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## Chapter X.32: Large-scale water infrastructure, territorial transformation and water rights dispossession

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## X.32 Large-scale water infrastructure, territorial transformation and water rights dispossession

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### **Abstract**

This chapter uses a political ecology approach to examine how large dams and mega-hydraulic infrastructure in many parts of the world dispossess smallholder families and communities of their water and water rights, transforming and disintegrating territories environmentally and socially. It deploys the notion of ‘hydraulic property creation’ to look at the relationships among hydraulic infrastructure development and changing water rights frameworks. It contrasts mega-hydraulic projects that separate designer-builder and user worlds, and user-developed hydraulic systems. It presents important points of attention for more people- and nature-inclusive water governance and hydraulic intervention projects that build on social and environmental justice.

### **Keywords**

Large dams, mega-hydraulic infrastructure, water rights, water governance, environmental justice, hydraulic property creation

### **Contents**

- X.32.1 Introduction
- X.32.2 Evaluating mega-hydraulics and water dispossession
- X.32.3 Current justice issues related to large-scale water infrastructure
  - X.32.3.1 The rise of large infrastructure and its impacts
  - X.32.3.2 User-led water control systems and expert-developed mega-hydraulics: diverging rationalities and the impact on water rights
- X.32.4 Considerations for the future: more reflexive and equitable water policies

### **X.32.1 Introduction**

Throughout history, the burdens and benefits of large-scale water exploitation and development projects have been unevenly distributed, with different consequences for different social groups, places, and regions at various levels of scale. Control over wells and aqueducts in early societies led to water dispossession. With the increasing scale of hydraulic engineering the scale of dispossession increased. In many parts of the world, policies supporting urban-based modernity and industrial-commercial growth have produced specific forms of development that lead to rural marginalization. Large-scale water development projects make water available for growing urban water needs, hydro-electric generation, large commercial export agriculture, and industrial growth sectors, including large mining projects. These projects often claim water resources that are used

for subsistence agriculture by local communities and available for ecosystems.<sup>1</sup> Existing water uses and rights tend to be disregarded when water is allocated to be ‘developed’ for large-scale projects. This neglect, the expropriation of land and water it provokes, and the displacement of rural people that such projects often entail, trigger flows of migration to the expanding cities, further increasing urban water and energy demands.<sup>2</sup>

Using a political ecology focus, and the notion of hydraulic property creation, this chapter focuses on how large dams and mega-hydraulic infrastructure often dispossess smallholder families and communities of their water and water rights, thereby re-configuring territories institutionally, environmentally, and socially in ways that are difficult to reverse. It examines relationships among water’s technological and normative/sociolegal development (the interactions among hydraulic and water rights frameworks), contrasting user-developed hydraulic systems and mega-hydraulic projects. It also discusses how policies, knowledge frames, and politics mediate these processes, and what social responses they provoke. The last section focuses on the future and presents some points of attention for more reflexive water policies.

### **X.32.2 Evaluating mega-hydraulics and water dispossession**

An important issue is how, in comparison with small user-built water works, large water development projects produce inclusion and exclusion, development and marginalization, and benefits and burdens, as well as particular water rights and property relations among different groups of people – and how such processes are contested and legitimized.<sup>3</sup> Water, technology, and society are deeply interrelated in shaping ‘hydrosocial territories’.<sup>4</sup> In comparing large hydraulic infrastructure projects with (contemporary and previously existing) small dams, weirs, and diversion structures developed by farmers and user communities, it is crucial to see how different water acquisition, storage, and provision arrangements and distribution networks structure conditions of access and use for different categories of users.

How do different groups of people gain or lose access to water rights – in particular water flows (in terms of quality, quantity, timeliness, and security) and decision-making power over system governance – through hydrosocial transformations, choices of technology, and development of large versus small dam infrastructure. Such analyses need to include an examination of changing legal (including customary law-based) property in water and related resources (eg land), and how these are contested, legitimized, or agreed upon.<sup>5</sup> This analysis builds particularly on the notion of ‘hydraulic property creation’<sup>6</sup> during water infrastructure development: how investing labour, financial, and other resources in building and maintaining water facilities establishes water property rights and water decision-making privileges among the water technology builders as

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<sup>1</sup> Hommes and others (2019).

