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# A Multiplicity of *Prek(s)*: Enacting a Socionatural Mosaic in the Cambodian Upper Mekong Delta

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## Abstract

In Khmer, the word *prek* designates a connection between things. In Kandal province in Cambodia, *preks* crisscross the landscape, connecting rivers with floodplains, supporting rich ecologies and a variety of livelihoods. Drawing on science and technology studies (STS) and critical water research, this paper explores *prek(s)* as a *multiplicity*. Rather than taking *the prek* as a passive object around which various practices occur, we examine how *prek(s)* are enacted as ontologically different: as irrigation infrastructure, as pathway to rice intensification, as device for Cambodian state-making, and as climate-friendly agricultural development. After analyzing *interference patterns* between enactments and their *scale-making effects* in- and outside the Mekong floodplains, we make explicit our own *ontological politics*. Focused on sustaining multiple uses and ecosystems, "our" *prek* is a socionatural mosaic landscape where many human and more-than-human actors and practices can co-exists. This ontological politics, we suggest, has implications for planetary environmental knowledges and delta management far beyond Kandal's landscape.

**Key words:** Infrastructure, Enactments, Ontological Politics, Mekong delta, Cambodia

## Highlights

- A focus on *enactments* sheds new light on socionatural dynamics
- *Prek(s)* multiply as irrigation infrastructure, engine of rice intensification, climate-friendly agricultural development, and devices for Cambodian politics.
- Each enactment *scales* the *prek(s)* differently.
- *Interferences* among enactments generate surprising effects.
- Enacting *prek(s)* as a socionatural mosaic offers new avenues for delta management

## Introduction

Coming from the north, the Mekong River branches out by Phnom Penh, forming a delta that spans Cambodia and Vietnam. Just south of the city, the Bassac River and the main stream of the Mekong flow roughly parallel through the Kandal province for around 70 kilometers, before both rivers cross into Vietnam and continue their journeys towards the sea.

The national road 21, a narrow strip of potholed asphalt rehabilitated prior to the commune elections of 2017, runs along the right bank of the Bassac River. Traveling by car or motorbike, the visitor may notice that the road resembles a succession of small bridges spaced at 500 m to 1 km intervals. Each of these bridges crosses earthen channels 10 to 50 meters wide and several meters deep. Locally, the channels are known as *preks*, a Khmer term that designates a connection between things. And indeed, the channels do connect the Bassac River with a floodplain located to the West known by the generic term *boeung* and sustaining productive capture fishery during the flood season and rice farming during the dry season. Crisscrossed by *preks* and other earthen channels originally built during the Khmer rouge period, the landscape can be described as a mosaic agricultural floodplain. In this landscape, many farmers-cum-fishermen cultivate a few hectares, breed livestock, and engage in diverse forms of small rural business.

Close to the main river levees, where village settlements have been built so they are seldom flooded, small fields run perpendicular to the *preks* (hence parallel to the main rivers). In this area, called *chamkar*,<sup>1</sup> farmers cultivate a diversity of fruit trees, sugarcane, beans and vegetables, mostly for the urban markets of Phnom Penh. To supplement rainfall, farmers place small diesel pumps on the edge of the *preks* to pump water for their *chamkar* fields. Further away, in the *boeung*, they cultivate less regularly patterned rice fields twice a year, when they are not flooded (see Figure 1).

*Preks* have been around since the 19<sup>th</sup> century. One story describes how the first *prek* was excavated on the right bank of the Mekong River by a Cham leader in the early 1800s to carry a large boat from the river to harvest the natural vegetation growing in the *boeung* located “behind” its village (Barthelemy 1915).<sup>2</sup> The story recounts how a narrow breach in the river levee quickly widened when the river flood entered. Unexpectedly, the deposition of sediments significantly increased the size of land that could be cultivated. The French term *canaux de colmatage*, which has been used to describe these systems

