Ludwig et al., Chapter 9). Ringler et al. assess water security in terms of current and future access to sufficient water resources for productive uses and economic growth. They note the need but also the potential for considerable improvements in efficiency and productivity to avoid increasing the risk of water stress which would increase conflicts and sustainability deficits. Such improvements require a multi-level approach.

3.3. Water Security – At Which Scale?

Different water security concepts refer to different scales and water security problems must be tackled at different and often simultaneously at multiple scales. Achieving WASH targets requires a sophisticated understanding of local determinants of water security at household level. National statistics typically used to monitor compliance with the MDGs may blur what happens on the ground. But national policies and the global process of setting targets have been essential. Ringler et al. (Chapter 11) discuss scenarios at global levels which are useful to capture the overall picture. At the same time they may blur important regional patterns of, for instance, water scarcity. Australia, as a continent, for example, exhibits as a whole no major water stress. However, water stress and serious problems with drought are critical in many regions. A similar dependence of water stress patterns on spatial resolution can be noted for the Iberian peninsula. Measures to enhance water security need to be taken at national, regional or even local levels and require spatial details, and as Meza and Scott (Chapter 15) point out, indicators to assess environmental, economic and social sustainability need to be developed at the scale where socio-technical solutions are introduced. Resolving more spatial detail in scenario planning comes with an increase in uncertainties, for example, from impacts of regional climate change (Ludwig et al., Chapter 9). Hence it is important to avoid spurious precision and to adopt approaches to enhancing water security that take different kinds of uncertainty into account. Uncertainties have always been particularly pronounced for groundwater resources, the ‘invisible’ resource. Transboundary governance of river basins has mainly addressed surface water problems. Conti et al. (Chapter 10) point out that achieving groundwater security is a complex multi-level governance challenge aggravated by lack of data and knowledge. Providing targets for dealing with the water security problem at the global level can be a strong driver for improvement at national and regional levels as the example of the MDGs shows. However, Obani and Gupta (Chapter 12) illustrate the need for global human rights norms to also be translated into contextually appropriate operational targets and instruments for policy implementation at national and local levels. Important lessons can be drawn for the implementation of the future Sustainable Development Goals (SDGs). It is evident that addressing water security problems requires integrating and taking into account different spatial and temporal scales. Water governance and management have not been particularly effective in the past in doing so (see Section 3.4).

3.4. Governance Challenges – Overcoming Fragmentation

Introducing a new concept does not solve governance deficits that are the main cause of many problems in water management. As pointed above and documented in many studies (Bavinck and Gupta (eds), 2014), many water governance systems suffer from a lack of vertical and horizontal integration. What matters is not only an integration of issues but also making explicit different framings and integrating different logics of argumentation. Some may argue using the logic of the market whereas others may refer to ethical principles and moral obligations. A major governance challenge is the need for institutional settings which could support negotiation about water-related trade-offs within a guiding logic and an integrative framework.

Obani and Gupta (Chapter 12) argue that the human rights approach could be instrumental in overcoming trade-offs which hinder the provision of basic services for human needs. The human rights approach addresses important social and economic aspects of providing water WASH which are not adequately covered by prevailing governance approaches, namely, safety, affordability and accessibility. Combined with effective governance, the human rights approach offers great potential for addressing the various drivers for the lack of access to WASH at different levels of governance where enforced.

Pahl-Wostl and Knüppe (Chapter 14) argue that the ecosystem services concept could be a central notion and a boundary object to overcome fragmentation if embedded in appropriate governance structures and deliberation processes. Ecosystem services describe the benefits derived for human well-being from terrestrial and aquatic ecosystems. They can thus translate the logic of ecosystem integrity into what is important for economic production and human well-being (livelihoods and quality of life). However, ecosystem services have predominantly been associated with a commodification of the environment. This is a narrow conceptualization and does not capture the encompassing meaning of this concept. Combinations of governance modes and approaches that integrate different dimensions of valuation could overcome the frequently prevailing emphasis on monetary arguments. The ecosystem services approach could become an important boundary concept and communication tool.

The notion of governance modes is quite useful to convey the importance and meaning of different logics of argumentation and different modes of steering. A commonly used approach makes the distinction between bureaucratic hierarchies, markets and networks. In bureaucratic hierarchies governmental actors play the dominant role and coordination is mainly achieved by top-down control. In markets non-state actors dominate and interactions among actors are mainly characterized by competitive relationships. In networks coordination is mainly based on trust and cooperation (Pahl-Wostl, Chapter 6). These governance modes resonate strongly with ideal types identified by the cultural theory of risk: individualists being risk seeking, hierarchists hoping to be able to keep risks within controllable bounds and egalitarians being risk averse (Pahl-Wostl et al., 2008; Thompson et al., 1990). Without entering the fierce debates about cultural theory, this distinction illustrates that different types of logical approaches may come to quite different conclusions about what are acceptable risks. A combination of different governance modes and the use of boundary concepts such as ecosystem services may facilitate steps towards more integration.

