International Journal of the Commons

High-Efficiency Irrigation: Local Water Users' Responses to the Modernization of Village Irrigation Technology and Government Control in China

CONTESTED SOCIO-MATERIAL TRANSFORMATIONS IN IRRIGATION COMMUNITIES

QINHONG XU
RUTGERD BOELENS
GERT JAN VELDWISCH
*Author affiliations can be found in the back matter of this article

ubiquity press

ABSTRACT

In this paper, we investigate China's vigorously promoted high-efficiency irrigation policies for farmland water conservation, deploying a governmentality framework. The paper explains how the modernist irrigation policies follow global discourses but seek to imbue these with new ambition and the meaning of ecological civilization. At the same time, the government aims to mold water users' subjectivity in accordance with its development strategies. Following a local village case study, the paper further elucidates how, amidst the decline of commons' local governance and water user responses, the state's high-efficiency irrigation water governmentality project is adapted and negotiated. Local government bureaucracy actors and ordinary villagers challenge irrigation policies through local noncongruent institutions. Thereby, villagers' pragmatic, non-aligned irrigation technologies and actions contradict state-assumed collective collaboration and government-aligned smooth operation.

CORRESPONDING AUTHOR:
Qinhong Xu
Wageningen University & Research, Netherlands
qinhong.xu@wur.nl

KEYWORDS:
high-efficiency irrigation; water saving; China; rural water governance; governmentality

TO CITE THIS ARTICLE:
Xu, Q., Boelens, R., & Veldwisch, G. J. (2024). High-Efficiency Irrigation: Local Water Users' Responses to the Modernization of Village Irrigation Technology and Government Control in China. *International Journal of the Commons*, 18(1), pp. 148–163. DOI: https://doi.org/10.5334/ijc.1253

INTRODUCTION

For a decade, irrigation has gained renewed, special attention in national development plans in China. This is situated in the context of the "Construction of Ecological Civilization" (生态文明建设), which envisions an ideal future characterized by the integration of economic growth, environmental conservation, and the harmonious coexistence of humans and nature. Ecological civilization aims to provide an alternative perspective for addressing the challenges posed by climate change, which Western approaches have not successfully overcome (Hansen et al., 2018; Weins et al., 2023). Ecological civilization was politically endorsed in 2012 and subsequently established as a central development strategy, guided by President Xi Jinping. It has also been officially incorporated into the Constitution. Notably, ecological civilization assigns considerable significance to the ecological carrying capacity and the conservation of natural resources. In line with this, the "new era water governance guidelines", launched in 2014, focus on water-saving (节水优先), spatial equilibrium (空间均衡), systematic governance (系统治理), and the combined efforts of state and market (两手发力). "High-efficiency irrigation" and "water-saving technologies" – both terms that we approach as imbued with and shaped by powerful modernist discourse (Scott, 1998; Hommes et al., 2022)- take a central position in China's response to increasing pressure on water resources, aiming and claiming to increase the productive capacity of agriculture and water saving in general. Policy documents emphasize that irrigation and farmland water conservation need to be enhanced through infrastructure construction and upgrading, providing supporting facilities and improving water use efficiency both through the renovation of large-scale irrigation,[1] and by increasing the investment in small-scale irrigation and farmland water conservation[2] (see The 12th and 13th 5-year Water Conservation Planning, 2012, 2016). China monitors its growing area under so-called water-saving irrigation, which by the end of 2020 had reached 567 million mu (37.8 million hectares), according to the Ministry of Water Resources. Among them, 350 million mu (23.3 million hectares) are equipped with high-efficiency water-saving irrigation systems in which pipelines have replaced open canals and water is applied to the field by means of sprinklers or drip-emitters.

In this paper, we argue that large-scale irrigation facilities are also political devices (Winner, 1980; Swyngedouw, 2013; Shah and Boelens, 2021). By promoting modernist irrigation, the Chinese government aims to embrace global discourses of water scarcity, efficiency, modernization, and sustainable development, and to take a lead in response to environmental challenges through 'civilizing people through ecology'. Promoting such water-saving policies often has the symbolic function of demonstrating modernity, technological sophistication, and environmental awareness. China's drive for high-efficiency irrigation can thus be viewed as a form of governmentality (Foucault, 1991, 2008), aiming to conduct society through technology and infrastructure. However, the outcomes of irrigation interventions are affected and mediated by the context's socio-ecological and techno-political relations in which they take place.

To understand China's rationale of and unravel the processes of conducting people's conduct towards high-efficiency irrigation, we examine its introduction in a village in the south of Shandong Province, looking at state design mentalities, the socio-political context in which people's daily practices impact the outcomes of water policies, in terms of the technology's materiality and beyond. In the village under investigation, irrigation is predominantly managed and governed by its users, but in a complex way interlinked with state control, market mechanisms, and a variety of socio-cultural factors that affect collective action in the community.

Despite the government's goal of emphasizing the combination of construction and management (建管并重) in water governance, the case study demonstrates that the governmentality for high-efficiency irrigation is largely construction-oriented, by deploying materials and techniques. Hereby, the newly designed irrigation infrastructure (implicitly) requires close collaboration among the villagers in a way that contradicts the existing reality of largely individualized irrigation use and management, and the decline of collective village governance. Infrastructural changes, in practice, have not been complemented with the development of new principles for social relations, nor have new vehicles been developed to support its operation and maintenance. In the case under investigation, we show how the decline of local governance, people's individualized actions, pragmatic everyday practice, and the cheap availability of alternative small irrigation technologies, resulted in the reluctance of the villagers to engage in the state-led design of the high-efficiency irrigation technologies.

This paper is based on fieldwork conducted in the mountainous D town and L Village under its jurisdiction in Shandong Province. The area relies heavily on small-scale irrigation for agricultural production. During fieldwork in 2018 and 2019, primary data was collected by combining interviews, participant observations, and documentation of life histories. Due to Chinese policies and restrictions, the COVID-19 pandemic made further on-site research unfeasible. As a result, we resorted to online interviews as an alternative. In 2021 and 2022, complementary

interviews were conducted through WeChat, China's most popular social media. However, obtaining concrete data and establishing contact and trust with, for example, the irrigation design company, which was not based in the local town, proved to be a challenge during online interviews, particularly regarding design-related information. The respondents were selected to represent diversity in income source, age, household size, and geographical spread at the fieldwork site. In total, 80 people were interviewed and re-interviewed in the Shandong dialect, including 1) town and village leaders, (2) villagers who run private irrigation businesses, (3) villagers who own individual irrigation pump engines, and (4) villagers who do not engage in agricultural production and irrigation. Furthermore, secondary sources were gathered, including academic literature, government documents, official speeches, media, and grey literature.

The paper is organized as follows. Section 2 presents the theoretical framework around technology, infrastructure, and governmentality. Section 3 examines the evolution and mentalities of China's modernist irrigation within this framework. Section 4 introduces the case study area and empirically investigates how the socio-political context, people's pragmatic concerns, and the availability of small technologies in the market influence the outcome of a high-efficiency irrigation project. The final section concludes on how the drive for modernist irrigation is incomplete as a governmentality project and how, implicitly, its infrastructure-centered implementation is deeply contested.

CONCEPTUAL NOTES

Technologies are combinations of both material and socio-political components that do not exist independently from each other, their historical constitution, and their context. Technological change is thus not just about the introduction of new material artifacts or infrastructure, but also includes the creation of "a new world of social relations and myths in which definitions of what 'works' and is 'successful' are constructed by the same political relations the technology engenders" (Pfaffenberger, 1988:249–250). Technologies, often materialized in artifacts and physical infrastructures, mediate behavior (Jasanoff et al., 2001; Latour, 1993; Mollinga and Veldwisch, 2016; Hommes et al., 2020), build on and simultaneously steer human morality[3] (Shah and Boelens, 2021; Verbeek, 2008), and co-shape experiences and interpretations of the world. Technical artifacts exist within the networks of actors and their practices, embedded in a web of social and ecological relationships, expressed in many different cultural and institutional forms (see Richards and Diemer 1996, Glover et al. 2017, Pfaffenberger, 1988). Artifacts and infrastructure can be cast in different ways to speak to various social worlds and communities of practice, they can embody multiple discourses and mediate between different actors in many ways (Mollinga, 1998; Zwarteveen, 2017).