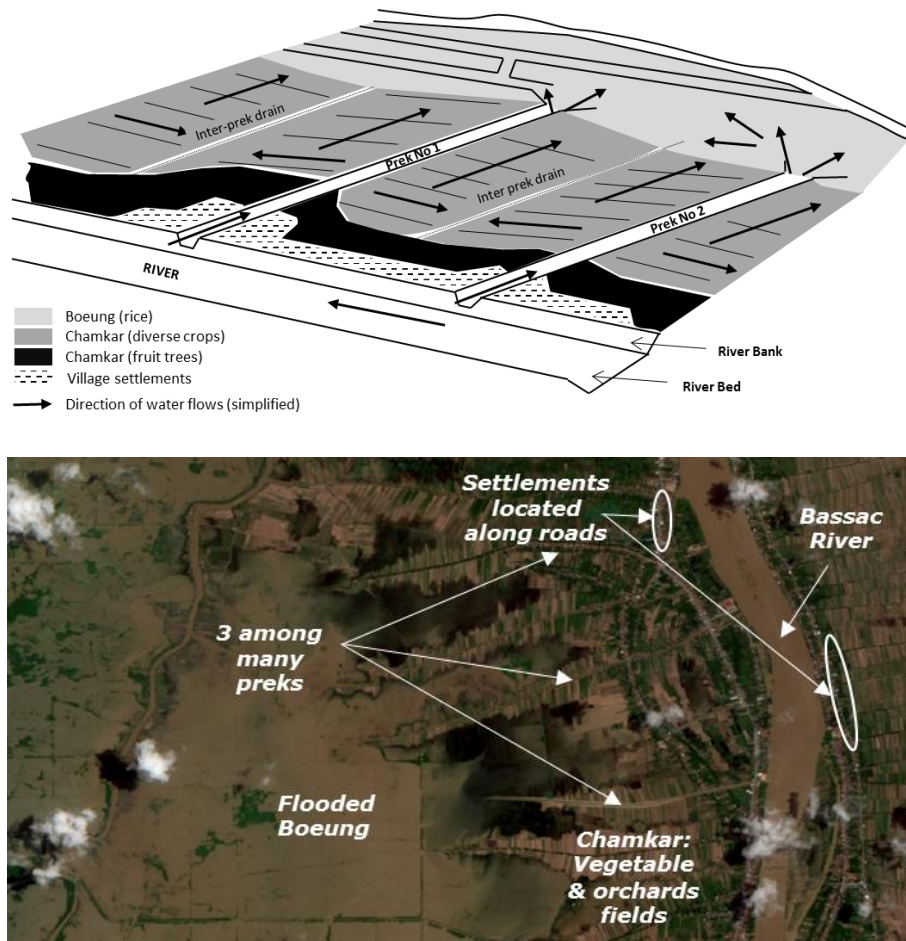
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<sup>1</sup> In Khmer, *chamkar* is a generic term used to designate land that is not cultivated with inundated rice. Covering diverse agricultural situations (from small vegetable gardens close to homesteads to large rubber plantations), it can be translated as plantation, field, farm, garden (of vegetables), or orchard. In the floodplain of Kandal, farmers use it for land that does not flood.

<sup>2</sup> The Chams are a Muslim minority mostly living in the south of Cambodia.

since the French colonial period, emphasizes that *preks* raise land as sediments accumulate in the *boeung* where water flows slower and natural vegetation enables siltation.<sup>3</sup>

**Figure 1.** Envisioning a *prek* landscape (top panel is adapted from SOFRECO, 2018; Background image of bottom panel is Landsat image of 13/09/2018)



Since colonial times, *preks* have been recognized as complex systems serving multiple purposes. Later, their agricultural productivity was rediscovered by international development organizations. In the 1990s, a JICA (Japanese International Co-operation Agency) report characterized the mosaic landscape as “the most productive farming system [...] in the whole of Cambodia” and stressed that it is “adapted for the natural conditions and utilizes them for agricultural production” (JICA 1998: 58).

Since then, several development organizations, including the French Agency for Development (AFD), have funded projects to rehabilitate *preks* and increase agricultural output by building water control and irrigation infrastructure. Although these projects focus on the capacity of the *preks* to sustain diversified, intensive irrigation practices, most reports highlight that *preks* *also* serve land reclamation and soil fertility replenishment, are

<sup>3</sup> In French, *colmatage* describes the deposition of sediments contained in water.

used for transport of people and goods, contribute to flood mitigation, are crucial for maintaining an ecologically healthy floodplain, and support rapidly dwindling small-scale capture fisheries (JICA, 1998; SOFRECO, 2018).

This paper examines the interwoven technoscientific and sionatural dynamics of Kandal's *preks*. Following an introduction to our encounter with the *preks*, we review how the interplay between "society" and "nature" has recently been dealt with in critical irrigation and water scholarship. Much of this literature maintains the image of a divide between ontological domains (nature and culture, water and society) which thus needs continuous bridging. In contrast, with inspiration from the science and technology studies (STS) notion of *enactments* we examine ontological multiplicity through *material practices* (see also Barnes and Alalout, 2012; Yates et al., 2017).

Rather than taking *the prek* as a passive object *around which* various practices occur and *on which* people have diverse perspectives, we evoke *prek(s)*<sup>4</sup> as a multiplicity (see also Wilson and Inkster, 2018). We show how they are simultaneously enacted as irrigation infrastructure in recent AFD rehabilitation projects, as pathways to rice intensification, devices for Cambodian state-making, and climate-friendly sites for agricultural development. A discussion of *interference patterns* between these enactments leads us to an examination and questioning of their *scale-making effects* in- and outside the mosaic landscape. Drawing on earlier insights into the mosaic landscape and more recent debates on nature-based engineering, we end by sketching our own ontological politics and its ramifications for delta management beyond Kandal's floodplains.

