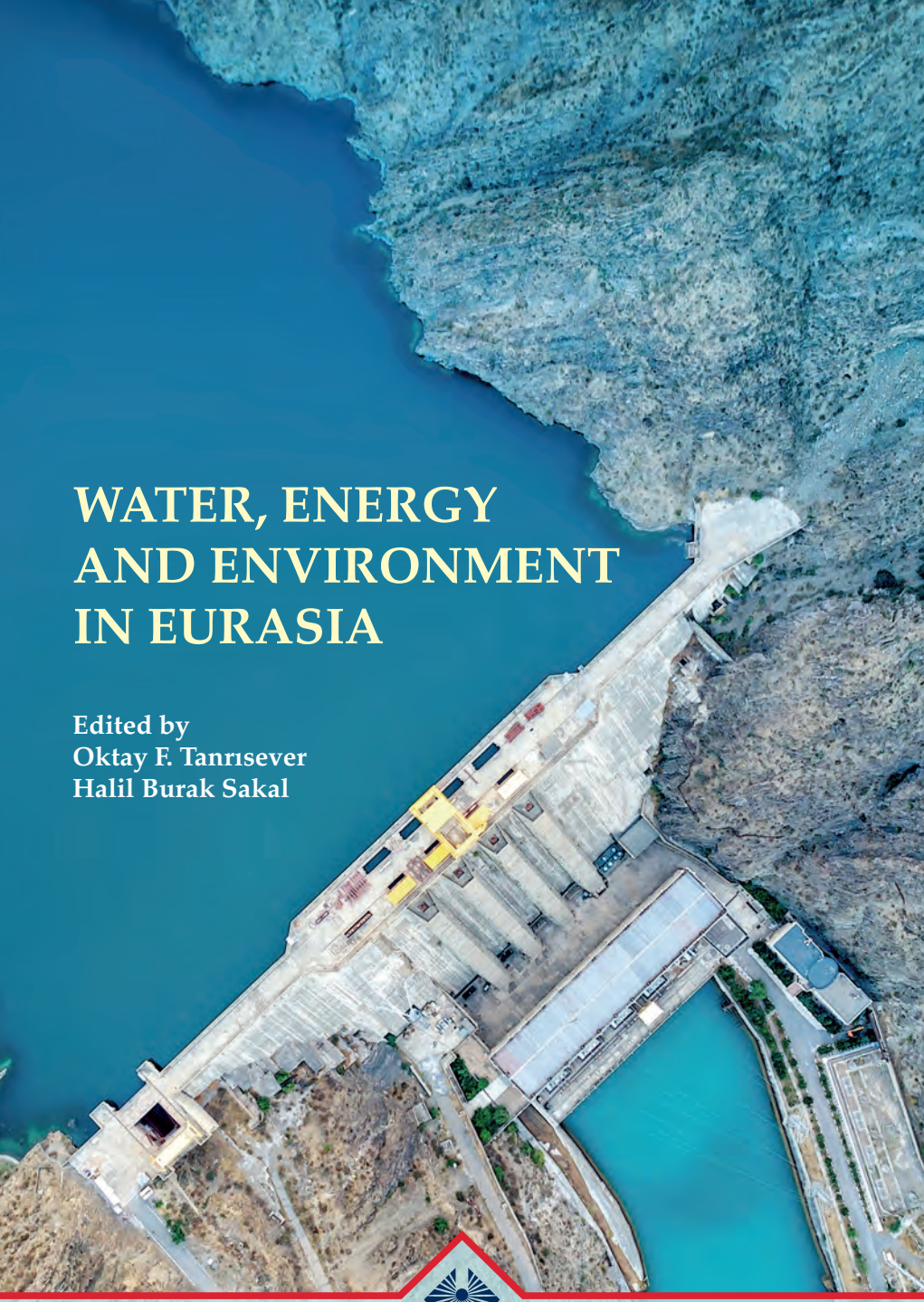
WATER, ENERGY AND ENVIRONMENT IN EURASIA

Edited by
Oktay F. Tanrısever
Halil Burak Sakal



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CAPPADOCIA UNIVERSITY PRESS
yayinevi@kapadokya.edu.tr
kapadokyayayinlari.kapadokya.edu.tr
+90-384-3535009
www.kapadokya.edu.tr