Technological change can be an aspirational terrain for political authority (Anand et al., 2018) to combine and materialize diverse political projects, social visions, ecological concerns, cultural imaginaries, discursive formations, institutional practices, and economic strategies of global competitiveness together (Swyngedouw, 2013: 261). It also becomes the site for active negotiations between state agencies and populations. This dynamic nature of technology and its impact on the environment and individuals underscores the technology's inherently social and politically significant nature, as highlighted in various scholarly works (Hommes et al., 2020; Hommes et al., 2022; Anand et al., 2018; Clarke-Sather, 2017; Meehan, 2014; Menga and Swyngedouw, 2018; Rodina and Harris, 2016).

In a similar vein, water technology and infrastructure are frequently associated with governmentalities[4] (Foucault, 1980, 1991, 2008), various techniques, instruments, and tactics that the government or dominant actors deploy (consciously or not) to conduct society and people's behavior. They are crucial in shaping the hydrosocial territories and subjects when combined. The state's dominant strategy for gaining control of local water resources is often to rationalize water management by standardizing local perceptions, rights, and rituals in accordance with dominant interests (Boelens et al., 2023). Commonly, diverse hydrocultural frameworks are being forced into hegemonic expert-modernist models through naturalization processes that refer to a scientific basis and seek to reinforce elite and state control over local resources (Boelens and Vos 2012; Rogers and Crow-Miller, 2017). Power generates reality, and engenders knowledge, thereby establishing "regimes of truth" (Foucault, 1980:133) regarding water in these processes.

For example, piped irrigation distribution and precision water application methods such as drip irrigation have been associated with concepts such as efficiency, productivity, and modernity, construing positive imagery of these technologies: that they can address a few current challenges and contribute to the shaping of a better future. In the process, technology is neutralized, covering its moral, cultural, social, and political nature (Boelens, 2015; Zwarteveen, 2017). Such naturalized, depoliticized views on technologies are equated with reality and truth. In practice, however, high-efficiency irrigation has long been, and continues to be, clearly associated with specific political and ideological movements, agendas, and discourses,

with the goal of aligning those who use it (Venot, 2017; Zwarteveen, 2017).

The same goes for the entities that are assumed to adopt irrigation technology and therefore, explicitly or implicitly need to align with the technology's organizational and cultural-political requirements. Already existing forms and patterns of local organization are thereto assumed to vanish or become functionalized and realigned 'conveniently'. For instance, in China, the State does not advocate explicitly for one specific collective water sharing and management modality but assumes the existence or constitution of adopter and management collectives for high-tech irrigation (e.g. village committees and water users' associations), possibly supported by private service entities (for design and/or management). Therefore, State-convenient irrigator entities, as technology-and-discourse-adopter and high-tech management collectives, are assumed to be (set) in place, are morally promoted, and are expected to self-correct accordingly: to make the socio-technical-political water use system function as premeditated. This artifact-driven governmentality (through the 'moralization of hydraulics') is often omitted in water politics studies which tend to concentrate on scrutinizing just the explicit laws, policies, pre-scribed management structures, etc. (Sanchis-Ibor et al., 2017). In fact, the (sometimes explicit but mostly implicit) organizational and management structures of water will necessarily have to respond to the 'social requirements for use' that are (visibly and invisibly) embedded in the high-tech irrigation technology design (Mollinga and Veldwisch, 2016; Shah and Boelens, 2021): in terms of people's technology-use and -maintenance skills; their financial capacities; agro-productive planning; required forms of organization and decision-making; artifact-dependent rotational schedules and water distribution to different actors; overall system management, etc. In other words, the process of technology transfer implies efforts towards 'governmentality through convenient communities' (Li, 2011; Valladares and Boelens, 2017) and mostly deploys subtle forms of inclusive power, pushing people toward normalization and self-correction (Foucault, 2008). Through high-tech irrigation designs, transfers, and promotion, the government seeks to construct, mostly tacitly, new irrigator subjects (cf. Rodríguez de Francisco and Boelens, 2016). Thereby, norms embedded in these new hydraulic-legal-political designs seek to replace, reshape, and reconnect the knowledge and principles of individual and collective users, and align micro-water control to supralocal state-governance rationality and order.

Using a governmentality lens to study technological change in water management entails looking at how truths, rationalities, and technologies powerfully shape people's subjectivities and behavior in their social and material relations (e.g., Hidalgo-Bastidas and Boelens, 2019; Meehan, 2013, 2014; Hellberg, 2014). But as Pfaffenberger (1988, 239) correctly stated, while technological change requires the re-creation of the preconditions, norms, and values inscribed in it, irrigation technology is not "an autonomous agent that dictates the patterns of human social and cultural life". Both technology designers and users are complex networks that frequently accommodate non-aligned values and visions, divergent interests, and incongruent expectations (see, Boelens and Gelles, 2005; Wiber and Turner, 2010). Dominant actors may strive to structure sociotechnical relationships to materialize their wished-for hydropolitical society, but they are generally unable to produce direct replication of their norms, values, and organizational structures because technological scripts are mediated by both users' society and surrounding socio-natural and political forces (Boelens, 2015; van der Ploeg, 2003; Rogers and Wang, 2020). Irrigation design and operation involve multiple stakeholder groups, and negotiation, conflict, and collaboration in specific contexts frequently result in the adaptation or transformation of water intervention projects (see Benda-Beckmann et al. 1989; Long and van der Ploeg 1989; van der Ploeg, 2012, 2013). This suggests that the deliberate design of irrigation facilities frequently results in unforeseen consequences. Water access can be shaped by the daily practices of agents with different beliefs and priorities (Cleaver, 2002; Franks and Cleaver, 2007), and alternative rule spaces often coexist alongside state-managed infrastructure (Meehan, 2014). An understanding of the relations and resources that underpin the local "messiness" of the commons and commons-market-state relations is therefore critical to understand the workings of irrigation in practice (Aubriot, 2022; Whaley, 2022).

The following section presents the mentalities of high-efficiency irrigation in China, leading up to section 4 and section 5, in which we explore and discuss the practice and reactions in a specific local context.

THE MENTALITIES OF HIGH-EFFICIENCY IRRIGATION PROMOTION IN CHINA

The Chinese government promotes modern water-saving technologies not only to install artifacts, but also to change existing relationships, such as the relationship between people and nature (water), and to shape new subjectivity (see also Rogers and Crow-Miller, 2017; Rogers and Wang, 2020; Xu et al., 2022; Sheng and Han, 2022; Nickum, 2010). The central government intends to materialize the

imaginary of ecological civilization for harmony between sustainable socioeconomic development, agricultural modernization, and environmental protection through high-efficiency irrigation technology and infrastructure that shares both global trends and China's newly developed discourses.

First, in line with global trends, high-efficiency irrigation such as drip, sprinkler, and pipeline irrigation are being promoted in China as a solution to water saving and agricultural modernization. Water saving was introduced in government documents in the late 1970s and early 1980s when China faced severe water shortages and overexploited groundwater in the north. At the time, the government recognized that water in China was not an infinite natural resource and that industry and agriculture would face severe water shortages. In 1990, it was established that China is a country with relatively limited water resources (General Office of Ministry of Water Resources, 1988–1992). The water demand increased in conjunction with advancements in industry and improvements in people's living standards. The government proposed "conserving water" and utilizing it "scientifically" (General Office of Ministry of Water Resources, 1993–1997). Since the 1990s, water saving has become a dominant discourse about dealing with water scarcity and rebalancing the relationship between people and water.

In the late 1990s and early 2000s, water issues began to be framed globally as a conflict between agriculture and the environment. Agriculture was identified as the largest water user, with irrigation being highlighted as a major contributor to water wastage (see Postel, 1997; Gleick, 2001). Consequently, there is a recognized imperative to enhance irrigation techniques and promote water-saving approaches in agriculture, aiming to conserve water for allocation to both environmental preservation and other user needs. According to the Chinese government, agricultural modernization should aim for irrigation and drainage facility construction and increase water use efficiencies. Consequently, the "National Agricultural Water Saving Outline (2012–2020)" was issued by the State Council. The 2015 "Government Work Report" established the goal of converting 100 million mu (6.67 million hectares) irrigated areas into high-efficiency irrigation areas from 2015 to 2020. High-efficiency agriculture and water-saving are two important principles for developing farmland water conservancy, according to the Regulations on Farmland Water Conservancy, which went into effect in 2016. A 2017 report in China Daily based on an interview with the Ministry of Water Resources asserted that "Saying goodbye to the traditional flood irrigation, the effective utilization coefficient[5] of irrigation water has reached 0.542" (China Daily, 7, Oct. 2017).