### **Encountering the *Prek(s)***

Our first encounter with the *preks* took place about five years ago as part of a social science research project about knowledge production and uncertainty in Southeast Asian deltas (see <https://deltasoutheastasia-doubt.com/> and <http://delta.hus.osaka-u.ac.jp/>). In Cambodia, this involved a detailed examination of development discourses and practices relating to land and water management in the upper Mekong delta.

In this context, AFD's Water and Agriculture Sector Project (WASP) turned out to be significant. Implemented by the Cambodian Ministry of Water Resources and Meteorology (MoWRAM), the project aimed, among other things, to rehabilitate 25 *preks*. During our research, AFD further committed to support rehabilitation of an additional 20 to 40 *preks* as part of the WAT4CAM project, to be implemented between 2019 and 2025.<sup>5</sup>

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<sup>4</sup> We use the term *prek(s)* to characterize particular *enactments*. When referring to specific locations we use *prek* or *preks*.

<sup>5</sup> WASP was a five-year project funded with 25M Euros to support the development of the Cambodian irrigation sector through infrastructure rehabilitation and establishment and support to Water User Associations (FWUC) in four provinces, including Kandal. Building on the WASP project and co-funded by AFD and the European Union (E.U.), the *Water Resources Management & Agricultural Transition for Cambodia Project* (WAT4CAM) is a 200M Million Euros, six-year project, to be implemented in five

Clearly, an understanding of AFD project design and implementation would be important to our research. Since then, the first author had countless informal interactions with people involved with AFD-funded water and agriculture projects implemented in Cambodia. Interviews were conducted with AFD project officers in Phnom Penh and Paris, with agents from other development agencies and with staffers from MoWRAM in Phnom Penh and Kandal, and with the technical assistance teams charged with supporting AFD's project implementation. Another substantial source of materials include observations and conversations during short, frequent field visits, and from participatory activities, as well as occasional interviews with farmers, fishermen and local elected officials. This body of qualitative data is complemented with a review of project and ministerial reports, assorted grey literature, as well as social and environmental research on agriculture, delta planning and infrastructure in Cambodia and elsewhere.

Rather quickly, it became evident that a particular diagnosis sat in the background of AFD's focus on *prek* "rehabilitation." In the late 1990s, projects officers began to argue that *preks* had become unable to fulfill their traditional role of *colmatage* and soil fertility replenishment because they had filled up. Limited water availability in the dry season further inhibited agricultural intensification. Fulfilling the agricultural potential of *preks* thus entailed restoration of their original hydraulic properties, and this goal was primarily pursued by excavating canals and building sluice gates (SOFRECO, 2018). The *preks* furthermore appealed to AFD because they presented a rather "unique" form of nature-based engineering and multiple use system. Compared with other types of irrigation works that have been critically scrutinized (both in- and outside Cambodia) due to poor results and high socio-environmental costs (e.g. World Bank, 2006a), they could be supported with relatively light capital investments and moderate impacts on their surroundings.

However, our forays into Phnom Penh offices and the mosaic landscape made clear that many other things were also going on. Some enacted *prek(s)* as climate-friendly sites for mixed agriculture, while others turned them into pathways for rice intensification. And while politicians enrolled *prek* development into matters of state-making, we became increasingly interested in their interwoven technoscientific and socionatural dynamics. Over time, we thus began to favor a particular enactment of the mosaic landscape that would sustain multiple human and more-than-human lives and practices. In collaboration with Cambodian NGO and university partners, we engaged in a variety of participatory activities to bring together farmers-cum-fishermen, development agents, administrative staff, local elected politicians, and researchers to support this enactment.

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provinces, including Kandal. AFD only operates through loans in Cambodia and the E.U. support mostly consists of a grant to finance the (foreign-lead) technical assistance teams that the Cambodian government declines to fund through the loans it contracts.

This trajectory is exhibited in the structure of the discussion. We start from our original focus on *prek* rehabilitation as envisioned by engineers, consultants, development staffers and ministerial officials. Subsequently, the discussion fans out as an exploration of multiple *enactments* of *prek(s)*. Because enactments orient to material practices, processes, and things being done, we can replace seemingly endless discussions about how to *bridge* nature and culture with empirical inquiries into how variable practical ontologies are created, how they mutually interfere, and how they generate scale.

The same conceptual move elicits the present text as a device for interfering in reality.<sup>6</sup> It gains a double orientation: simultaneously a description of *other enactments and their consequences* and an enactment of *prek(s)* in its own right. Thus, we end by highlighting our favored enactment of *prek(s)* as a profoundly networked socionatural mosaic, where numerous human and more-than-human beings are provided with generous opportunities for living together. Emphasizing the possibility of “conjunctions” (Jensen and Morita, 2020; Yates et al., 2017) that “interfere with modernity” (Choi 2021) this ontological politics, we suggest, has implications for environmental knowledges and delta management far beyond the gates that dot Kandal’s landscape.