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Chapter 1

Water, Energy and Environment Nexus

Halil Burak Sakal, Oktay F. Tanrisever

Introduction

Water issues and policies are often linked to other issues, such as the environment (World Bank, 2016), pollution (P. Kumar & Saroj, 2014), climate change (Beck & Walker, 2013; Welsch et al., 2014), agriculture (or food) (Bazilian et al., 2011; Cooley et al., 2014; Finley & Seiber, 2014; Keskinen et al., 2016; Lawford et al., 2013; Lele et al., 2013; Muller, 2015; Smajgl et al., 2016) or population (Chen et al., 2016), and these interconnected policies and issue-linkages form a system, a complex, or more simply, a nexus. While academicians have focused on various nexuses since the 1970s and 1980s (Allan et al., 2015; Cooley et al., 2014; Dodder, 2014; Muller, 2015), there is as yet no commonly agreed-upon definition for the term. The nexus as an analytical tool supports scientific research, and is embraced as a governance framework by politicians and decision-makers alike (Keskinen et al., 2016).[1] This approach of governance relies on the application of "multisectoral" and "multistakeholder processes" at multistate or regional levels (Keskinen et al., 2016, p. 14).

1 The authors have carried out a comparative analysis of the water-energy-food nexuses of Central Asia, South Asia and Southeast Asia (the Mekong).

The United Nations (UN) and other international organizations increase emphasis on sustainability issues. The Sustainable Development Goals (SDGs) set out within the UN 2030 Agenda for Sustainable Development have expanded the dimensions of sustainability and focused on stakeholder responsibilities. Most of the SDGs are closely linked to the water, energy and environment nexus, making sustainability a priority for public and private sectors. The 2021 UN Climate Change Conference in Glasgow showed the urgency of immediate action in environment, energy and water related problems of the planet.

Problems of energy, water, and the environment are often interconnected, and the solution to these problems needs a nexus-based approach. The nexus approach gained prominence during the UN Conference on Environment and Development in Rio de Janeiro in 1992 amid the debates on "development versus environment". This debate was based on the economic aspect of water and energy and their "social and cultural dimensions" were ignored (Muller, 2015, p. 675). Today, it is understood that this approach failed to resolve environmental problems, and so the nexus approach regained momentum in academic and policymaking circles focusing more on socio-economic sustainability and resilience.

The necessity of going beyond the resource management discourse made the nexus approach gain impetus in academia and decision-makers in the 2000s. According to Smajgl et al., a dynamic nexus approach balanced among the sectors is needed (Smajgl et al., 2016). In this chapter we present a framework for the *water*, *environment*, and *energy* nexus, as one of the most commonly analyzed linkages in literature (Ackerman & Fisher, 2013; Allen et al., 2014; Biswas et al., 2013; Hoekstra & Mekonnen, 2012; Holland et al., 2015; Hussey & Pittock, 2012; Liu et al., 2015; Siddiqi & Anadon, 2011; Sovacool & Sovacool,

2009; Walsh et al., 2015) from a social and political perspective (Allan et al., 2015, p. 309).

The water-energy-environment nexus

The water-energy-environment nexus focuses on the natural and technical phenomenon at a system level (Dodder, 2014, p. 7), suggesting that water, energy and environment rely on each other. This reliance has been reported to be asymmetrical, although the energy needed to capture (Cooley et al., 2014, p. 6), pump, transfer and treat water is relatively less significant than the amount of water used for mining, hydraulic fracturing (Cooley & Donnelly, 2014), refining oil and gas, power plant cooling and hydroelectricity generation (Hussey & Pittock, 2012). On the other hand, the impact of processes such as water withdrawal, irrigation, mining, energy generation and the final consumption of energy has an enormous impact on the environment (Tidwell & Pebbles, 2015). As the increasing global greenhouse gas emissions deteriorate the negative impacts of global warming, the interrelated systems of water, energy and environment need urgent focus of policymakers (Wan & Ni, 2021).

Blue water is often defined as the water available from such water bodies as lakes, seas and rivers; green water, on the other hand, is the water provided by rainfall that is held in the soil; and gray water refers to water pollution. Blue water is used in the production processes of nearly all commodities, while food and other agricultural productions around the globe rely heavily on green water. When blue water is used in agricultural production, "it competes with other water users in industry" (Allan et al., 2015, p. 305).