Second, high-efficiency irrigation in China is seen as relevant not only to water use efficiency and agricultural modernization but also has become part of the dominant discourse of sustainable development; increasingly framed as an adaptation strategy to climate change (see Venot, 2017; Clements et al., 2011). China participated in the 1992 United Nations Conference on Environment and Development and pledged to support the new century's Sustainable Development Goals. Sustainable development was highlighted as a national development strategy in 1996. Water was regarded as a limited and valuable natural resource, in need of water-saving irrigation infrastructure. In the 1990s, 300 counties were chosen as demonstration counties for water-saving practices. Since 2012, particularly at the 18th National Congress of the Communist Party of China, the "Construction of Ecological Civilization" envisioned a society with ecologically sustainable modes of resource extraction, production, and environmentally conscious and responsible citizens. For irrigation, this implies a focus on improving resource utilization efficiency, protecting the ecological environment, and coordinating irrigation development with the carrying capacity of resources and the environment (Li, 2014).

Third, consistent with the international trend, China includes high-efficiency irrigation as a method of addressing food security and poverty alleviation (see Hillel, 1988; Postel et al., 2001). In his speech at the 2013 Central Rural Work Conference, President Xi stated, "As long as there is no major problem with food, China will be stable" (只要粮食不出大问题，中国的事就稳得住), "Our rice bowls should mainly contain Chinese grain" (我们的饭碗应该主要装中国粮). The Deputy Minister of Water Resources Minister (2014) stated that to meet the rigid growth demand for grain consumption in the future, it would be necessary to vigorously accelerate the development of high-efficiency irrigation and improve agronomic productivity. Modernist irrigation is thus closely related to food security. It is reported that while continuing to ensure national food security this is achieved without further increasing the total amount of irrigation water (China Daily, 7, Oct. 2017). While the global discourse on poverty alleviation primarily focuses on supporting smallholders (Polak, 2008; Venot, 2017; Postel et al., 2001), in China, high-efficiency irrigation aims to support realizing "the comprehensive well-off society" (全面建成小康社会), in combination with promoting the ecological civilization. It aims to solve the problem of low water use efficiency in poor areas, increase agricultural production capacity and farmers' income, and transform agricultural irrigation methods from traditional to modern water-saving methods (See, The 13th Five-Year Water Conservancy Poverty Alleviation Plan, 2016; Ministry of Water Resources, 2018).

What becomes clear is that China's promotion of high-efficiency irrigation has strong parallels to international discourses around irrigation modernization, productivity, efficiency, sustainable development, food security, and poverty reduction, all of which share a positive imaginary of the role of technological progress in bringing a bright future. However, from 2012 onwards, the new discourse around constructing an ecological civilization became dominantly linked to China's ambition to take a leadership role in the global arena when it comes to solving climate and environmental problems. In this context, high-efficiency irrigation technology takes on new symbolisms and meanings as part of top-down design imaginaries and mentalities.

High-efficiency irrigation carries a variety of interests and politics of China's state development. The state uses irrigation artifacts to build new social and economic connections and reinforce a political culture centered on government rationality, national order, and modernizing progress. By leveraging high-efficiency irrigation infrastructure and technologies, the state aims to promote modernized water-saving agriculture and cultivate environmental awareness among farmers, seeking a harmonious balance between economic growth and environmental conservation. To meet this end, the state uses several government techniques. High-efficiency technologies as a positive solution to water challenges were set up as "regimes of truth" through state power. Through the moralization of high-efficiency technologies, a disciplinary governmentality aims to shape ecologically civilized subjects. For example, in the process of developing water-saving agriculture, model water users and model water products such as "water efficiency leader" (水效领跑) and "water-saving certification" (节水认证) were developed. 50 water products, 20 irrigation districts, and a group of public institutions were selected as water efficiency leaders in 2020 (see National Development and Reform Commission, 2019, No.295). State-convenient irrigator entities, as technology-and-discourse-adopter collectives, are thereby assumed and morally promoted (Xu et al., 2023). In addition, such disciplinary governmentality necessitates popularizing water-saving knowledge among all people through education and the cultivation of moral values, both implicitly and explicitly stated in national planning. Water education has been incorporated into the school curriculum, and water training has been provided to leaders and civil servants at all levels according to the 13th 5-year Water Conservation Planning. The same plan also propagates to improve public awareness around water conservation and law-based water governance and to create enthusiasm and a good social environment for water conservation, a change "from being required to save water to wanting to save water" (要我节水到我要节水). Awards for "Green Community", "Green School," and "Green Family" are handed out to highlight exemplary models in water saving and the construction of ecological civilization. Thematic activities such as World Water Day, China Water Week, and Urban Water Conservation Publicity Week are equally promoted to advocate simple and moderate consumption styles.

A distinguishing characteristic of water governance in China is the combination of state and market – a two-hands approach (Xu et al., 2022; Xu et al., 2023; Jiang et al., 2020), in Foucault's words the "sovereign" and "neo-liberal" governmentality (next to the above mentioned, normalizing and moralizing "disciplinary" governmentality, based on self-correction (Fletcher, 2017; Valladares and Boelens, 2019, Xu et al., 2022). In addition to state-led administrative directives, central planning, legislation, and financial investment, the market is harnessed as a driving force in water resource allocation. To enhance irrigation management, water rights, water price, and property rights reforms are being implemented. For instance, apart from privately invested water projects, high-efficiency irrigation systems can be contracted or assigned to individuals or private companies to improve management practices.

However, it is important to acknowledge that governmentalities are not fixed or predetermined, but rather contested and negotiated processes. The following case highlights the intricate interplay between high-efficiency irrigation technology and the specific cultural and social contexts in which it is situated. It emphasizes how the outcomes of implementing such technology are shaped by local practices, further underscoring the dynamic and context-dependent nature of these processes.

4. THE CASE STUDY AREA AND ITS IRRIGATION TRANSFORMATION PROJECT

Existing literature has demonstrated the challenges faced in the promotion of high-efficiency irrigation in China (see Burnham et al., 2015; Burnham and Ma, 2018). In this section, we present a specific example to illustrate these challenges. This is followed by an analysis of the implementation of a high-efficiency irrigation project in the case study village and the people's responses.

CASE STUDY SETTING

D Town, located in Shandong Province, governs over 40 villages with a population close to 50,000, predominantly consisting of the Han (汉族) ethnic group. L Village in the north part of D town is surrounded by mountains on three

sides, with the remaining side facing a moderately sized man-made reservoir. A stream flows through the village from north to south, serving as a seasonal tributary river to the reservoir. This village is inhabited by around 800 individuals belonging to the Han ethnicity. Operating under the "household contract responsibility system," households possess fragmented plots of land. In the early 1990s, L Village underwent agricultural modernization in alignment with the comprehensive development plans of the county and town. This transition involved a shift from traditional crop farming practices to the cultivation of peaches. Significant portions of agricultural land previously used for corn, wheat, and sweet potatoes have been transformed into peach orchards. After the agricultural transition, villagers shifted from producing their own wheat flour and corn pancakes to purchasing these items for daily life. Irrigation in L Village is mainly for peach trees and predominantly depends on small-scale methods. Nevertheless, like numerous towns across China, L Village is encountering significant trends of de-agrarianization and an aging agricultural workforce (Liu et al., 2019). Most of the labor involved in peach cultivation in L Village is provided by individuals between the ages of 50 and 70, while those under 40 seldom participate directly in agricultural production, opting for alternative sources of income. Even the primary labor force in the village engages in off-farm work to supplement their income during non-farming periods.

According to the estimation of the village committee director, L Village encompasses approximately 600 mu (40 hectares) of agricultural land. More than half of the land was allocated to peach cultivation. For irrigation, L Village primarily relies on water from the reservoir, which is abundant and free to the villagers for irrigating the peach trees. The following section will discuss the irrigation situation, preceded by a brief historical review embedded in the transformation of government policies.