To situate our approach, we now turn to a discussion of streams of irrigation and water scholarship that have grappled with hybridity and the materiality of infrastructure.

### **Infrastructural Interfaces and the Question of Hybridity**

The actor-oriented approach to development sociology (e.g. Long, 1989, 2001) can be seen as a (now somewhat overlooked) precursor of current critical irrigation and water scholarship, not least due to its prominent notion of the ‘interface.’ Originally, it had emerged in response to what proponents saw as an unsatisfying alternative between then regnant institutional and political economical approaches and their poststructuralist competitors, which emphasized discourse to the detriment of practical action.

The approach emphasized that development interventions are implemented at concrete interfaces, where actors have opportunities for mediation, transformation, or obstruction (see also Mosse, 2005). Norman Long (2001: 17) invoked Bruno Latour’s (1986) argument that influencing others and gaining power is a matter of aligning and stabilizing interests in a network (see also Wanvoeke et al., 2016). But he paid less attention to Latour’s insistence that the actors are more and other than human.

Critical irrigation studies, meanwhile, developed a marked interest in *materiality*. It is exhibited in studies that show how infrastructure embed particular representations, norms and standards of the environment, while also holding potential for social

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<sup>6</sup> Adele Clarke and Theresa Montini (1993: 42) made a similar point: “If we try to follow all the actors, we find a fuller and more historicized arena, and, ironically, we too can be construed as implicated actors in it.”



transformation (e.g. Bolding et al., 1995; Vincent, 1997; Ivars and Venot, 2018). Irrigation infrastructure appear as interfaces where human and nonhuman actors encounter and shape each other. We can discern similarities with the influential STS concept of the boundary object (Star and Griesemer, 1989), which was developed to explain how different social groups manage to collaborate across their differences. In contrast with the somewhat static notion of the “interface,” however, the boundary object emphasizes that successful collaboration between heterogeneous groups require objects that are sufficiently *fluid* to support divergent goals. Beyond the interface, it also encourages attention to what happens to actors and practices located ‘downstream.’

In combination, these points shape an image of infrastructure as flexible, if not unstable interfaces, of consequence for a wide range of human and nonhuman actors, both near and far (Clarke and Montini, 1993: 42). Indeed, recent explorations at the intersection of STS and critical water studies depict phenomena like deltas, droughts, and nature itself, as infrastructural (Biggs, 2012; Carse, 2012, 2017; see also Harvey et al., 2016).

Meanwhile, hydrosocial scholarship (e.g. Linton, 2010) draws from a trajectory within geography that is increasingly attentive to conjunctions between “environment” and “society” (Whatmore, 2002; Bakker and Bridge, 2006; Goldman et al., 2011). It combines a focus on water as a socio-political phenomenon (not itself novel; Mollinga, 2014) with an interest in the material capacities, or ontology, of water (Linton and Budds, 2014: 170, Götz and Middleton, 2019; Yates et al., 2017).<sup>7</sup> Generally oriented to large-scale dynamics, this research often embeds a critique of the capitalist or neo-liberal underpinnings of contemporary water regimes (Swyngedouw, 2004; Damonte and Boelens, 2019). It is also emphatic about “hybridity,” but in a particular way (Ghiotti, 2018).

Characterizing water and social power as “internally related” (Linton and Budds, 2014: 173), hydrosocial researchers depict a composite that in principle belongs to neither nature nor culture. In practice, however, those domains reappear in specific analyses. Thus, Karen Bakker (2002: 774) described water dually as both a “physical flow” *and* a “socially and discursively mediated thing.” Linton and Budds (2014: 176, following Swyngedouw 2004, 2009) evoked a process where the ‘materiality of water’ *intervenes* in social structure. Both cases depict points of contact between ontologically distinct domains. Rather than constitutively hybrid, the resulting image is of a “gap” (between the ‘hydro’ and the ‘socio’) that needs bridging. Moreover, those domains are asymmetrical. While Bakker characterizes water flows as “physical” and, as such, apparently “non-negotiable,” social understandings of water are culturally variable.

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<sup>7</sup> Somewhat confusingly, socio-hydrology is *another* field that grapples with the interplay between social and hydrological processes (Sivapalan et al., 2012; Srinivasan et al., 2018). In contrast with the hydrosocial literature dominated by social scientists, socio-hydrology mostly remains the realm of hydrologists concerned to find ways of incorporating social processes in hydrological models (for review and comparison see Wesselink et al., 2016; Ross and Chang, 2020). Massuel et al. (2018) position themselves differently, depicting socio-hydrology as an interdisciplinary method of enquiry.

Despite the emphasis on internal relations and mutual interferences, a dichotomy between the real materiality of water and social perspectives on it is thus retained. The ontological priority of the former remains in place. In a sense, “water” in hydrosocial research operates analogously to infrastructure in critical irrigation studies: it is the “object in the middle,” around which inquiry and controversy revolves. It is therefore particularly interesting that strands of STS oriented to ontological multiplicity have developed an alternative to the very idea of a passive object sitting in the middle.