<sup>2</sup> Boelens and others (2018); Swyngedouw (2015); Zwarteveen (2015).

<sup>3</sup> Shah and others (2019).

<sup>4</sup> Boelens and others (2016).

<sup>5</sup> Roth and others (2015).

<sup>6</sup> Coward (1986) 491.

well as power relations with and within the broader political-geographic environment.<sup>7</sup> Hydraulic property relations shape the normative-political basis for water system maintenance, operation, and governance action, and work differently for community versus governmental or private sector action.

### **X.32.3 Current justice issues related to large-scale water infrastructure**

In recent decades, developing large-scale dams and river diversion schemes has been accompanied by large controversies. Mega-dams were beneficial for some social groups, but the social and environmental costs of water and energy production are huge for many, particularly marginal, population groups, as well as for local ecologies. In many places, people affected by hydropower projects and river diversion schemes, through dispossession, expropriation, or resettlement, have been left bearing the burdens but receiving no benefits.<sup>8</sup> User-developed water control systems and water rights exhibit very different characteristics. This part explores how to understand the two approaches.

#### *X.32.3.1 The rise of large infrastructure and its impacts*

Swelling local and international controversies over large dams in the 1990s, as with the Sardar Sarovar Dam in India and the Three Gorges Dam in China, called for a review of the effectiveness of large dams but also proclaimed the need to rethink their impacts.<sup>9</sup> Large-scale interventions in hydro-territorial systems have become icons of maldevelopment, representing capital-centric and construction-biased civil engineering projects based on supply-side hydrology that fail to recognize the complexity of river systems, ecosystems, and social systems.<sup>10</sup>

Despite two decades of widespread criticism of mega-dams on social and environmental grounds (leading to the withdrawal of international policy institutes and funding agencies), hydropower and large dam development have made a worldwide comeback,<sup>11</sup> sometimes financed by local banks.<sup>12</sup> In the global South, there are ambitious plans for new water resources development projects. Many of them are situated in the environmentally fragile upper catchments of large river systems, such as the Andes and the Himalayas, or in the world's crucial ecological or political regions, such as the Amazon and Nile basins. Unlike earlier large dam projects that were mainly spurred by agriculture and food security goals, these new developments are inspired by the need to meet rapidly growing water and electricity demands of industrial and non-agricultural sectors, including mega-cities and agribusiness.

Generating 'clean electricity' for a 'green economy' has become a main justification for dams and water storage schemes.<sup>13</sup> The World Energy Council stated that in

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<sup>7</sup> Roth and others (2005); Boelens and Vos (2014); see Gupta and Bosch, Chapter X.23 in this book.

<sup>8</sup> Johnston (2018) 169; Duarte-Abadía and others (2015).

<sup>9</sup> World Commission on Dams (2000).

<sup>10</sup> McCully (2001); Lynch (2019).

<sup>11</sup> Del Bene and others (2018).

<sup>12</sup> Merme and others (2014).

<sup>13</sup> UN Water (2009); Shah and others (2018).

2015 76 per cent of all renewable electricity came from hydropower plants.<sup>14</sup> The World Bank, criticized in the 1990s for its major support to ill-conceived mega-dam electricity projects, temporarily moved away from these projects, but since the early 2000s has returned to funding controversial big dam and water transfer projects.<sup>15</sup> Dam development was reinvented and reframed in the strongly depoliticized language of overall progress, sustainable, clean development, and efficient, rational water management, disregarding ‘competing claims and conflicts over water, landscape and hydropower development and assorted interrelated struggles over socio-cultural issues, problem definitions, knowledge frameworks, ontological meanings, decision-making and preferred solutions’.<sup>16</sup>

At least superficially, new large water development projects display a greater awareness of their social and environmental consequences, and project plans often include meticulously detailed protocols for environmental impact assessments, mitigation, and compensation. In practice, however, much of this exists only on paper. The new water projects prioritize the needs of industries and big cities over those of food security, poverty alleviation, and rural livelihoods. Simultaneously, particularly in the global South but also in the North,<sup>17</sup> grassroots organizations, displaced communities, and indigenous protestors are increasingly criminalized and violently suppressed for defending their land and water rights.<sup>18</sup>