Irrigation in L Village goes back to the Mao era (1949–1978). During that time, the local commune constructed a man-made reservoir in the village and implemented an open canal irrigation distribution system for the low-reach villages, while L Village only benefited from the canal for irrigating a small portion of land near the reservoir for corn and wheat. Production teams, comprised of multiple households, were responsible for managing and coordinating irrigation activities. In the early 1980s, following the economic reforms, individual households regained decision-making authority in agricultural production, while the village committee, an autonomous self-governing organization, took charge of irrigation management. From the late 1980s to the early 1990s, the open canal irrigation system was abandoned due to inadequate operation and maintenance, as tensions grew between collective water management and individual production. Instead, two villagers bought diesel engines to pump water from the reservoir, marking the start of private irrigation businesses in L Village. Other villagers relied on the two diesel engines for irrigation and paid the two villagers for irrigation operations.

In the late 1990s, the local county initiated the privatization of farmland water conservation through property rights reforms, whereby (water) rights, infrastructure, and services were auctioned and contracted to private entities. The objective was to introduce incentives for irrigation management and water governance in rural areas. In L Village, the collective open canal irrigation system and the stream were auctioned off to two farmers. However, the private management failed to reinstate the open canal irrigation system. The purchaser of the stream constructed a small dam and attempted to collect fees from peasants utilizing river water. Nonetheless, the peasants continued to adhere to customary norms, considering the river and its water to be accessible to all villagers free of charge. Consequently, the owner was unable to establish a successful irrigation business following the river purchase.

A significant turning point in transforming state-rural society relations occurred during the abolition of the agriculture tax, starting in 2003. The prohibition imposed by the state on levying taxes and fees from peasants resulted in the loss of revenue for township governments. Consequently, the town and village committee gradually abandoned their responsibilities regarding agricultural production and public service. The abolition of agricultural tax led to a rupture in the relationship between villagers and the local government, including the village committee (Zhou, 2006; Xu et al., 2022). While intended to prevent exploitation, this uniform government measure also had profound implications for the sustenance of common resources in various regions. It was during this period that individual peasants across China began assuming responsibility for water services, as towns and village committees abandoned their responsibilities in local agricultural production and public affairs (Xu et al., 2022; Zhao, 2011). The transition from collective irrigation management to individualized irrigation modes occurred as a consequence.

The rupture in relationships and the subsequent individual responsibility heightened the risks to agricultural production and underscored the need for irrigation reform. To compensate for this situation, the government introduced the "one issue, one discussion" (一事一议) institution at the village level. This institution aimed to establish a rural public goods supply system, encouraging farmers to contribute funds and participate in democratic decision-making processes voluntarily. However, similar to

other locations, the implementation of such noncompulsory policies has not been fully realized in L Village (He and Guo, 2010).

Furthermore, the government implemented the "project system" (项目制) funded through "fiscal transfer payments" (财政转移支付) to enhance rural public services, including irrigation upgrading. Towns and villages could apply for project funds from the county. However, these funds were typically transferred directly from the county to contractors who won the bidding process, usually professional construction companies. Consequently, the decision-making process rarely involved meaningful participation from villagers. With a substantial influx of state funds into rural areas, village cadres were no longer required to mobilize grassroots support. The project system has been observed to decrease the autonomous governance capabilities of villages and impact the management of common resources in rural areas (He, 2019; Zhou, 2012; Chen, 2015; Xu et al., 2022).

The developments and ongoing processes in L Village align with the evolving dynamics of state-rural society relations and the shift towards individualized irrigation practices prevalent in rural areas throughout China. Compared to previous decades, the management of L Village by the village committee has become looser. Before 2000, the committee had diverse responsibilities, including agriculture tax collection, public service, and mobilization. However, with the removal of agricultural tax and the implementation of the "project system," the committee's role has been restricted to administrative tasks delegated by higher-level government authorities, no longer encompassing agricultural production. The "one issue, one discussion" institution has not been implemented, and opportunities for collective mobilization and participation are rare.

Around 2010, the two operators who previously owned diesel pumps, along with another villager, invested in electric pumps and upgraded the irrigation system. Each of them acquired an electric engine and installed underground pipelines, leading to the expansion of the irrigation system that now covers a substantial land area. The combined capacity of the three engines enables the irrigation of approximately 300 mu (20 hectares) of land in the village. The pipelines used had a diameter of 75 mm, allowing for a flow rate of 20 m3/hour. Based on our interviews, the operators expressed uncertainty regarding the water-saving or efficiency aspects of their system. Their decision to purchase the equipment was mainly driven by its popularity in the local market and the ease of controlling maintenance costs. Because the reservoir water is provided free of charge, the irrigation fee is calculated based on hourly electricity consumption and equipment service, amounting to 42 yuan (approximately 7 dollars). There is no fixed schedule for irrigation, and villagers arrange with the operator whenever they require irrigation services. Frequently, the operator allows villagers to keep a record of their time usage, and payment for the services is typically made before the Chinese New Year to finalize the year's bookkeeping.

Due to the low cost of small electric pumps (400 Yuan, 70 USD) and durable plastic pipeline on the market, as well as the free installation of a meter to the electricity grid, many people with land near the reservoir installed their small pumps, paying only for electricity. One respondent who installed personal small pumps described: "Go and see how many electricity meters and pumps there are along and, in the reservoir, a pile and a pile" (Interview, 2021). The villagers welcomed the small mobile equipment as it provided them with greater flexibility, especially considering their off-farm work.

The peach trees in L Village require irrigation at least five times a year. Although the trees require irrigation at similar times, there is no collective irrigation management or scheduling in place. Consequently, villagers irrigate their peach trees individually based on their convenience. The village committee cannot provide precise data regarding the areas irrigated using different methods due to its lack of responsibility in agriculture production.

Overall, it is evident that irrigation in L Village has been and continues to be managed by the farmers themselves, spanning from the Mao era to the present day. The management mode has transitioned through different eras, from state-led farmers' collective management under people's communes to farmers' individualized management. The individualized management encompasses household-based irrigation utilizing cheap and small water pumps, as well as private irrigation businesses operated by three villagers. The irrigation schedule has shifted from a collectively established timeframe to a flexible schedule based on individual convenience.

HIGH-EFFICIENCY IRRIGATION IN THE COUNTY & D TOWN

From 2009 to 2020, the local county successfully applied for the "Construction of Key Counties of Small-Scale Farmland Water Conservation Project" (小农水重点县建设项目). The county implemented water-saving irrigation projects for eight consecutive years under this project, promoting pipeline irrigation, sprinkler irrigation, and micro-irrigation. According to the county head's public speech, the newly added area of high-efficiency irrigation was up to 303,700 mu (20, 247 hectares) by the end of 2020, completing the transition from "flood irrigation" to "precision irrigation"

and 64% of the county's irrigated area was characterized as "high-efficiency".

THE HIGH-EFFICIENCY IRRIGATION PROJECT IN L VILLAGE

Without involving peasants, in 2017, the village committee of L Village applied for a modern pipeline irrigation project which was approved in 2019. At the end of 2019, the construction company began to install the infrastructure, which included two electric pumps at the reservoir and underground pipelines with an outlet every 100 meters at field level from which soft pipelines can supply water to the peach trees. According to the committee estimation, the new irrigation system covered 300 mu (20 hectares) of the village land, largely overlapping the private operators' network. With a diameter of 160 mm, the pipes are significantly larger than that private operators use. The engine pump is 47 Kilowatt, and the discharge volume is 60 m^3/hour. Due to the large volume, the system requires that at least three outlets open at the same time (with three households for each outlet), whereas the private system can function well in supplying just one outlet and one household at a time. The design of the new system implicitly assumed cooperative behavior among irrigators and consensus on an irrigation schedule, which differs significantly from the actual situation in the village. The quality control of the high-efficiency project was limited to the installation phase. There is no specific measurement to assess the amount of water saved or the potential reallocation for other purposes. Overall, it is important to note that this high-efficiency project in L Village is not primarily intended to address water scarcity, as water availability is sufficient. Instead, it is part of a nationwide irrigation upgrading initiative aligned with the goals of modernized agriculture and ecological civilization in China. In an interview in 2021, the village director indicated that the government-invested piped system was never used as villagers prefer the flexibility of the old system, which supplies sufficient water in normal years.