### **The Disappearing Object in the Middle**

This development relates to the empirical focus of science and technology studies. Science, of course, is where Westerners conventionally turn for authoritative knowledge about the entities and processes of the world. But STS scholars went into the laboratories, studied scientific practices, and *opened the black-box* of fact-making (e.g. Latour, 1987). They were able to observe how nonhumans from fruit flies to quarks gained distinctive qualities *through* particular scientific set-ups (Kohler, 1994; Pickering, 1995). Analogous to Long’s (1989: 3) observation that policy and implementation cannot be separated into “watertight compartments” due to a continuous seepage and mixing of elements, the domains of nature and culture were replaced with networks populated by constitutively hybrid actors.

In *The Body Multiple*, Annemarie Mol (2002) gave these insights a distinctive inflection. Similar to other works in the sociology of illness, Mol considered patients and bodies, medicine and procedures. However, rather than focusing on perspectival or power differentials between patients and doctors, she examined how ailing bodies are differently *enacted in practices*. In her case, this ‘doing’ concerns an ‘entity’—a body—that is handled in many ways: “sliced, colored, probed, talked about, measured, counted, cut out, countered by walking, or prevented” (Mol, 2002: vii). Depending on enactment, the body is “a slightly different one each time” (vii). Once “practices are foregrounded *there is no longer a single passive object in the middle*” (5, our emphasis), and the question of what the body ‘truly is’ recedes to the background.

The disappearance of a passive object in the middle has implications for water studies (Barnes and Alatout, 2012; Jensen, 2017). Water is not “ultimately” a physical flow, but it can be enacted as such in some practices. However, water is also not a reflection of social power “in the final instance,” though it might be enacted as such. Yet, this *also* does not reduce water to a play of incongruent perspectives. Instead, like bodies (and *prek(s)*), water “come into being—and disappear—with the practices in which [it is] manipulated” (Mol, 2002: 5, also Ballesteros, 2019). This has inspired critical water scholars to explore alternatives to dominant water governance approaches (e.g. Yates et al., 2017). More generally, a focus on enactment offers an escape route from interminable debates about whether there is a single, material world or many perspectival ones. In place

of these futile discussions, we engage in empirical inquiries into how practical ontologies (Gad et al., 2012) are created, how they interfere, and how they change over time.

As the epistemological question of what water (or infrastructure) “truly is,” recedes to the background, we are provided with concrete answers to how “incommensurate worlds emerge and how they are sustained” (Povinelli, 2001: 319). They *emerge* from different constellations of heterogeneous elements. They are *sustained* as actors keep their relations stable. And they can become *relatively dominant* by extending relations further.

In one practice, *prek(s)* are channels for storing water to be used for agriculture. The elements include technical experts, hydrological gauges, excavators, and sluice gates, but also farmers, fruit trees, and tools of agriculture. In another, *prek(s)* are engines of rice intensification. The experts and sluice gates remain, but the central actors and activities change as *prek(s)* are now composed by rice farmers and their implements in the *boeungs*, which are linked to policy agendas in Phnom Penh and compared with productivity in the Vietnamese Mekong delta. With Helen Verran (2002: 166), we can describe the situation as different enactments, which perform *prek(s)* as *ontologically distinct places*.

The result is not necessarily fragmentation or chaos. Sometimes enactments align more or less neatly, like when AFD, the ministry, and vegetable farmers share an interest in rehabilitating *preks* for agricultural purposes. But there can also be clashes of enactments, as when an over-zealous emphasis on rice intensification threatens biodiversity, small-capture fisheries, or projects’ climate indicators. In such cases, we are dealing with *interference patterns* (or conjunctions; see Yates et al., 2017), the possibility of breakdown, of coordination across practices, or of mutual irrelevance. These are unpredictable surprises of practice to be explored empirically.

### **Irrigation Enactments: Dredging and Sluice Gates**

The Water and Agricultural Sector Project (WASP) developed through discussions between AFD and the Government of Cambodia that started in the early 2010s. Launched in 2015, it built on expertise acquired over more than two decades of AFD-support to the Cambodian irrigation sector (Venot and Fontenelle, 2016). WASP was a novelty, however, as the first loan-based agricultural sector project funded by AFD, and the first to incorporate a large component specifically targeting *preks*.<sup>8</sup> Like earlier projects, it was implemented by the Ministry of Water Resources and Meteorology (MoWRAM) with support from dedicated “technical assistance teams,” consisting of international (mostly French) and Cambodian experts in irrigation engineering, agricultural development, and social water management.