A remarkable peculiarity here is the difference between the concepts of withdrawal, use and consumption of water (Wu et al., 2008). Water withdrawal is defined as "any water

diverted from a surface or groundwater source" (US Department of Energy, 2014). Consumed water does not return to its source because of evaporation, transpiration, incorporation into products, transfer to a different basin, or stored in the dams (Hoekstra et al., 2011). Nearly 80 percent of the evaporation and transpiration associated with agricultural production comes from green water, and the remaining from blue water (Molden, 2007, pp. 5–7).

Withdrawn water, used or consumed during such economic processes as energy generation or agricultural activity, is "any water diverted from a surface or groundwater source" (Dodder, 2014, p. 8; Liu et al., 2015, p. 319; US Department of Energy, 2014, p. 1), and has impacts on the environment (Kumar & Yaashikaa, 2019). Both blue and green water can be consumed (US Department of Energy, 2014, p. 1), in that water consumption means the "loss of water from the available ground-surface water body in a catchment area" (Hoekstra et al., 2011, p. 2). This consumption alters the water cycle, has impacts on fragile ecosystems by changing the flow regime, temperature, and other chemical properties of water (Döll et al., 2012).

Industry is a significant user of water, with the main area of use in the industrial sector being for "heat transfer" in the form of heating or cooling, steam production, washing of products and factories, control of air pollution or incorporation into products (Green, 2003, p. 219). Power plants, especially thermoelectric plants, use vast amounts of water for cooling, for the production of steam to drive turbines and for the operation of "environmental control systems" (Dodder, 2014, p. 8). Some of the power plants built in the mid-20 century up until the 1970s used a technology called "once-through" or "open-loop" cooling, which withdraws water from the source and returns it to the source at a higher temperature after cooling.

More recent systems use a recirculating cooling approach in which the same water is used several times for cooling. During this process, evaporative consumption is higher, while water withdrawal is less than in once-through systems. Often, hybrid system installations that combine dry cooling and recirculation are preferred (Dodder, 2014, p. 8). In the production process of hydroelectricity, the consumptive use of water differs significantly. Large amounts of water are subject to evaporation from huge reservoirs. In the United States, calculations of the water lost to evaporation from reservoirs range from 0–68 cubic meters of water per MWh of produced hydroelectricity (Dodder, 2014, p. 11).

Water and climate change

The "water footprint" of a process or product is the amount of water consumed while completing the process, and includes fresh surface water withdrawals (blue water), rainwater intake (green water) and the degree of water pollution (gray water) during industrial and agricultural production processes, tourism activities or domestic use. (Hoekstra et al., 2011; Vanham, 2016, p. 2). There are two basic approaches to estimating the water footprint, being the volumetric approach (Hoekstra et al., 2011, p. 23),[2] and "life-cycle assessment". While the former is based on "water management", the latter focuses on production processes. The volumetric approach encompasses blue, green and gray water, while life-cycle assessment includes only blue water.

On a global scale, agricultural production generally has the highest water footprint (92 percent), while industry and domestic use account for 4.4 and 3.6 percent, respectively (Hoekstra

2 In this approach, water footprint is calculated as water volume per product or per time period.

& Mekonnen, 2012, p. 3233; Holland et al., 2015, p. E6708). Around 24 percent of domestic and industrial use is related directly to the energy sector, which globally accounts for 6.5 cubic kilometers of clean water consumption per year, while the petroleum and natural gas sectors consume 1.6 and 0.3 cubic kilometers, respectively (Holland et al., 2015, p. E6708). It should be kept in mind that bio-energy crops also consume water (Wu et al., 2008). The International Energy Agency estimates that between 2010 and 2035, an 85 percent increase in clean water consumption is likely to occur, driven largely by the increased demand for biofuel (Holland et al., 2015, p. E6713). The large amount of water used in the energy lifecycle (oil, electricity, bio-energy) raises the issues of sustainable water and energy production, water degradation and pollution, and ecosystem damage (Wu et al., 2008, p. 4).