At completion, ownership of the irrigation infrastructure was transferred to the village committee, which struggled to manage it because no effort had been made to conceptualize, design, operate, and maintain it as a common system. The committee found the three operators in L village hesitant to take on a contract to operate the system. First, the operators were skeptical of the quality of this irrigation system because, upon completion of construction, some joints were already leaking. Second, the profit forecast was low. Spare parts for large pipes and engines are difficult to find locally, leading to high maintenance costs. Furthermore, there is no clear regulation regarding contract liability. In the spring of 2021, the village committee finally contracted one of the three farmer operators, who was allowed to charge the villagers 1.5 yuan (20 cents USD) per kilowatt, in total, a similar price as the private irrigation charges. The operator must submit 15 cents (2 cents USD) per kilowatt to the village committee. The operator oversees the project's daily maintenance and repair. If the project encounters serious damage, the village committee supports paying half the repair costs. More than two years after it was installed, the irrigation system was first used in 2022. According to our online interview in 2022, the contractor has already repaired the system twice due to joint damage. He complained that the irrigation system established by the government was not profitable for him (Interview conducted by Qinhong Xu on 21 April, 2022).

TECHNOCRATIC GOVERNANCE

As previously mentioned, the implementation of the technocratic "project system" has resulted in a decline in autonomous local governance and a shift in the responsibilities of local cadres within the villager's committee (He, 2019; Zhou, 2012; Qu et al., 2009; Xu et al., 2023). This technological approach has had a significant impact on local institutional performance, which had to respond to a non-adapted governmentality project. The techno-scientific "project system" has very strict standards and supervision procedures. These standards aim to supervise the correct use of government investments but reject local rural governance norms and customs and limit the autonomy of local cadres (ibid). As an effect, the cadres become more careful to follow orders and avoid conflicts or disputes in their work with peasants. Even to such an extent that in local governance, it is common to find a negative attitude toward project applications and a logic of "do less work, therefore make fewer mistakes" (少做少犯错) (He, 2019; Chen, 2015). When local cadres discover that the top-down infrastructural designs do not fit the local context, they often prefer not to report this to the higher-level government to avoid unnecessary trouble.

Scholars have argued in their study of sub-Saharan Africa that high-efficiency irrigation has higher success rates if it is able to build on existing social structures and institutions (Woltering et al., 2011; Burney and Naylor, 2012). In L Village, the institutions and social structures in place do not match the presumption of the high-efficiency irrigation infrastructure. The village committee has not reclaimed its responsibility to organize and coordinate the villagers in terms of irrigation. The high-efficiency project did not introduce new commons institutions or build local capacities while building infrastructure. As one villager who had private small pumps said: "If you put the (government) pumps into use, you need to spend time and energy to manage them and coordinate with villagers; the

committee does not want to do that" (Interview conducted by Qinhong Xu on 20 April, 2022).

Another example is the national water education and moralization programs that simply assume governance through state-convenient entities without checking their existence in the field (see also Li, 2011; Valladares and Boelens, 2019). The committee in L village takes such education work very casually, usually by filling out evaluation forms without contacting the villagers. The villagers did not connect daily water use to the concepts of water saving and public affairs. Even when the respondent (only one in our case) installed his micro sprinklers in the fields, it was not to save water but rather to save time and labor.

"The grassroots work is the most difficult and complicated," said the L village director, "and the government unitary design sometimes does not work because they do not take reality into account" (Interviews conducted by Qinhong Xu, resp. on 21 July, 2019 and 20 July, 2021). He provided several examples, one of which was the relatively new drinking water project. He said: "I think this project is unsuitable for our local situation; the water price is too high. The villagers will not afford and accept that; many villages connected to the project but do not put it into use; sometimes the government is 'losing money to make a yell (to improve the reputation)' (赔钱赚吆喝)" (Interview conducted by Qinhong Xu on 20 July, 2021).

The governmentality through high-efficiency irrigation technologies and infrastructure is negotiated inside the government system in such a way that the village cadres and the local government adapted the top-down water polices to ensure both a positive annual evaluation of their performance (the project is 'implemented') and avoid direct disputes in practical water use from the villagers by adopting the water system as it was.

CONTINUATION OF LOCAL PRACTICES AND IMPLICIT CONTESTATION

With the development of economic reform, the expanding market system and urbanization are undermining rural normative and ethical systems, which some Chinese scholars refer to as rural disorder (e.g. He, 2007; Zhang and Ding, 2022). One of the most visible manifestations is the atomization of people in rural areas. The power of normative organizations capable of organizing public services, particularly water services, beyond individual households, such as clans and kinships, has also been weakened. Village L is a typical atomized northern Chinese village, and coordination among villagers is difficult (Xu et al., 2022).

When encountering irrigation challenges, people have taken responsibility for resolving the problems using resources available to them, including the purchase of cheap small pumps. Pragmatic risk avoidance strategies vis-a-vis local authorities became the implicit contestation for the villagers to respond to irrigation.

When discussing the newly installed project, several respondents expressed dissatisfaction with the village committee's capability. One respondent, who used her small pump and a private irrigator's service, said: "Many people privately complain about the irresponsibility of the committee" (Interview, conducted by Qinhong Xu on 20 July, 2021). Rather than saying that publicly, they continued to rely on their pumps and informal arrangements.

Easy market access to irrigation technologies such as small electric pumps, durable pipelines, and spare parts plays a role in shaping social relations and irrigation behavior as it reduces reliance on others and creates the conditions for individual action. One operator expressed that it was easy to get the patterns for the connection joint, pipe, and engine parts in town. He mentioned four stores in the vicinity of the L Village. The price is not prohibitively high. His system, which uses 75 mm pipe and produces 20 m^3/hour of water, does not require irrigation collaboration among people. He recently upgraded the control system and connected it to his smartphone. As a result, he controls the irrigation through his smartphone, saving much time and work (Interview conducted by Qinhong Xu on 20 April, 2022). For ordinary villagers, the market-available 63 mm soft pipes can be connected to a 75 mm pipe outlet, but it is incompatible with the larger high-efficiency pipes and outlets. In comparison to the high maintenance costs associated with the high-efficiency irrigation system's technological default, the operator stated that 20 m^3/hour was most appropriate for the village's situation, and his irrigation system was the most widely used by the farmers. The constrained technical compatibility within the market remains an impediment to the willingness to adopt the governmental irrigation system.

In addition to providing a flexible irrigation schedule after off-farm work, the small, mobile technologies even facilitate individuals to escape the social-embedded mechanisms for coordination, such as family or kinship. One widow-headed household, for example, used to rely on her brother-in-law to irrigate her land near the water reservoir. After her brother-in-law for several times failed to irrigate her plot and did not even inform her anymore when he carried his pump to his plot, which was adjacent to hers, she purchased her own small pump to reduce such reliance (Interview conducted by Qinhong Xu on 25 July, 2019).

According to our interviews, through the ownership of individual small electric pumps and the services provided by private irrigation operators, people are less critically dependent on government irrigation infrastructure. Already

existing relatively well-functioning irrigation practices requiring little collective management make it unattractive for peasants to embrace the high-efficiency irrigation infrastructure implemented by the state, which requires coordination or collective action of a set time for irrigation. Rather than open political resistance, the villagers implicitly negotiated and contested the top-down governmentality through irrigation artifacts in their everyday water use practices.

5. DISCUSSION AND CONCLUSION

With the collapse of state-managed (commune system) irrigation systems first, followed by the weakening of village governance more broadly, in our case, regional irrigation practices have de facto become managed by the users themselves. Despite the state's contemporary endeavor to cultivate an ecologically civilized society in rural areas through the adoption of high-efficiency irrigation technologies and infrastructure, governmentalities are incomplete in practice on the ground. Contestation and negotiation are not open, but both within the government system and among the farmers. Under the strict standards of the technocratic "project system," local government actors negotiated the top-down governmentalities by delicately balancing project implementation with the maintenance of existing water usage practices. This strategy ensures the successful completion of higher-level evaluations and avoids potential disputes and conflicts from the villagers, thereby upholding social stability. Additionally, the operation of the "project system" extends beyond villagers and village organizations. Such technology-centered interventions are known to externalize technical maintenance, knowledge, financing, and material inputs and extend into organizational and governance requirements (Boelens, 2015; Sanchis-Ibor et al., 2017). The difficulty in accessing spare parts of these externally designed systems on the local market increases the technical and financial risks for the contractor and their reluctance to contract the project. Furthermore, the designers' assumptions deeply differ from the users' reality. The large discharge of the infrastructure requires coordination of villagers, while the absence of coordination from the village committee and the long-time individual responsibility and atomized action for water access negatively affects the possibility of collective action in rural social cohesion and commons management. These findings align with the observations made by Burnham et al. (2015) in their examination of the human aspects of high-efficiency irrigation. Given the easy availability of small and cheap irrigation facilities and private irrigation businesses in the prevailing irrigation landscape, villagers exhibit reluctance in embracing the top-down installed high-efficiency irrigation infrastructure. As Gupta (2018) points out, once an infrastructure project begins, it does not have to be completed. It can be suspended, abandoned, delayed, or postponed. Rather than neatly following policymakers' designs and intentions, water technologies and infrastructures perform differently depending on social context.