Underpinning the project in Kandal province was the idea that the intensification of high-value agriculture in the *chamkar* was mainly inhibited by lack of water in the dry

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<sup>8</sup> Previous AFD supported projects had targeted *preks* in the context of “pilot activities” that mostly focused on agricultural development rather than irrigation and water management.

season. This coincided with the fact that the construction of irrigation infrastructure is at the very core of MoWRAM's interests and activities (Ivars and Venot, 2018; Blake, 2019). From this conjunction emerged an enactment of *prek* rehabilitation revolving around particular engineering conceptions.

This had a series of consequences. First, despite acknowledging the complexity of the mosaic landscape on paper, *preks* were primarily defined as channels for transporting and storing water. Rehabilitation became a matter of ensuring that *preks* would be able to hold more water for a longer period of time. That question, in turn, was translated into a technical issue about the depth at which the bed of the *preks* should be excavated.

This discussion revolved around two options. According to the first, "deep calibration," the bed of the *preks* should be dredged "below the minimum water level observed in the Bassac River." This would allow water from the Bassac River to flow to the *preks* throughout the year. On the flipside, it would require significant capital and maintenance investment and entail a substantial loss of land for farmers who owned land along the *preks*. In contrast, "shallow calibration," would enable flow throughout the year *only if* pumping stations were installed at the entrance of each *prek*. This second solution required smaller initial investment, and entailed less loss of land. Its drawback, instead, was higher operational costs and the need to devise collective management modalities for the pumping stations (SOFRECO, 2018).<sup>9</sup>

We can observe that turning the *prek* into an irrigation infrastructure requires putting together a series of divergent but quite specific relations. Starting from ministerial interests in building infrastructure and French irrigation expertise and concerns with agricultural intensification, *preks* are enacted as water channels and, as such, primarily as sites for *digging*. If you think about it, this way of rehabilitating a landscape known to serve multiple purposes is both quite specific and very narrow.

Even so, *preks* can be dug in various ways, and thus it is relevant to consider how the two calibrations options emerged. Here, the minimum water level in the Bassac River became a crucial differentiating element. But how is a minimum observed water-level known? Where does it come from? Implicitly, this question sat behind technical discussions about the options. It was decided to rely on daily water levels manually recorded between 1981 and 2015 at the Koh Khel gauging station just north of the rehabilitation sites.<sup>10</sup> Irrespective of the accuracy of those records, we can observe that a rather simple technology, a series of graduated iron scales (Figure 2), became an obligatory passage point for the enactment of *prek(s)* as irrigation infrastructure.

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<sup>9</sup> Though much debate revolved around the issue of "excavation depth," this is of course not the whole picture of how *preks* were enacted in the WASP project. In line with global irrigation debates, there were also ample discussions about agricultural development and devising modalities for sustainably managing the rehabilitated infrastructure.

<sup>10</sup> These records were held by MoWRAM and the Mekong River Commission.

On the basis of these records, project experts estimated that excavating *preks* to a depth around sea level ought to ensure year-round water supply (SOFRECO, 2018). The choice of shallow or deep calibration was made during 'community meetings' organized by project staff. Accepting some loss of land, most villagers chose the deep calibration option (20 *preks* were dredged in this way). Soon, however, it became clear that this decision had further ramifications. By facilitating greater water flow through the channels, deep calibration increased the likelihood that crops in the *boeung* would be damaged as the flood rose, or that the banks of newly dug-out *preks* might collapse. Close to the Vietnamese border, where water levels are heavily influenced by the tide and flows change direction every six hours during the dry season, deep calibration allowed water to flow back from the *preks* into the Bassac River, hindering their capacity to store water.

Partly surprising, partly foreseen by the WASP project team, these issues made clear that excavation *alone* would not consistently ensure yearlong water availability and intensified agriculture. Turning the *preks* into successful irrigation infrastructure depended on another element: the *sluice gate*. Like a "high modernist" (Scott, 1998) equivalent of the temporary earth-dams farmers had built across *preks* until the 1990s, building sluice gates at the entrance to the *preks* would enhance water control. The gates would also limit the potential negative impacts of quickly rising floods, and make it possible to retain water during the dry season. For these reasons, sluice gates were designed and built at the entrance of most *preks* (20 out of 25) while "tail-end gates" were built along 5 *preks* where they merged into the *boeung*.

Even so, the complex mosaic landscape made it quite difficult to assess the impact of dredging and sluice gates on water flows. While the gates enabled partial water control, fields were still flooded, *preks* filled and emptied, in consequence of unpredictable flows in and out of streams, old Khmer rouge canals, aquifers, and *boeungs*. Poor engineering choices increased flow velocity in some channels, and led to bank erosion, partial collapse of infrastructure, and complaints by farmers and village officials. Meanwhile, quite different enactments of the *prek(s)* took place beyond the gates.

### **Beyond the Gates I: Poldering the Floodplain**

As sluice gates were drawn by engineers, built by construction companies, and placed in the mosaic landscape, the enactment of *prek(s)* as irrigation infrastructure gained in reality. At the same time, these gates also participated in some quite different enactments. Their *material* rigidity notwithstanding, they turned out to be rather flexible objects, contributing to *prek(s)* with different characteristics and aims in places.