However, the effectiveness of governance systems is essential for the development of innovative governance ideas, be it the human rights approach or the ecosystem services concept. Effectiveness hinges on the respect of good governance principles or contextually relevant governance principles. Governance challenges associated with enhancing water security manifest themselves differently in different world regions.

4. REGIONAL PERSPECTIVES

4.1. Introduction

Water security is a concept with multidimensional objectives which vary over time and are particularly defined by the specific socio-economic, hydrologic and climatic context of different regions. The chapters under regional perspectives provide varied contexts, different viewpoints and, at the same time, validate and contest the global concept of water security itself. These regional perspectives provide an opportunity to study interventions, governance and management of water that have been encountered in achieving water security and sustainability in Latin America, China, South East Asia, Australia, South Africa and Europe.

Part III of this book comprises five chapters. López-Gunn et al. (Chapter 16) explore different dimensions of water security relevant to Spain. Meissner (Chapter 17) investigates how various stakeholders in South Africa have used the concept of water security and linked it to other issues over the past decade and more. Yang et al. (Chapter 18) present an overview of the status of China's water resources and water development with respect to quantity and quality, and addresses the challenges to China's economic growth and water security. Lansigan and dela Cruz (Chapter 19) present an assessment of water scarcity and water stress in the Southeast Asia region by looking at different dimensions as well as various indices or measures. Patrick et al. (Chapter 20) provide an inter-sectoral perspective on how policies have been conceptualized, and help to implement actions to ensure water security for Australian cities and rural regions. The following section summarizes how these chapters provide different insights and understanding of the water security concept based on regional perspectives.

4.2. Regional Evolution of the Water Security Concept

The concept of water security did not co-evolve with its redefinition by the Global Water Partnership (2000) in the early 2000s only, but it has been in use in different regions and among different communities in which water contributes to human well-being in ways beyond those strictly linked to society's material well-being. It is important to trace the evolution in the concept of water security from a regional perspective. Given that many of its different dimensions have been progressively recognized over time it is necessary to address its dynamic nature, which largely reflects the evolution of both water resources and societal needs through time. López-Gunn et al. (Chapter 16) analyse water security from a Spanish perspective and in the Mediterranean context by focusing on the evolution of the concept which has been adapted over time. The chapter highlights a number of different dimensions of water security in Spain (namely productive water security and environmental water security), which are sometimes difficult to balance, and it explains how politics plays a key role in strengthening public participation and in developing robust institutions to address allocation and re-allocation issues.

Similarly Meissner (Chapter 17) addresses various conceptualizations of water security in the South African context. These include the water security concept that is directly linked to the provision of other material needs and wants (water, energy, food), while an alternative definition focuses on the acceptable level of water-related risks to humans

and ecosystems to support livelihoods, national security, human health and ecosystem services. The chapter shows how different interest groups have played a significant role in the water governance of Southern Africa at different levels. Depending on the type and objective of such interest groups, the water security concept has been either linked to physical human well-being or to policies and practices that could have an impact on aquatic ecosystems; and thus it has influenced the discourse and conceptualization of water security in a varied way in the same region.

4.3. Water, Energy and Food Security Nexus

Lansigan and dela Cruz (Chapter 19) and Patrick et al. (Chapter 20) do not just address the water security concept in isolation but frame it in the regional context of the water, energy and food security nexus. Patrick et al. provide an inter-sectoral perspective on how policies have been conceptualized, and help to implement actions to ensure water security for Australian cities and rural regions. The chapter shows how functional mismatches occur when the mandate of an institution is too narrow in relation to the whole system comprising each sector (water, energy, food and environment), which each have their own goals, targets and aspirations that they are mandated to achieve through policy and strategy in a country of extremes (extreme temperatures, extreme rainfall variations and extreme surface run-off variations). Similarly, but in a different context, Lansigan and dela Cruz (Chapter 19) review how exerting pressure on water resources for food production, energy and power generation also influences the use and management of water resources for sustainable development and particularly the provision of water for environmental services. They also call for improving governance and institutions for better management and utilization of multiple and competing water resources in the region with spatial and temporal variability in water supply.