Large dams are based on strong coalitions. Large-scale water infrastructure is often favoured over smaller and cheaper alternatives because of the powers and interests of the ‘iron triangle’ of bureaucrats, politicians, and engineers.<sup>19</sup> These make effective use of ‘normalizing’ and legitimizing discourses of scarcity, efficiency, and national development to discredit alternatives that may be more socially and environmentally sound. What characterizes current social debates on dams is strong polarization mainly along a small-versus-large dichotomy. ‘Bad’ large infrastructure based on modern engineering is pitted against ‘good’ community-based, small-scale infrastructure. Yet ‘small’ and ‘large’ are relative categories and the scale of the infrastructure is not the only determinant of how water interventions impact on environment and societies. Small-scale infrastructure is also influenced by existing power structures and social differentiation based on class, caste, ethnicity, or gender. But scale and size certainly do matter. The sheer size of mega-dam development and operations makes them capital-intensive, requiring and building on universalist, positivist, expert-knowledge that cannot be found locally but is embedded in (trans-)national knowledge centres, engineering schools, and private sector consultancy networks. The above-mentioned ‘iron triangle of powers’ and impressive commercial gains give these projects enormous political interests, promote corrupt practices, and stimulate non-transparent operations.<sup>20</sup> In addition to causing huge transformations of the existing hydrosocial environments, they build on the idea that economic growth must be pursued at all costs and ignore legal frameworks that recognize human

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<sup>14</sup> Menga and Swyngedouw (2018).

<sup>15</sup> Lynch (2013).

<sup>16</sup> Hommes and others (2016) 11.

<sup>17</sup> Boelens and others (2019).

<sup>18</sup> Eg Hidalgo-Bastidas and others (2018); Del Bene and others (2018); Lynch (2019).

<sup>19</sup> Ajaya and Gyawali (2010); Molle and others (2009).

<sup>20</sup> Dye (2016); Huber and Joshi (2015).

rights and the rights of indigenous peoples,<sup>21</sup> with local water rights remaining unnoticed, irrelevant, and undermined. Yet these localized, smaller hydraulic works – though not necessarily equitable to all – are characteristically based on local history, culture, site-available materials, organizational capacities, and knowledge frames.

*X.32.3.2 User-led water control systems and expert-developed mega-hydraulics: diverging rationalities and the impacts on water rights*<sup>22</sup>

A fundamental issue is that, differently from user-developed water works, large infrastructure development separates the designer-builder and the user worlds, with profound consequences for property and water-governance power relationships. Locally developed and managed water control systems, such as irrigation, drinking water, or micro-watershed management systems, are complex institutions that dynamically interweave ecological, technological, normative, and economic domains with local histories, cultural patterns, and political structures – social configurations that constitute water user collectives’ multi-domain balancing acts. Around the world, small communities and farmer groups manage irrigation systems developing their own diverse, often ‘hybrid’ water rights and control frameworks, now and in history. Water usually is diverted from rivers through small, rustic (often temporary) weirs that take part of the water and leave the rest for downstream communities, or it is taken from springs, creeks, and wells.

Water distribution modes in collective smallholder systems have commonly been consolidated through lengthy experiments and modifications. They are rooted in practices of generating and conserving water, investments made by families to gain these rights, and the rules governing inheritance and exchange of rights, all institutionalized in context-specific forms of customary law. In such user-developed systems, a water right legitimates claims to use particular quantities and qualities of water and decision-making privileges, under specified conditions and for specified purposes. The terms, obligations, penalties – the definition and contents of ‘water rights’ – differ from system to system, as do the mechanisms for acquiring and maintaining water rights. Humans’ socio-environmental patterning is essential to capture water, operate water use systems, and materialize rights.<sup>23</sup>