Our case demonstrates that the decline of local governance following the "project system" has greatly influenced the formal organizational institutions of public service governance in the town and L Village. This case also helps us to learn how the daily practices of water users may shape the outcomes of water governance of a conscious top-down design that simply assumes the workings of government disciplinary techniques and organizational patterns. The reason why people prefer individual irrigation in L Village is due to the atomized action without commons or state-functionalist structure (both formal and normative), the greater consideration of pragmatic needs produced by the socio-political context, and the resources available on the market, such as small and inexpensive irrigation technology. Understanding the messy local reality helps to see how top-down policies are lived by people subject to them, and how the situatedness of practice does not grant social context a unitary influence or similar control over subjectivity (Agrawal, 2005). The governmentalities carried out through high-efficiency irrigation were negotiated and mediated both within the government system and in the practice of ordinary villagers. The unitary, top-down, irrigation technology design does not fit the reality; the normalizing and moralizing impacts of such technology have not succeeded in the village.

To conclude, first, in this paper, we deconstructed the Chinese government's mentalities of promoting modernist irrigation and showed how it combines both global discourses and new meanings of ecological civilization in high-efficiency irrigation to construct and sustain social and economic development. At a national level, this comes across as a coherent, integrated, socio-technical governmentality scheme, with a change in thinking promoted through a variety of mechanisms and a strong drive for converting local irrigation practices to so-called modern irrigation. It results in a quick expansion of the area registered as "high-efficiency irrigation" throughout the country. Upon analysis of such a transformation process in our case, it shows, however, for L Village, that the drive primarily focuses on changing infrastructure and other material components without much attention to the existing local institutional and socio-cultural context. In the case study village, the design assumptions implicitly engrained in new infrastructure contradict the reality of

existing individualized irrigation and the decline of, and negative attitude towards, collective governance.

Second, in L Village the socio-political structure and daily practices of water users shape the consequences of top-down infrastructural change. We can see that in the context of the changing social relations in rural areas, the introduction of the "project system" logic, and the local governors' priority of maintaining social stability, high-efficiency irrigation has not encountered a matching institution that already exists or will be implemented. The state administrative command and the disciplinary governmentalities were negotiated and largely neutralized in our case.

Third, in such a structural context, villager's pragmatic attitude, the already existing private operators' system, and the local availability of small and cheap pumps strengthen individual irrigation and decrease reliance on one another in L Village, which further counteracts the requirement of "government through community" (Li, 2011; Valladares and Boelens, 2019) and associated forms of collaboration that are implicit in the design of high-efficiency irrigation infrastructure.

This case demonstrates how a shift in irrigation management discourse and thinking does not always translate into changes in practice on the ground, especially when the material layout is changed through the top-down construction of high-tech irrigation infrastructure. A critical examination of the local social, political, and cultural structure and available resources can help in revealing the process by which people negotiate state governmentality and how the results of state water governance diverge from its initials. This goes beyond the physical and organizational manifestations of formal institutions.

NOTES

1 In China, "large-scale irrigation district" refers to an irrigation system with a capacity of covering 300 000 mu to 500 000 mu. The medium scale is below 300 000 mu and above 10 000 mu. 1 mu = 0.0667 hectares.

2 Small-scale irrigation and water conservation refers to areas smaller than 10,000 mu.

3 Morality here refers to accepting the moral mission of thinking, behaving and acting 'well' and avoiding 'wrong-doing' : a civilizing water rationality steering so-called moral right-ness. In practice, it relates to substituting local water knowledge and rights systems by modern ones under state and/or market control (Boelens, 2015).

4 According to Foucault, governmentality can be summarized as "the conduct of conduct" or "the art of government," where "government" includes various techniques (notably, sovereign, disciplinary, Truth, and neo-liberal governmentalities) of control that render individuals manageable subjects (see Fletcher, 2017; Boelens and Valladares, 2019; Mills-Novoa et al., 2020).

5 "Effective utilization coefficient of irrigation water" (灌溉水利用系数) in China is an important indicator for evaluating the engineering condition and management level of irrigation canal systems. It reflects the leakage losses at various levels of the irrigation area and the water losses in the management process. China aims to reach 0.55 and 0.6 by 2020 and 2030.

ACKNOWLEDGEMENTS

We would like to extend our appreciation to the anonymous reviewers for their meticulous review and constructive feedback, which have contributed significantly to the refinement of this manuscript.

COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR AFFILIATIONS

Qinhong Xu
Wageningen University & Research, Netherlands

Rutgerd Boelens
Wageningen University & Research, Netherlands

Gert Jan Veldwisch
Wageningen University & Research, Netherlands

REFERENCES

Anand, N., Gupta, A., & **Appel, H.** (Eds.) (2018). *The Promise of Infrastructure*. Durham: Duke University Press. DOI: https://doi.org/10.1215/9781478002031

Agrawal, A. (2005). Environmentality: Community, Intimate Government, and the Making of Environmental Subjects in Kumaon, India. *Current anthropology*, *46*(2), 161–190. DOI: https://doi.org/10.1086/427122

Aubriot, O. (2022). The History and Politics of Communal Irrigation: A Review. *Water Alternatives*, *15*(2), 307–340.

Boelens, R. (2015). *Water Justice in Latin America. The Politics of Difference, Equality, and Indifference*. Amsterdam: CEDLA and the University of Amsterdam.

Boelens, R., Escobar, A., Bakker, K., Hommes, L., Swyngedouw, E., et al. (2023). Riverhood: Political Ecologies of Socionature Commoning and Translocal Struggles for Water Justice. *Journal of Peasant Studies*, *50*(3), 1125–1156. DOI: https://doi.org/10.1080/03066150.2022.2120810

Boelens, R., & **Gelles, P. H.** (2005). Cultural Politics, Communal Resistance and Identity in Andean Irrigation Development. *Bulletin of Latin American Research*, *24*(3), 311–327. DOI: https://doi.org/10.1111/j.0261-3050.2005.00137.x

Boelens, R., & **Vos, J.** (2012). The Danger of Naturalizing Water Policy Concepts: Water Productivity and Efficiency Discourses from Field Irrigation to Virtual Water Trade. *Journal of Agricultural Water Management*, *108*, 16–26. DOI: https://doi.org/10.1016/j.agwat.2011.06.013

Burney, J. A., & **Naylor, R. L.** (2012). Smallholder Irrigation as a Poverty Alleviation Tool in Sub-Saharan Africa. *World*

Development, *40*(1), 110–123. DOI: https://doi.org/10.1016/j.worlddev.2011.05.007

Burnham, M., & **Ma, Z.** (2018). Multi-scalar Pathways to Smallholder Adaptation. *World Development*, *108*, 249–262. DOI: https://doi.org/10.1016/j.worlddev.2017.08.005

Burnham, M., Ma, Z., & **Zhu, D.** (2015). The Human Dimensions of Water Saving Irrigation: Lessons Learned from Chinese Smallholder Farmers. *Agriculture and Human Values*, *32*, 347–360. DOI: https://doi.org/10.1007/s10460-014-9565-8

Chen, F. (2015). The Hierarchy of Profit Division and Grassroots Governance Involution: The Logic of Rural Governance under the Background of the Resource Input. *Chinese Journal of Sociology*, *35*(3), 95–120. (In Chinese).

China Daily. (2017). The total agricultural water consumption in has achieved zero growth, and the new high-efficiency water-saving irrigation area has increased by 100 million mu in five years. http://cn.chinadaily.com.cn/2017-10/07/content_32941560.htm

Clarke-Sather, A. (2017). State Power and Domestic Water Provision in Semi-arid Northwest China: Towards An Aleatory Political Ecology. *Political Geography*, *58*, 93–103. DOI: https://doi.org/10.1016/j.polgeo.2015.12.003

Cleaver, F. (2002). Reinventing Institutions and the Social Embeddedness of Natural Resource Management. *European Journal of Development Research*, *14*, 11–30. DOI: https://doi.org/10.1080/714000425

Clements, R., Haggar, J., Quezada, A., & **Torres, J.** (2011). *Technologies for Climate Change Adaptation: Agriculture Sector*. Roskilde: UNEP Risø Centre.