According to informants, sluice gates had not initially been seen as integral components of *prek* rehabilitation. They only gained prominence once the discussions started to focus on excavation. For some actors, however, the gates were something more

and other than a technical solution to local problems with water flows. To understand this, we have to take leave of the mosaic landscape and move both down- and upstream: to the floodplains of Vietnam and to the ministry in Phnom Penh.

Across the Vietnamese border, large-scale construction of dikes and sluice gates has supported agricultural intensification for more than two decades (e.g. Biggs, 2008). While Kandal is a major Cambodian producer of dry season rice (MAFF, 2018), the province still falls far short of the intensively cultivated Vietnamese Mekong delta. Cambodian officials rarely make explicit comparisons with Vietnam's rice productivity, probably because it would reflect poorly on the country. Nevertheless, they are keenly aware of the discrepancy, and their minds are set on finding ways to intensify rice production.

With this agenda in mind, the construction of sluice gates had clear appeal. It could be seen as a first step to network the *preks* with older Khmer Rouge irrigation canals with a view to creating a larger "floodplain irrigation system." In the longer run, as staff from MoWRAM explained, such a system might prepare the ground for building "polders,"<sup>11</sup> which has long been the dominant approach to delta management, including in the Vietnamese Mekong delta often held up as a global exemplar (Wesselink et al., 2015).

Despite the shared emphasis on agricultural intensification through water infrastructure, there are nevertheless some quite radical differences between poldering and the WASP project. The agricultural focus of the former is on rice intensification in the *boeungs* rather than on high-value cultivation in the *chamkar* along the *preks*. The required investment is massive and would dwarf AFD's financial commitments. The underlying 'philosophy' assumes the possibility and advisability of neatly separating the *preks* and their agriculture from natural water flows. Finally, the WASP project and the polder dream *scale* the *prek(s)* in different ways. While the former enacted *preks* as independent channels more or less disconnected from their surrounding environment, "poldering" renders them as productive 'parts' to be carved out from an unproductive environmental 'whole.'

Here we see sluice gates stretching beyond Kandal's mosaic landscape: into the Vietnamese delta, into Phnom Penh, and indeed also into academic discussions of delta management. Aside from sitting as material devices at the entrance of *preks*, they are activated in national comparisons and large-scale infrastructural planning. They are central elements in dreams of agricultural intensification. And this is not the end, for the sluice gates are also elements in a particular enactment of Cambodian state-making.

## **Beyond the Gates II: Cambodian State-Making and Clientelist Networks**

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<sup>11</sup> Polders are tracts of land completely insulated from surrounding water flows thanks to a system of dikes and sluice gates.

Critical water scholars are well aware of the close relations between irrigation infrastructure and politics (e.g. Obertreis et al., 2016). Leila Harris and Samer Alatout (2010: 148) showed territorial contestations underpinned by diverse scientific arguments to emerge in administrative frameworks dealing with Middle Eastern water basins. However, mundane state-making is also plainly in view in rural Cambodia, where posters for the ruling Cambodian Peoples' Party (CPP) can be seen wherever one travels. At issue in both cases is the enactment of state as material and semiotic practice.

Prior to the commune elections in 2017, many such posters were visible along the roads of Kandal, perhaps because most communes had previously voted for the main opposition party. Featuring the usual slogans and serious-looking politicians, they also showed prominent images of new sluice gates and canals (see the vignette on the right in right panel of figure 2). Equally distant from the technicalities of calibration and the comparative productivity of rice and vegetables, the sluice gates appear here in the symbolic realm of Cambodian politics. Representing technological advances and agricultural prospects on posters, infrastructure projects the concern of the government for the Cambodian population. The relation between these images and the nitty-gritty of *prek* rehabilitation appears tenuous, hardly existing at all. And yet...

Return to 2015. In the early days of the WASP project, it was particularly important for the technical assistance team to live up to the expectations of MoWRAM, which they regularly described as "their client." And, according to informants, despite the absence of in-depth understanding of the floodplain, this client pushed for the project to start dredging and building sluice gates as quickly as possible. Officially, this was motivated by concerns about meeting project milestones and expenditure objectives. This explanation, however, can be complemented with one that zooms in on interference patterns between enactments. Thus, we surmise, one other reason why the project had to hurry up with construction was to make the sluice gates elements in the establishment of CPP as Cambodia's caretaker. Quite possibly, speeding up construction also supported clientelist networks made of ministry officials, construction companies, and local politicians (Transparency International, 2008; Blake, 2019).