Beyond legal constructs, water rights become manifest concurrently in hydraulic technology, normative arrangements, and organizational frameworks, all ingrained in particular political-economic and cultural-symbolic settings. Water user collectives in many parts of the world practice water rights under legal pluralism, whereby rules and norms of different origin and legitimization co-exist and interact in the same water territory.<sup>24</sup> Most user-managed water use systems’ rights frameworks dynamically interrelate rules, rights, and organizational forms from different sources, hybridizing local, national, and global rules. Water user collectives reinvent and experiment with their rights definitions and system operation codes. This continually shapes their collective water rights and their social and ecological boundaries, to defend against intruders, and to face outside

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<sup>21</sup> See Cosens, Chapter X.31 in this book.

<sup>22</sup> This section is based on Boelens and Vos (2014).

<sup>23</sup> Boelens and Vos (2014); Dellapenna and Gupta (2009); Shah and Boelens (2021).

<sup>24</sup> von Benda-Beckmann and others (2006) 1.

authorities and adverse environmental threats. Simultaneously, they organize each family's internal rights, in order to regulate day-to-day water practices and enable system operation and maintenance. Possible mechanisms for acquiring rights in user-managed irrigation (and often, drinking water) systems – arrangements that may operate concurrently or in various combinations are: State concession; historic rights; socio-territorial rights; transfer of water rights between right-holders; acquisition of water rights by force; and users' investment.<sup>25</sup>

Concentrating on users' investments illustrates how territories organize and are organized through particular patterns of water rights, hydraulics, and user organizations. In local water control systems, communities and families invest their resources (in-kind, labour, capital, time, and intellectual and ritual contributions) to build or rehabilitate hydraulic facilities, thereby creating their water rights. This was, and continues to be, institutionalized in numerous local and customary law frameworks all over the world, from Latin America,<sup>26</sup> to North America,<sup>27</sup> Europe,<sup>28</sup> Africa,<sup>29</sup> Asia,<sup>30</sup> Australia,<sup>31</sup> and in the Islamic water law tradition<sup>32</sup> as well as in Hindu water law.<sup>33</sup> Building water facilities establishes property rights, and the creation of irrigation works establishes property relations among the collective creators. These become the fundamental basis for their collective action in performing various water management tasks.<sup>34</sup>

'Hydraulic property creation' links individual water users to each other and to the collective system and entwines human-built property rights and material artefacts. It drives the formation of local water culture and identity, water rights defence, and collective social action in water control. The property creation mechanism guarantees that users, as collective bodies, will have effective control over the development and application of their own norms for system management. In many smallholder and indigenous systems, 'investments' can also be inherited (by families and communities as a whole). After creating property rights, users often consolidate them, again, through the logic of investment: by fulfilling operation and maintenance obligations to the water use system. Labour input, but also other investments in the upkeep of the hydraulic system, are important: financial contributions, agricultural produce, materials, instruments, intellectual inputs, and organizational efforts, and often 'cultural investments' such as joining in ritual activities. The consolidation of water rights through irrigation and drinking water systems' maintenance includes conserving the territorial (social and physical) infrastructure and the ecological environment. User groups often take water conservation measures in the catchment area that supplies river water for their irrigation systems: expanding their hydraulic property water rights to include a territorial claim to the river's headwater

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<sup>25</sup> Boelens (2015a).

<sup>26</sup> Eg Paerregaard and others (2016).

<sup>27</sup> Eg Wilson (2019).

<sup>28</sup> Eg Boelens and Post Uiterweer (2013).

<sup>29</sup> Eg Veldwisch and others (2019).

<sup>30</sup> Eg Roth and others (2015).

<sup>31</sup> Eg Jackson (2018).

<sup>32</sup> Eg Naff (2009) 37.

<sup>33</sup> Eg Cullet and Gupta (2009) 157.

<sup>34</sup> Coward (1986).

areas.<sup>35</sup> Water rights creation and re-creation follows a general logic of user-managed water control. They build on a strong interdependence among three key domains:

1. generating and reconfirming *rights* (creating and recreating the normative framework);
2. constructing and rehabilitating *infrastructure* (creating and recreating the technological framework); and
3. creating and strengthening the *organization* (creating and recreating the organizational framework).