The withdrawal of water for irrigation, and domestic and industrial use has been increasing since the beginning of the 20th century. According to estimates, agricultural withdrawals have increased more than five-fold, while domestic and industrial withdrawals have increased 18 times throughout the 20th century (Davies et al., 2013, p. 296), and whether these trends will continue is a subject of frequent discussion in the literature. There have been several attempts to calculate the future water demands for the production of electricity, with some authors concluding that by the end of the century the water withdrawals for electricity production will decrease, while general water consumption will increase as a result of population and economic growth. Any decrease in the withdrawal of water for electricity generation will be thanks to the development of cooling technologies in power plants, the increased awareness of climate change, the adoption of water-saving technologies, etc. (Davies et al., 2013; Liu et al., 2015). These decreases could be possible under different assumptions or scenarios,

such as through laws and regulations aimed at reducing water use, caps on carbon emissions, or water and carbon limits (Ackerman & Fisher, 2013).

Carbon footprint is used for measuring impacts of processes on the environment. Almost all processes of water use and energy production and consumption cause carbon footprint. Energy is used for the sourcing, treatment and distribution of water, while water is used in various phases of energy production. The energy required to deliver 1 cubic meter of water for human usage differs depending on the source of the water, with the cheapest source being water withdrawn from lakes or rivers, which has an average cost of 0.37 kWh energy per cubic meter. In contrast, drilling for groundwater costs 0.48 kWh; treating wastewater costs between 0.62 and 0.87 kWh; reusing wastewater costs 1–2.5 kWh; and treating seawater requires 2.58–8.5 kWh of energy per cubic meter of water supply (Walsh et al., 2015, p. 19). Globally, approximately 8 percent of all generated energy is used to pump, transport and treat water (The Climate Reality Project, 2016).

On the other side of the coin is the water used for energy generation. Nearly 90 percent of the global power generation is "water-dependent." A large proportion of global electricity is produced by boiling water to create steam to drive the turbines (The Climate Reality Project, 2016). Thermal power plants, which have the largest share of global energy production, are responsible for around 40 and 50 percent of the total clean water withdrawals in Europe and the United States, respectively (Liu et al., 2015, p. 319; The Climate Reality Project, 2016; US Department of Energy, 2014, p. 1). Furthermore, irrigation in the United States is responsible for 37 percent of total withdrawals (Liu et al., 2015, p. 318). Globally, according to International Energy Agency estimates, in 2010, nearly 15 percent of the total clean water withdrawals were linked to

energy production (Walsh et al., 2015, p. 20). There have been suggestions that internationally accepted standards such as the ISO14046 "Environmental Management: Water Footprint" and management practices increase efficiency in water management (Walsh et al., 2015, p. 27).

Water is also consumed in the lifecycle of energy. In secondary phase oil-recovery processes during hydraulic fracturing (Cooley & Donnelly, 2014), large amounts of water with chemical additives and "propping agents" (e.g. sand, ceramic beads, etc.) are injected into the earth to extract more oil through the creation of cracks in the rocks. During this process, much of the injected water and its additives remain underground (Cooley & Donnelly, 2014, p. 64). Although this amount depends on the well, in the United States, the net water use (water injection minus produced water) ranges from 2–5.5 gal per gal of extracted crude oil (Wu et al., 2008, p. 3). Refining oil also consumes water. In the United States, the amount of water ranges from 0.5 to 2.5 gallons per gallon of processed crude (Wu et al., 2008, p. 4).

The nexus approach and policy making in water, energy and environment

Academicians studying the water-energy-environment nexus advise policymakers to assess issues based on technical subjects such as "water footprint" and "virtual water flows" that complicate the already challenging water and energy policies.

Virtual water and its trade contribute to the scarcity of water and the political milieu surrounding water and is essential in terms of development policies (Warner & Wegerich, 2010, p. 5). Hussey and Pittock note that energy, environment and water policies are usually developed separately (Hussey & Pittock, 2012). Policies aimed at developing one sector or protecting the natural environment may place pressure on another

interrelated sector – either water- or energy-related sectors (Hussey & Pittock, 2012). This is especially true for developing countries. Considering the increasing pressure of fighting climate change on the developing countires, the Paris Agreement foresaw a US$ 100 billion of climate aid each year from the industrialized countries to the developing world.

On the other hand, the policymaking circles in the developed countries give rising importance to environmental issues and have already begun treating nexuses as a whole (US Department of Energy, 2014). In the United States, the energy sector uses the largest quantities of water, having an immense impact on the environment, and prominent international organizations such as the United Nations and the World Business Council for Sustainable Development are all well aware of the importance of this issue (Hussey & Pittock, 2012).