4.4. Water Security and Risk

The concept of water security implies concern about potentially harmful states of coupled human and natural water systems. Those harmful states may be associated with water scarcity (for humans and/or the environment), floods or harmful water quality. The theories and practices of risk analysis and risk management have been developed and elaborated to deal with the uncertain occurrence of harmful events. Today, a large part of the global population faces a high level of water-related risk and other interdependent problems. The concept of water security implies that the goal is to overcome a threatened state of the coupled human and natural water systems. Currently, we are armed with the theories and practices of risk analysis and risk management which have been developed over the years to encounter such uncertain events. Achieving water security can lead to tolerable levels of such water-related risk to society. Risk also offers a unifying framework to link across multiple water security challenges and take into account the tolerability of risk and the trade-offs in risk among different actors (Hall and Borgomeo, 2013). Yang et al. (Chapter 18) views water security in the framework of an acceptable level of water-related risks. They explore how China, a water stressed country by international standards with an uneven spatial and temporal distribution of water resources, has developed its water infrastructure over the years to reduce water-related risk but at

the expense of the environment, which might affect the well-being of future generations and intensify conflict with neighbouring countries. They also address the further need for implementing 'soft-path' measures in water management in China involving changes in governance, for instance where water management targets could be incorporated into the performance evaluation of the government officials and water managers.

4.5. Transboundary Water Sharing

Many rivers are not confined to political boundaries and thus the water availability of one country or region depends on the water usage of the upstream country or region. This increases the likelihood of a conflict, which may put the water security of a region at greater risk (see Chapter 7). Further, the way the water is shared between regions and countries also influences individual responsibility in terms of water security, be it national security, individual human security or environmental security. Countries in different regions emphasize different dimensions of security (environmental and human) and pursue different strategies for transboundary water resources cooperation to sustain economic growth and avoid inter-state conflict. Chapters 16, 17 and 18 also analyse water security through transboundary water cooperation, water sharing and its connection with political stability. South Africa has constructed several dams and inter-basin transfer schemes to increase access to water resources. It has entered into cooperative agreements to secure strategic water supplies – the Lesotho highland project being a classic example. Meissner (Chapter 17), while illustrating the case in South Africa, argues that water scarcity is often not the (direct) source of conflict between states sharing transboundary water resources and can at times lead to deeper cooperation. López-Gunn et al. (Chapter 16) find that in Spain, although it shares a number of large river basins with Portugal, which occupy almost 50 per cent of the Iberian peninsula (namely the Douro, Miño-Sil, Tagus and Guadiana), issues of international transboundary basins are kept relatively stable through an agreement called the Albufeira convention. The EU Water Framework Directive also provides a catalyst for a deeper level of coordination based on the exchange of information, knowledge, coordination of methodologies, and work programmes.

However, Yang et al. (Chapter 18) show that sometimes upstream countries, like China, often lack the incentive to collaborate with the downstream neighbours in water development on the concerned rivers, and one of the reasons could be their self-enforced upper riparian rights. China, for instance, is geographically upstream of most of its international rivers such as the Lancang River (Mekong), Yarlung Zangbo River (Brahmaputra) and Nu River (Salween) in the southern borders and the Heilongjiang River and Irtysh River in the northern borders; and its current water policies and development strategies have not explicitly addressed the issues relating to fair, equitable and sustainable utilization of the water resources in the shared rivers. Yang et al. also state that the conflicts between China and its neighbouring countries over the shared waters can have repercussions for its water security, socio-economic development and international trade and relations. Hence, along with improved water governance, it is also strategically important for China to cooperate with its neighbouring countries for its long-term water security and socio-economic development, as well as environmental sustainability.

5. BRINGING THE THREADS OF THE DISCUSSION TOGETHER

The conceptualization of security differs from discipline to discipline, from area to area, from theme to theme. What is clear is that while the theoretical explorations of the concept have examined the notion of security from different disciplines, the thematic and regional dimensions have taken a more pragmatic and target-oriented approach to analysing water security. In a globally interconnected world it is quite pertinent to understand how efforts to achieve human water security at transboundary, national, regional and local level influences the security of the water in other regions and accumulate as global syndromes of increasing environmental stress. Such understanding brings in the case of unidirectional externality, where consumption in one region influences water scarcity or water-quality degradation in another region. The notion of a Global Water System with water management, governance and hydrologic engineering as fundamental features is important here to understand how to attain water security and/or sustainability while minimizing the effects of such externalities. Uniting several disciplines such as engineering, socio-economics, law and politics and biogeophysics can help to identify the collective impact of regional-level actions to achieve water security on the overall global picture.