Users attempt, consciously or unconsciously, to synchronize and harmonize these aspects. The heart of a sustainable water use system is not so much the hydraulic infrastructure itself, or its management framework, but the interaction between the infrastructural, organizational, and normative sub-systems as expressed and materialized simultaneously in collective and individual property rights.<sup>36</sup>

Local customary rules drive many smallholders/indigenous water control systems around the world, yet go unnoticed by most water policy frameworks and water development interventions, and often are entirely absent from national water laws. Academics (legal, engineering, economics, anthropology, etc.) often lack the trans-disciplinary perspective to understand how water rights operate in conditions of legal pluralism combining official and unofficial legal systems while deeply moulded by material artifacts and technology. Adopting state- or market-centred norms and conceptualizations of water rights, they commonly structure policy in order to socially and legally engineer rational water use organizations and so-called efficient water management, by establishing 'modern' water rights and enforcing the rule of law.<sup>37</sup>

Colonial powers imposed their water law aiming to serve their interests instead of local communities.<sup>38</sup> In post-colonial systems, with the domination of neo-liberalism, state- and market-centred water rights frameworks and water governance discourses have become fundamental cornerstones of mega-hydraulic system development and implementation. They build on engineering knowledge and pursue a growth agenda for the economy; in the process they implicitly create a different value system and water rules and energetically institute them, neglecting (and often, annihilating) local water control and rights. The basic rationality of well-functioning local water rights and governance institutions remains unknown, is misrepresented, or is undervalued by such a water policy focus.<sup>39</sup>

This more subtle, 'hidden,' or 'invisible' subordination of local water rights systems forms part of the overall, more visible ways in which mega-hydraulic projects and large dams cause profound transformation of hydrosocial territories. Large dam construction (including the development of large-scale irrigation systems replacing local ones) impounds water from the watersheds (rivers, springs, and aquifers) enabling corporate profits and often expropriates water resources that were previously used by subsistence

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<sup>35</sup> Boelens and Vos (2014).

<sup>36</sup> Boelens (2015a).

<sup>37</sup> Zwarteveen and Boelens (2014).

<sup>38</sup> Bijker (2007); Gupta and Dellapenna (2009) 391.

<sup>39</sup> Espeland (1998); Roth and others (2015).

communities, indigenous peoples, local fishermen, and peasant families. This mega-hydraulic regime builds on a modernist normative and epistemological discourse, which is importantly founded on the ‘Dark Legend of UnGovernance’.<sup>40</sup> This untold legend involves a deep, often subconscious, neglect of the existence of diverse water cultures, values, and societies, and claims that local water territories are basically unruly and disorganized with unproductive ecologies, inefficient resource use, and continual water conflicts. It ‘disfigures water societies by overlooking water users, meanings, values, identities, and rights systems on the ground. It then constructs its own water users, with identities that conveniently fit the models, with needs and rationales matching the imaginations of those in power, shored up in their science, technology, and policy towers ...’.<sup>41</sup>

The UnGov Legend presents mega-hydraulic projects as benevolent, shedding light in the darkness and bringing rational order to the water regime without the need to adapt to the realities and practices of local populations; it is these local populations and their territories that need to adapt, not the plans.<sup>42</sup> Ignorance of the diversity of governance and knowledge forms involves erasing localities’ place-making, place-experience and meaning-giving.<sup>43</sup> This dominant normative and epistemological notion seeks to transform territories through the construction of mega-dams to fit the new extractive order, as an active ‘un-imagination’ of communities, knowledges, and livelihoods.<sup>44</sup> Mega-hydraulic modernism (also ‘high-modernism’)<sup>45</sup> converts inhabitants of ‘hydrological zones’ into ‘uninhabitants ... the convergent unruliness of “irrational” river people and an “irrational” river must be straightened out and channelled into a national culture of rational development. We thereby witness a combined assault on an “unregulated” river and purportedly “lawless” people ...’.<sup>46</sup>