Allan, Keulertz and Woertz identified a link between the nexus and economy, suggesting that food and energy are both "emotional" inputs for society, and that water, food and energy policies, such as taxes and subsidies, have a direct effect on the "social contract" between political leaders and society (Allan et al., 2015, p. 302). Internationally, the agricultural policies of rich OECD countries have a determining effect on food prices, while energy prices, especially the price of oil, are determined by big oil corporations and governments. The nexus of food, water and energy is "dominated by market mechanisms" according to the authors, and these mechanisms have damaging impacts on the nexus that are often underreported (Allan et al., 2015, pp. 302–304).

Considering the environment as a whole when shaping water and energy policies is essential. Scott et al. suggest the application of two concepts in nexus-based decision-making, being "resource coupling" and "multi-tiered institutional arrangements". Resource coupling takes into account the regional and

basin-scale resources of water and energy required to meet human demands. It is argued in this regard that the global demand for resources has an impact on local levels. Multi-tiered institutional arrangements refer to "laws, policies and organizations that operate across jurisdictional levels for the management of resources" (Scott et al., 2011, p. 6623), and the authors suggest that institutions and decision-making practices should be integrated into the nexus approach (Scott et al., 2011, p. 6629).

The similarities and differences between water and energy play a decisive role in the nexus-based approach to environmental policymaking. In their utilization of both water and energy, people have an impact on the climate and environment. As national incomes have grown around the globe, the demand for energy and water has followed suit throughout history, yet, the quality and quantity of both vary significantly geographically. There is a dramatic difference between the relative costs of water and energy resources, and as a result, the energy sector is much larger than that of water. Consequently, the energy sector and business both influence and are being influenced by politics and policymaking. Furthermore, they are being impacted by environment-related international agreements, binding regulations such as the EU's Green Deal, and increasing social pressure. As the energy sector is relatively more developed than the water sector globally, there is greater availability of energy data than water data to be used in policymaking (Walsh et al., 2015). While energy is transferable and can travel long distances in various forms (such as electricity, hydrocarbons through pipelines), water is a "local or regional resource" (Scott et al., 2011, p. 6629), which means that energy policies can be on a global scale, while water policies remain at a local, regional or basin scale. This difference results in a situation where energy policies (such as use, reduction, efficiency)

are referred to as solving global environmental problems while water problems may be ignored based on their local scale.

A highly significant aspect noted in relevant literature and in policymaking is the recognition of the importance of climate change, its impacts on the global economy (Koch, 2002) and its relationship with water and energy issues. With a focus on the climate, land, energy and water nexus, Welsch et al. revealed the importance of climate change when assessing the linkages in the subject matter, and the increasing demand for hydroelectricity may further increase the importance of such a nexus (Hermann et al., 2011; Welsch et al., 2014, pp. 1443–1444). A World Bank study concluded that water scarcity, together with the accelerating impacts of climate change, may lead to a shrinkage in national incomes of to 6 percent by 2050, leading to mass migration and conflict around the globe. The fact that the negative impacts of water scarcity and climate change may be reversed through better water and environment policies (World Bank, 2016) increases the importance of resource management at a global level.

Criticizing the nexus approach from a Foucauldian perspective, Leese and Meisch argue that nexus approaches are dominated by the neoliberal discourse, and suggest that the current understanding of the water, energy and food nexus is highly "securitized". The agenda of nexus debates, they claim, has undergone a change of focus from "distributional justice" to the security of supply and economy, and suggest that the issue of sustainability is seen as an "imminent threat that legitimizes urgent action" (Leese & Meisch, 2015, p. 704).

Previous studies have sought to combine the nexus approach with the integrated water resources management (IWRM) approach. According to Benson et al., the "IWRM and nexus approaches appear closely related" (Benson et al., 2015, p. 757), claiming that the priorities and aims of both IWRM and nexus

approach overlap to a great degree, although the IWRM has been dominant since it was first embraced on international platforms as a guide to development (Benson et al., 2015).