Grey et al. (2013) show that today many of the world's poor suffer from water insecurity and face water-related risks connected with complex hydrology while the world's wealthy enjoy water security and less complex hydrology. However, before any such concrete conclusions can be drawn with respect to water security, it is necessary to identify whether a country is also relatively water secure in terms of water consumption (from the demand side), and this is where the current literature lacks information about indirect effects that ripple through international supply chains, or quantifies virtual water trade without considering scarcity. Lenzen et al. (2013) address this concern partially by using a water scarcity index as a way of converting total water use into scarce water use, incorporating water scarcity as a factor in the global virtual water flow concept; their study finds that the global virtual water footprint changes significantly after adjusting for water scarcity. The conceptual analysis in this chapter has inquired into the wisdom of broadening and deepening the concept of security, while the thematic and regional chapters have investigated the issue of water security using a variety of different definitions in different fields and different countries.

This brings us to the issue of discourse pluralism. Does discourse pluralism in the area of water security provide us with an array of approaches to deal with the challenge of water governance? Can such pluralism facilitate integration of different perspectives and support a more holistic approach or will it rather encourage increasing fragmentation? Pluralism at the level of discourse may be beneficial in engaging diverse perspectives and different parties in the process of policy framing (Pahl-Wostl et al., 2013a). However, discourse and legal pluralism can both enhance and confuse governance. A Special Issue of *Current Opinion in Environmental Sustainability* entitled 'Sustainability Sciences: Legal Pluralism, Governance and Aquatic Systems' (Bavinck and Gupta, 2014a) focuses precisely on the issue of discourse, norm and rule pluralism in the area of water. It argues, inter alia, that such pluralism results mostly in fragmentation and rule incoherence; this may or may not be the desired outcome. While some authors in the Special Issue show

that discourse, norm and rule pluralism in relation to indigenous peoples and their access to water resources may result in their further marginalization as states engage in rule-shopping (Gupta et al., 2014), others argue that discourse pluralism is a major challenge to the implementation of human rights, namely the human right to water and sanitation (Obani and Gupta, 2014). Still others argue that such pluralism actually creates the space in which it becomes possible to protect myriad diverging interests from local through to global level (Jentoft and Bavinck, 2014). The question then is: can plural approaches to a concept and the diverging rule systems which will then emerge address fragmentation of water governance? The Special Issue argues that it cannot: plural approaches will always lead to fragmented, competitive and incoherent rules, but they may also lead to rules that are indifferent to each other or co-exist, rules that accommodate each other through encouraging public participation, and rules that are mutually supportive (Bavinck and Gupta, 2014b). This brings us to the question: when do we wish to encourage norm prioritization and when do we wish to encourage a diversity of perspectives that are contextually relevant to deal with various issues? While for some scholars the human right to water and sanitation is a non-negotiable basic right, for others this cannot be prioritized over other issues. This raises the enduring debate about whether there are objectively ascertainable primary norms which all societies should aim for or are all norms subject to negotiation?

But even agreement on basic norms cannot resolve the multifaceted challenges associated with implementing the water security concept. How can potential conflicts between water for basic human needs and water for the environment be resolved? Often these conflicts may have their origins in social inequalities and power structures and cannot be resolved unless we adopt a broader interpretation of the problem. What should be codified in rules? To what extent should they be procedural rather than substantive? Procedural rules regulate processes rather than outcomes. But making secondary rules is quite futile if the primary norms of rule of law and human rights are not respected and good governance principles are ignored (Pahl-Wostl et al., 2012). The implications of pluralism may manifest themselves quite differently depending on the quality of the discourse in which they are embedded.

We now return from the broader subject of discourse, norm and rule pluralism to the issue of whether 'water security' is just another new term to encapsulate the broad and systemic concerns the scientific and policy community have to deal with in water governance, or whether it is a much improved term that should replace those already existing. This book remains undecided upon this issue. Clearly the term is in vogue. Clearly it means different things to different people. Clearly it is used to enhance the sense of urgency to be given to the water governance challenge. However, equally clearly, merely adding the label of security will not ensure that it is achieved. This has been demonstrated by the long use of the term food security. At the same time, if it acquires the prioritization that energy security has achieved, this would imply the emphasis of national sovereignty and national securitization. For energy this has often been achieved using extraordinary measures including outright warfare. The question then is how can we raise the priority of water governance issues to such a level that everyone is willing to cooperate urgently in dealing with them as opposed to the use of hydro-hegemonic measures to control the resources exclusively for one group at the cost of others or hydro-economic measures to control these scarce and very valuable resources through privatization (e.g. Merme et al., 2014). In

other words, does the security concept also imply a sustainable solution or does it in fact challenge the possibility of sustainable solutions?

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