With ‘multiple modernities,’<sup>47</sup> the dam regime, its imaginaries, designs, and practices are not monolithic, yet there are commonalities within modernist large dam regimes.<sup>48</sup> Neglect or dismissal of existing cultural and ecological diversity is a key element in constructing the modernist mega-hydraulic discourse.<sup>49</sup> The emphasis on humanity’s ability to actively shape the physical and social water-world is another fundamental aspect. The realization of large dam projects is heralded as a step towards civilizing traditional societies in need of modernization, and nature as the Other, non-human, disordered, and savage that needs to be conquered and subjected to humanity’s will and benefit.<sup>50</sup> Water’s diverse cultural norms, meanings, values, language, and knowledge is reduced to a single rubric in order to arrive at one common metric: market-economic valuation and calculability, to make all social and material territorial elements measurable,

<sup>40</sup> Boelens (2015b).

<sup>41</sup> Ibid 7–8.

<sup>42</sup> Blackburn (2006); Harris and Alatout (2010).

<sup>43</sup> Dukpa and others (2019); Escobar (2001).

<sup>44</sup> Nixon (2010).

<sup>45</sup> Scott (1998).

<sup>46</sup> Nixon (2010) 74.

<sup>47</sup> Eisenstadt (2000).

<sup>48</sup> Hommes and Boelens (2018).

<sup>49</sup> Duarte-Abadía and Boelens (2019).

<sup>50</sup> Kaika (2006); Scott (1998).

comparable, and transferable.<sup>51</sup> The commodification of nature and society is fundamental for large-scale hydro-territorial development, and presented as a key process to materialize modern civilization.

... [P]erhaps more than any other development initiative, big dams have symbolized the progress of humanity from a life controlled by nature and tradition to one in which nature is ruled by technology, and tradition supplanted by science. On the other hand, big dams have more recently become symbols of the injustice of humanity through the untold destruction of nature, and the sacrifice of diverse cultures to inappropriate science and technology in the name of progress.<sup>52</sup>

Large dam technology and ‘iron triangle’ power structures are intimately interrelated. It is not just a question of a ruling class, dam experts, or state agents seeking to politically, legally, and economically dominate peasant and indigenous hydrosocial territories, but of projecting their own particular way of seeing and ordering the water world as objective, natural, legitimate, and common-sense. Design efforts are geared towards mechanically and organically linking micro-water control society to meso- and macro-scales of technical-legal-political governance, generating new hydrosocial territories founded on mega-hydraulism. Contextualizing water rights, cultures, and peoples is irrelevant because the challenge is precisely to reduce all complex human and non-human phenomena to measurable, repeatable, foreseeable, calculable, and ultimately controllable terms, reshaping hydrosocial territories in line with frameworks of state administrations and (neo-liberal) market advocates. Creators of mega-hydraulic projects share the vision and mission that through hydro-productive and socio-legal engineering and standardization, they can manufacture ‘rational’ allocation patterns with ‘functional’ water rights, ‘optimal’ water schedules, ‘efficient’ water use, ‘accountable’ organizations, and ‘disciplined’ water users.

Designing, building, and implementing mega-hydraulic infrastructures brings particular modes of hydraulic property creation very different from user-driven property creation. Financial investors in large dams are not users and have different interests from users. Politically, planners and technical designers of mega works are not water users. Property creation follows diverse public-private partnership modalities. Infrastructure and water property rights are allocated to powerful state, private, or public-private coalitions. A few (elite) water users become ‘clients’ together with new (and often faraway) mining, agrobusiness, or hydropower water service buyers. A majority of local water collectives are erased and whenever local smallholder and indigenous groups gain access to water, they have top-down established water access rights without property and decision-making rights. Users’ collective investment, democratic decision-making, and their control over system design, construction, operation, and maintenance is abolished. Given the capital-intensive design, construction, and implementation processes of mega-dams, building them demands powerful (trans-)national coalitions of funders, expert engineers, and national policy makers, all of whom intrinsically and automatically exclude local water collectives’ involvement and any form

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<sup>51</sup> Hoogendam and Boelens (2019).