The nexus of hydropower, water management and environment

The transfer of water and electricity has increasing impacts on the environment. Extensive irrigation systems often take the form of long networks of irrigation canals and large reservoirs, the length of which can have considerable impacts on the environment. First of all, the longer the network, the greater the surface area of the irrigation system, leading to increased evaporation in arid and temperate climates. Sometimes the water in a catchment area evaporates naturally in shallow and wide wetlands, such as the Sudd in the upstream Nile River Basin (Mohamed et al., 2005). The impact is further increased if the water is transported to agricultural regions outside the catchment area. Second, irrigation water that travels long distances and mixes with local waters, can lead to changes in the composition of the local water, such as in its hardness, temperature and flow regime, which may have a detrimental effect on some species that may even lead to total extinction. Third, newly established connections between water bodies may lead to the transfer of species from one region to another (Green, 2003, p. 294), with the potential to upset the local ecosystem.

Hydroelectricity production is often regarded as clean and renewable (Frey & Linke, 2002), although some studies challenge this claim (Gagnon & Van de Vate, 1997; A. Kumar & Sharma, 2012). As Orr et al. note, the construction of dams and reservoirs "always created conflicts between energy supply and related economic interests, versus their social and environmental impacts" (Orr et al., 2012, p. 926). As the global population growth and demand for greater economic and social wealth

continues, especially in developing economies, dams tend to continue to be the primary choice of policymakers in their efforts to bolster development (Chen et al., 2016).

Hydroelectricity production consumes considerable amounts of blue water, mainly through evaporation from the large surface areas of reservoirs. In a 2015 study, Zhao and Liu, summarizing the approaches to the assessment of the water footprint of hydroelectricity production, listed three main approaches. The first is the gross water consumption method, in which the gross amount of water that evaporates from the reservoir is evaluated; second is the net water consumption method, which considers the evaporation levels prior to the construction of the dam, and subtracting it from the gross water evaporation; and third is the water balance method, based on the difference between the annual inputs and outputs of the reservoir (Zhao & Liu, 2015, p. 41). The authors go on to suggest that a new method can be developed that distinguishes hydroelectricity production from the other uses of the dam – that is, considering the water consumption linked to the reservoir for its functions of flood control, recreation, navigation, water supply and agriculture, separately from its hydroelectricity production function, using an allocation coefficient based on the weight of the economic value of these individual functions (Zhao & Liu, 2015, pp. 42–45). The authors assume that reservoirs consume only blue water, and that no water pollution is caused during the production of hydroelectricity. However, other researchers showed the negative impacts of HPPs on water quality (Wei et al., 2009) and the environment (Pohl, 2004). The impact is high for large dams with large reservoirs, although moderately sized dams also have impacts (Brown et al., 2009; Pohl, 2004; Stanley, 2018; Tilt et al., 2009).

In their study of a reservoir in China, Wei et al. found that dams decrease the quality of water in the reservoirs over the

long term, although some improvements in quality may be experienced in the short term (Wei et al., 2009, pp. 1776–1777). Another study reported the water quality of rivers and streams to be severely affected by the construction of dams (Kurunc et al., 2006). The above studies generally refer to the contamination of the reservoir water, although other scholars have argued that the water quality in the lower part of a basin, downstream of a dam, generally remains unaffected (He et al., 2006, p. 24). In general, the impact of dams on river ecosystems, water quality, health (Lerer & Scudder, 1999) and other factors related to socio-economic and political outcomes are well documented, having been discussed at length in the relevant literature.

Another major impact of large dams is on fisheries, even in the presence of fish passages or fish ladders (Orr et al., 2012, p. 926; Rosegrant, 2015, p. 17), while the sediment accumulation or sedimentation associated with dams can be to the detriment of rivers (Morris & Fan, 1997), which can be a major issue in river basins where there is dense agricultural activity. Furthermore, most large dam projects necessitate the relocation of the local population, usually the poor, whose farmlands and pastures will be covered by the reservoir (Wang et al., 2013). As a general trend, dam removal has been touted as an important and viable alternative to decrease their negative effects (Stanley et al., 2002, pp. 172–173), with factors such as dam safety, the increasing costs of maintenance, environmental concerns and the reduced benefits from dams being put forward as justification. In the 20th century, 587 dams were decommissioned in the United States, gaining pace particularly between 1995 and 2000 when the number of dams removed reached 140 (Pritchard, 2001).