Fletcher, R. (2017). Environmentality Unbound: Multiple Governmentalities in Environmental Politics. *Geoforum*, *85*, 311–315. DOI: https://doi.org/10.1016/j.geoforum.2017.06.009

Foucault, M. (1980). Power/knowledge. In C. Gordon (Ed.), *Power/Knowledge: Selected Interviews and Other Writings 1972–1978* (pp. 109–133). New York: Pantheon Books.

Foucault, M. (1991[1978]). Governmentality. In G. Burchell, C. Gordon & P. Miller (Eds.), *The Foucault Effect: Studies in Governmentality*, pp. 87–104. Chicago: University of Chicago Press.

Foucault, M. (2008). *The Birth of Biopolitics*. New York: Palgrave Macmillan.

Franks, T., & **Cleaver, F.** (2007). Water Governance and Poverty: A Framework for Analysis. *Progress in Development Studies*, *7*(4), 291–306. DOI: https://doi.org/10.1177/146499340700700402

General Office of Ministry of Water Resources. (1988–1992) (1993–1997). Report Documents of Previous National Water Conservancy Conferences. (历次全国水利会议报告文件).

Gleick, P. (2001). Making Every Drop Count. *Scientific American*, February. DOI: https://doi.org/10.1038/scientificamerican0201-40

Glover, D., Venot, J.-P., & **Maat, H.** (2017). 'On the Movement of Agricultural Technologies: Packaging, Unpacking and Situated Reconfiguration'. In J. Sumberg (Ed.), *Agronomy for Development*. London: Routledge, pp. 14–30. DOI: https://doi.org/10.4324/9781315284057-2

Gupta, A. (2018). The Future in Ruins: Thoughts on the Temporality of Infrastructure. In N. Anand, A. Gupta & H. Appel (Ed.), *The Promise of Infrastructure*, New York: Duke University Press, pp. 62–79. DOI: https://doi.org/10.1215/9781478002031-003

Hansen, M., Svarverud, R., & **Li, H.** (2018). Ecological Civilization: Interpreting the Chinese Past, Projecting the Global Future. *Global Environmental Change*, *53*, 195–203. DOI: https://doi.org/10.1016/j.gloenvcha.2018.09.014

He, X. (2007). Peasants' Action Logic and Regional Differences in Rural Governance. *Open Times*, *1*, 105–121. (In Chinese).

He, X. (2019). Rules Going to the Countryside and Governance Involution: Dialectics of Rural Grassroots Governance. *Social Science*, 4. (In Chinese).

He, X., & **Guo, L.** (2010). Farmland Water Conservation and Its Cost-benefit Analysis, Shayang County, Hubei Province. *Management World*, *7*, 86–97. (In Chinese).

Hellberg, S. (2014). Water, Life and Politics: Exploring the Contested Case of eThekwini Municipality through a Governmentality Lens. *Geoforum*, *56*, 226–236. DOI: https://doi.org/10.1016/j.geoforum.2014.02.004

Hidalgo-Bastidas, J. P., & **Boelens, R.** (2019). Hydraulic Order and the Politics of the Governed: The Baba Dam in Coastal Ecuador. *Water*, *11*(3), 409. DOI: https://doi.org/10.3390/w11030409

Hillel, D. (1988). Adaptation of Modern Irrigation Methods to Research Priorities of Developing Countries. In G. Le Moigne et al. (Eds.), *Technological and Institutional Innovation in Irrigation*. WB Technical Paper 94. Washington, DC: World Bank.

Hommes, L., Boelens, R., Bleeker, S., Duarte-Abadía, B., Stoltenborg, D., & **Vos, J.** (2020). Water Governmentalities: The Shaping of Hydrosocial Trritories, Water Transfers and Rural-urban Subjects in Latin America. *Environment and Planning E: Nature and Space*, *3*(2), 399–422. DOI: https://doi.org/10.1177/2514848619886255

Hommes, L., Hoogesteger, J., & **Boelens, R.** (2022). (Re) making Hydrosocial Territories: Materializing and Contesting Imaginaries and Subjectivities through Hydraulic Infrastructure. *Political Geography*, *97*, 102698. DOI: https://doi.org/10.1016/j.polgeo.2022.102698

Jasanoff, S., Markle, G. E., Peterson, J. C., et al. (Eds.) (2001). *Handbook of Science and Technology Studies*. London: MIT Press. DOI: https://doi.org/10.1016/j.geoforum.2019.11.010

Jiang, M., Webber, M., Barnett, J., Rogers, S., Rutherfurd, I., Wang, M., & **Finlayson, B.** (2020). Beyond Contradiction: The State and the Market in Contemporary Chinese Water Governance. *Geoforum*, *108*, 246–254.

Latour, B. (1993). *We Have Never Been Modern*. Harvard: Harvard University Press.

Li, G. (2014). Analyzing the Situation, Clarifying the Goals, Steadily Promoting Rural Water Conservancy Work and Obtaining New Achievements. *National Rural Water Conservancy Work Conference*.

Li, T. M. (2011). Rendering Society Technical: Government through Community and the Ethnographic Turn at the World Bank in Indonesia. In: D. Mosse (Ed.), *Adventures in Aidland*, pp. 99–121. Oxford: Berghahn.

Liu, J., Zhang, C., Hu. R., Zhu, X., & **Cai, J.** (2019). Aging of Agricultural Labor Force and Technical Efficiency in Tea Production: Evidence from Meitan County, China. *Sustainability*, *11*(22), 6246. DOI: https://doi.org/10.3390/su11226246

Long, N., & **van der Ploeg, J. D.** (1989). Demythologizing Planned Intervention: An Actor Perspective'. *Sociologia Ruralis*, *29*(3/4), 226–249. DOI: https://doi.org/10.1111/j.1467-9523.1989.tb00368.x

Meehan, K. (2013). Disciplining de facto Development: Water Theft and Hydrosocial Order in Tijuana. *Environment and Planning*, *D 31*, 319–336. DOI: https://doi.org/10.1068/d20610

Meehan, K. (2014). Tool-power: Water Infrastructure as Wellsprings of State Power. *Geoforum*, *57*, 215–224. DOI: https://doi.org/10.1016/j.geoforum.2013.08.005

Menga, F., & **Swyngedouw, S.** (2018). *Water, Technology and the Nation-State*. London: Routledge. DOI: https://doi.org/10.4324/9781315192321

Mills-Novoa, M., Boelens, R., Hoogesteger, J., & **Vos, J.** (2020). Governmentalities, Hydrosocial Territories & Recognition Politics: The Making of Objects and Subjects for Climate Change Adaptation in Ecuador. *Geoforum*, *115*, 90–101. DOI: https://doi.org/10.1016/j.geoforum.2020.06.024

Ministry of Water Resources. (2018). Notice of the Ministry of Water Resources on the Three-Year (2018–2020) Implementation Plan for the Water Conservancy Poverty Alleviation Action.

Mollinga, P. P. (1998). *On the Waterfront: Water Distribution, Technology and Agrarian Change in A South Indian Canal Irrigation System*. Wageningen: Wageningen University.

Mollinga, P. P., & **Veldwisch, G. J.** (2016). Ruling by Canal: Governance and System-level Design Characteristics of Large-scale Irrigation Infrastructure in India and Uzbekistan. *Water Alternatives*, *9*(2), 222–249.

National Development & **Reform Commission.** (2019). National Water Saving Action Plan, No.295.

Nickum, J. (2010). Water Policy Reform in China's Fragmented Hydraulic State: Focus on Self-funded/managed Irrigation and Drainage Districts. *Water Alternatives*, *3*(3), 537–551.

Pfaffenberger, B. (1988). Fetishised Objects and Humanised Nature: Towards an Anthropology of Technology. *Man*, *23*, 236. DOI: https://doi.org/10.2307/2802804

Polak, P. (2008). *Out of Poverty: What Works When Traditional Approaches Fail*. San Francisco: Berret-Koehler Publishers.

Postel, S. (1997). *Last Oasis: Facing Water Scarcity*. New York: Norton & Co.