<sup>52</sup> Khagram (2004) 4–5.

of democratic and transparent institutions. Next to monopolies of expert-rule, the gigantic commercial gains and powerful political interests steer corrupt practices and non-democratic decision-making to the exclusion of smallholder collectives and their hydraulic property-rights creation.

Mega-hydraulic projects employ a modernist-rationalist discourse that portrays water administration as entirely plannable. Such neat social engineering is a myth. Water development realities are complex networks accommodating divergent values, norms, visions, interests, and expectations. Local groups may protest, boycott, or try to have their interests and ideas included.<sup>53</sup> While the official rules and policies are profoundly mediated by diverse actors and ‘the stubbornness of reality’, at the economic-political-technical design table, mega-hydraulic dream schemes form a coherent, potent discursive system, rationally linking individuals and micro-water management systems to meso- and macro-scales of governance, creating self-fulfilling prophesies. If components of the model fail, it is not its inherent rationality or the modernization discourse that is questioned; blame is assigned to the social user groups who fail to apply it as ‘rational clients’ would. Besides powerful political and economic interests in mega-hydraulic development, there is a conviction that the myth must be realized.

#### **X.32.4 Considerations for the future: more reflexive and equitable water policies**

Mega-hydraulic infrastructure, such as large dams and river diversion schemes, heavily impact hydrological regimes, creating issues of social justice, human rights, and ecological concern. Dams uproot and often irreversibly alter livelihoods of local communities, while in most cases the projects do not deal adequately with the needs of project-affected people in the processes of design and dispossession through expropriation, resettlement, or rehabilitation. These problems arise from the powerful dam coalitions’ social and material interventions in local livelihoods and managerial systems, but also from the epistemological and normative frameworks that are fundamental to mega-hydraulics’ engineering and law- and policy-making.

Water bureaucracies and expert epistemic communities often continue to adhere to a perspective that primarily relies on the construction of large-scale infrastructure for water development, storage, and transport, following a market-based development model. This approach is based on and requires the concentration of rights and resources, the depletion of natural resources, and the dispossession of vulnerable groups. New water policies often propose to formalise and unify water rights in order to allow water to be transferable across uses and users. Existing forms of accessing and regulating water use often do not fit these new legal arrangements. The need to use and manage water more efficiently therefore entails normalizing and disciplining, often eroding existing livelihoods, ways of life, and cultural practices. Water governance must give greater attention to justice and equity. Interrogation of the choices inherent in these water governance policies is necessary, and of the power relations around proposed uses and controls of water, paying close attention to differences of class, caste, gender, and identity.

Water policy must pay more attention to the co-production of environment and society: The environment is as it is because of long historical trajectories of co-existence

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<sup>53</sup> Eg Duarte-Abadía and others (2019); Hidalgo-Bastidas and Boelens (2019).

with humans. Through a transdisciplinary approach based on conceiving nature and society as co-constituted, policies can better grasp how environmental functions are shaped by interlinked environmental processes and human activities. This will fuel understanding of how socio-environmental processes work to re-define rights and obligations to water resources, to re-distribute benefits and burdens, and to legitimate these changes. A shift from existing mega-project-based knowledge traditions and hierarchic and prescriptive policy frameworks to more pluralistic, flexible, and interactive ones is necessary. This requires new ways of understanding socio-environmental realities and accepting more experiential and local forms of knowledge and rights frameworks, training water professionals in more pluralistic modes of dealing with water realities, and exploring more interactive water design and policy models.

Much thought and action on water problems continues to happen from a 'hydraulic mission' perspective, a mega-hydraulic planning mindset. Academic disciplines and policy agencies mutually constitute and reproduce each other, repeating the errors and dramas of large-scale hydraulic development and forming a major source of social and environmental injustice. The importance of critical reflection on the role of (academic and non-academic) professional water knowledges, and on rethinking established professional structures and routines, is increasingly recognized. Rather than imposing uniform policy ideas and water regulations, policy makers and implementers need to enter dialogues with grassroots communities and water user groups as deeply knowledgeable colleagues in water governance. Critical engagement does not deny but recognizes cultural and power differentials. Interactive policy and water design must be crafted to sustain user-oriented, equitable, and just territorial water governance.

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