Small hydropower projects are generally considered to be more environment-friendly (Abbasi & Abbasi, 2011, pp. 2139–2140; Frey & Linke, 2002), there being no, or only a small

dam, with a small reservoir (Paish, 2002, p. 538). Due to their small size, the efficiency of small hydropower generators is usually lower than that of large turbines (Paish, 2002, p. 540). On the issue of cost efficiency, small high-head, i.e. higher than 50 meters, HPPs are more cost-effective than those with a lower head, and while small low-head HPPs are more common, most are usually not attractive as an investment choice (Paish, 2002, p. 548).

There is a strong link between climate change, energy and electricity production. The Paris Agreement, under the UN Framework Convention on Climate Change, was signed in April 2016 in New York and entered into effect in November 2016. As of 16 December 2016, 118 parties, accounting for 80 percent of all global emissions, had signed the text, with China and the United States – two major sources of greenhouse gasses globally that account for 20 and 18 percent of the total global emissions, respectively – ratified the agreement. Turkey ratified the agreement in late 2021.[3]

Perhaps the key to the Paris Agreement is energy production, being responsible for at least two-thirds of the global emissions of greenhouse gasses. Accordingly, as the International Energy Agency argues, "transformative change in the energy sector" is essential if the agreement is to reach its aims (IEA, 2016, p. 21). Renewable energy and electricity production is an important aspect of this transformation. As of 2015, the increases in the amount of greenhouse gasses resulting from energy generation have stopped (IEA, 2016, p. 21), although the Agency stresses that the water and energy nexus will intensify in the coming decades due to the rising energy demand related to the provision of water (IEA, 2016, p. 347),[4] irriga-

3 The member states that did not sign the Agreement are Nicaragua, Syria and Uzbekistan.

4 Water sector demanded 120 Mtoe of energy in 2014, principally in the form of electricity.

tion and energy production. The trend here, however, is also optimistic, as the development of more efficient cooling technologies will lead to a decrease in the amount of water withdrawn from reservoirs (IEA, 2016, p. 347).

As suggested by Burgos, integrated electricity systems and a pooling of resources can support environmental policies and renewable electricity production, leading to greater efficiency in electricity generation (Burgos, 2007, p. 2), although this requires coordinated energy policies, and strong institutions and regulations (Burgos, 2007, p. 11) in countries with various energy sources. For instance, coal-fueled generators in a country with low potential for hydro or solar power can be supported by renewables from neighboring countries at times of peak demand. That said, such integrations can also have adverse effects, especially in liberalized and non-regulated energy markets, where private generators may prefer lower cost power plants for the production of electricity, including coal- or gas-fired plants (Burgos, 2007, pp. 2–3). It should be kept in mind, however, that the steady decline in the cost of installed solar power will make photovoltaic cells a more sustainable and preferable source of electricity generation in the future, ahead of fossil-fuel generators (Barbose & Darghouth, 2016; Bolinger & Seel, 2016; Fehrenbacher, 2016; Shankleman & Martin, 2017).

Conclusion

This chapter has analyzed and explored theoretical studies of water, energy and environment along with the recent debates on socio-economic and developmental aspects. The multidisciplinary character of the subject necessitates the scrutiny of a wide range of studies from various disciplines including, but not limited to, political geography, environmental history, hydrology, ecology, earth sciences, engineering, politics and economics.

Influenced by a neo-Malthusian realism, some studies tend to link water, energy and environment with security issues, and evaluate nexus-related policy areas within a state-centric framework. On the other hand, the approaches focusing on institutions, regimes and regional cooperation have a more optimistic outlook framed by socio-economic and environmental sustainability. The scholars embracing the latter approach tend to maintain the view that the application of widely-recognized nexus analysis would support optimum sustainable outcomes in water management and energy production. Finally, critical approaches try to maintain a distance from state-centrism or the determinism of traditional theories.

Here, a more technical aspect of literature is the nexus approach, based on its embrace of theoretical and practical politics and economics. This chapter reviews the nexus approach from the perspective of its impact on policymaking, arguing that water development and management issues within the significant river basins, along with energy production and trade issues, should be evaluated as a whole considering their impact on the natural environment. In this respect, this chapter provides a framework for the book, in which the highly interrelated issues of water, energy and environment are discussed based on case studies selected from the Eurasia region.

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