Postel, S., et al. (2001). Drip Irrigation for Small Farmers: A New Initiative to Alleviate Hunger and Poverty. *Water International*, *26*(1), 3–13. DOI: https://doi.org/10.1080/02508060108686882

Qu, J., Zhou, F., & **Ying, X.** (2009). From Macro Management to Micro Management. Reflections on Thirty Years of Reform from the Sociological Perspective. *Social Sciences in China*, *6*, 104–127. (In Chinese).

Richards, P., & **Diemer, G.** (1996). Agrarian Technologies as Socio-technical Hybrids. Food Crop Improvement and Management of Land and Water in sub-Saharan Africa. *Bulletin de l'APAD, 11*, electronic. DOI: https://doi.org/10.4000/apad.641

Rodina, L., & **Harris, L. M.** (2016). Water Services, Lived Citizenship, and Notions of the State in Marginalised Urban Spaces. *Water Alternatives*, *9*(2), 336–355.

Rodríguez-de-Francisco, J. C., & **Boelens, R.** (2016). PES Hydrosocial Territories: De-territorialization and Re-patterning of Water Control Arenas in the Andean Highlands. *Water International*, *41*(1), 140–156. DOI: https://doi.org/10.1080/02508060.2016.1129686

Rogers, S., & **Crow-Miller, B.** (2017). The Politics of Water: A Review of Hydropolitical Frameworks and Their Application in China. *Wiley: Water*, 4(6), e1239. DOI: https://doi.org/10.1002/wat2.1239

Rogers, S., & **Wang, M.** (2020). Producing a Chinese Hydrosocial Territory: A River of Clean Water Flows North from Danjiangkou. *Environment and Planning C*, *38*(7–8), 1308–1327. DOI: https://doi.org/10.1177/2399654420917697

Sanchis-Ibor, C., Boelens, R., & **García-Mollá, M.** (2017). Collective Irrigation Reloaded. Re-collection and Re-moralization of Water Management after Privatization in Spain, *Geoforum*, *87*, 38–47. DOI: https://doi.org/10.1016/j.geoforum.2017.10.002

Scott, J. C. (1998). *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*. New Haven: Yale University Press.

Shah, E., & **Boelens, R.** (2021). The Moralization of Hydraulics: Reflections on the Normative-political Dimensions of Water Control Technology. *Geoforum*, *121*, 93–104. DOI: https://doi.org/10.1016/j.geoforum.2021.02.009

Sheng, J., & **Han, X.** (2022). Constructing Payments for Ecosystem Services Hydrosocial Territories through Assemblage Practices: China's Xin'an River Basin Eco-compensation Pilot. *Environment and Planning C: Politics and Space*, 23996544221137442. DOI: https://doi.org/10.1177/23996544221137442

Swyngedouw, E. (2013). Into the Sea: Desalinisation as Hydro-social Fix in Spain. *Ann. Assoc. Am. Geogr.*, *103*(2), 261–270. DOI: https://doi.org/10.1080/00045608.2013.754688

The 12th 5-year Water Conservation Planning. (2012). https://www.ndrc.gov.cn › fggz › fzzlgh › gjjzxgh

The 13th 5-year Water Conservation Planning. (2016). http://www.gov.cn/xinwen/2016-12/27/content_5153465.htm

The 13th 5-Year Water Conservancy Poverty Alleviation Plan. (2016). http://www.jsgg.com.cn/Index/Display.asp?NewsID=21592

von Benda-Beckmann, F., van Eldijk, A., Spiertz, J., & **Huber, F.** (1989). Interfaces and Janusfaces: a Critical Appraisal of the Interface Approach in Development Sociology from a Socio-legal Studies Perspective. In: N. Long (Ed.), *Encounters at the Interface*, Wageningse Sociologische Studies, *27*, pp. 205–220, Wageningen.

Valladares, C., & **Boelens, R.** (2017). Extractivism and the Rights of Nature: Governmentality, 'Convenient Communities' and Epistemic Pacts in Ecuador. *Environmental Politics*, *26*(6), 1015–1034. DOI: https://doi.org/10.1080/09644016.2017.1338384

Valladares, C., & **Boelens, R.** (2019). Mining for Mother Earth. Governmentalities, Sacred Waters and Nature's Rights in Ecuador. *Geoforum*, *100*, 68–79. DOI: https://doi.org/10.1016/j.geoforum.2019.02.009

Van der Ploeg, J. D. (2003). *The Virtual Farmer*. Assen: Van Gorcum.

Van der Ploeg, J. D. (2012). *The New Peasantries*. London: Routledge. DOI: https://doi.org/10.4324/9781849773164

Van der Ploeg, J. D. (2013). *Peasants and the Art of Farming*. Winnipeg: Fernwood. DOI: https://doi.org/10.3362/9781780448763.000

Venot, J. P. (2017). From Obscurity to Prominence: How Drip Irrigation Conquered the World. In Venot et al. (ed.), *Drip Irrigation for Agriculture*, Taylor & Francis, pp. 16–37. DOI: https://doi.org/10.4324/9781315537146-2

Verbeek, P. P. (2008). Morality in Design: Design Ethics and the Morality of Technological Artifacts. In *Philosophy and Design*. Dordrecht: Springer, pp. 91–103. DOI: https://doi.org/10.1007/978-1-4020-6591-0_7

Weins, N. W., Zhu, A., Qian, J., Fabiana Barbi Seleguim, F. B., & **da Costa Ferreira, L.** (2023). Ecological Civilization in the Making: the 'Construction' of China's Climate-Forestry Nexus. *Environmental Sociology*, *9*, 1, 6–19. DOI: https://doi.org/10.1080/23251042.2022.2124623

Whaley, L. (2022). Water Governance Research in a Messy World: A Review. *Water Alternatives*, *15*(2), 218–250.

Wiber, M., & **Turner, B.** (2010). Moral Talk: the Ontological Politics of Sustainable Development, Max Planck Institute Working Paper Series, no. 123, MPI, Halle.

Winner, L. (1980). Do Artifacts Have Politics? *Daedalus*, *109*(1), 121–136.

Woltering, L., Pasternak, D., & **Ndjeunga, J.** (2011). The African Market Garden: the Development of A Low-pressure Drip Irrigation System for Smallholders in the Sudano Sahel. *Irrigation and Drainage*, *60*(5), 613–621. DOI: https://doi.org/10.1002/ird.610

Xu, Q., Boelens, R., & **Veldwisch, G. J.** (2022). Rural Drinking Water Governance Politics in China: Governmentality Schemes and Negotiations from Below. *Political Geography*, *97*, 102703. DOI: https://doi.org/10.1016/j.polgeo.2022.102703

Xu, Q., Boelens, R., & **Veldwisch, G. J.** (2023). The Evolution of China's Rural Water Governance: Water, Techno-political Development and State Legitimacy. *The Journal of Peasant Studies*. DOI: https://doi.org/10.1080/03066150.2023.2261860

Zhang, B., & **Ding, X.** (2022). The Dilemma of Rural Public Cultural Governance and Its Transcendence. *Theoretical Investigation*, *2*, 83–90. (In Chinese).

Zhao, X. (2011). The Dilemma of China Farmland Water Supply-Taking the Practice of Rural Water Conservancy Reform in Jingmen, Hubei. *Jnl Party School CPC Hangzhou*, *2*. (In Chinese).

Zhou, F. (2006). From Absorption Regime to Suspension Regime: A Study on the Impact of Tax Reform on Relations between the State and Farmer. *Sociological Studies*, *3*. (In Chinese).

Zhou, F. (2012). Fiscal Investment Projectization and Its Problems. *Chinese Journal of Sociology*, *1*, 1–37. (In Chinese).

Zwarteveen, M. (2017). Decentering the Technology: Explaining the Drip Irrigation Paradox. In Venot et al. (Eds.), *Drip Irrigation for Agriculture*. Taylor & Francis, pp. 38–53. DOI: https://doi.org/10.4324/9781315537146-3

TO CITE THIS ARTICLE:
Xu, Q., Boelens, R., & Veldwisch, G. J. (2024). High-Efficiency Irrigation: Local Water Users' Responses to the Modernization of Village Irrigation Technology and Government Control in China. *International Journal of the Commons*, 18(1), pp. 148–163. DOI: https://doi.org/10.5334/ijc.1253

Submitted: 23 December 2023 **Accepted:** 15 January 2024 **Published:** 26 February 2024