It is, of course, one thing to push for construction in the abstract, and another to concretely build infrastructure. For one, the latter requires deciding *where* to build. In Kandal province, there are nearly 200 *preks* and the project planned to rehabilitate only 30.<sup>12</sup> Accordingly, the question of which *preks* should be rehabilitated became the subject of stiff negotiations between MoWRAM and the technical assistance teams, with AFD staffers quietly trying to influence things in the background. We have no way of knowing

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<sup>12</sup> It had been estimated that each *prek* rehabilitation would cost about 400,000 USD. This proved to be an underestimate so only 25 *preks* were rehabilitated eventually.

whether political allegiance and the choice of *preks* was directly linked.<sup>13</sup> However, several times we heard rumors that *somehow* choices were shaped by clientelist networks that connected MoWRAM officials (or even the minister) to specific areas of Kandal.<sup>14</sup>

**Figure 2:** Examples of objects through which *preks* are enacted



Gauging station in Koh Khel  
(Sylvain Massuel)



Electoral poster along national road 21  
(The authors)

**Beyond the Gates III: Rice and Climate Change**

Compared with the muddy relations between clientelism and irrigation infrastructure, the interference patterns between *prek* enactments oriented to *different kinds of* agricultural intensification is more accessible. It can easily be examined since project reports were explicit about criteria for selecting *preks* and technical teams were keen to describe their procedure for scoring and ranking them. Thankfully, we do not need to understand the somewhat confusing relations among the many criteria.<sup>15</sup> We merely have to consider how the list of *preks* transformed prior to the final selection for rehabilitation.

<sup>13</sup> The issue is also complicated because selection of a *prek* for rehabilitation might either be a *present* for supporting the ruling party or an *incentive* to win over the opposition.  
<sup>14</sup> Deligne (2013) discusses how personal networks shape the practices of MoWRAM.  
<sup>15</sup> Projects reports present the selection of *preks* as the result of an objective multi-criteria analysis, which weighs and scores numerous indicators including: the potential for year-long water supply in the *preks*; the proportion of villagers interested in the project; the willingness to establish a user-group and contribute to future operation and maintenance costs; the number of households requiring resettlement; the absence of land-use conflicts; the risks of sedimentation at the entrance of the



A preliminary list of *preks* had been jointly prepared by MoWRAM and the technical assistance teams based in Phnom Penh. Following rapid field visits and ranking, the team 'experts' removed several *preks* along the right bank of the Mekong. Even so, due to repeated requests from MoWRAM officials, those same *preks* reappeared on the final list.

The contentious *preks* were distinctive in 'morphing' into a large *boeung* that supports small-scale, collective capture fisheries during the flood season and rice cultivation during the dry season. Their rehabilitation would obviously lead to intensified rice production. While this was in line with ministerial priorities for AFD it was problematic.

Due to recognition of high economic, social, and environmental costs, irrigation had been out of favor with international donors for almost two decades.<sup>16</sup> However, it resurfaced on the international agenda with the publication of two influential reports (World Bank, 2006b, 2007) and the quest for higher agricultural productivity after the 2008 rise in food prices. At this time, an apparently minor change from 'irrigation' to 'agricultural water management' suggested a shift away from infrastructure construction and an increased emphasis on irrigation as a climate adaptation strategy (Hydroconseil and Agriate, 2019; UNESCO and UN-WATER, 2020). In this changing context, AFD staffers must demonstrate that their projects align with the climate compatibility requirements of French development policy. Specifically, they have to deal with the inconvenient reality that rice cultivation is a major contributor to greenhouse gas emissions.<sup>17</sup>

In Kandal, rice cultivation held little attraction to AFD staff for another reason. Since much of the paddy is exported to Vietnam where most of the value is created, it is hardly profitable for Cambodian smallholders. Hence, for AFD, the *preks* along the right bank of the Mekong were poor candidates for rehabilitation. But, as the ministry kept pushing, some of these *preks* were anyway selected for rehabilitation.

Discreetly unfolding beneath the public surface of controversy, interferences between enactments of *prek(s)* as climate-compatible irrigation infrastructure (in support of agriculture in the *chamkar*) and as engines for rice intensification (inspired by a sideways glance to the Vietnamese delta) can thus be observed as changes to the circulating list.

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*preks*; the size of the potential irrigated area and the relative importance of *chamkar* (fruits and vegetables) and *boeung* (rice) agriculture; the length of the canal; the potential influence of urban and industrial development; the cost of operation and maintenance related to expected improvements in farmers' revenues; the rate of return on investment, etc. (SOFRECO, 2018).

<sup>16</sup> Economic costs include the construction of water infrastructure, social costs include the displacement of people, and environmental costs cover issues like ecosystem degradation and pressure on water resources (e.g. World Bank, 2006a for a mainstream view).

<sup>17</sup> Since COP21 was held in Paris in 2015, a dedicated AFD team assesses the climate-compatibility of each project considered for funding. Among other things, this involves calculating the *added Greenhouse Gas (GHG) emissions* each potential project would cause (thus, each additional hectare of rice expected from an investment is "translated" into an amount of CO<sub>2</sub>). If a project is deemed to have a low climate compatibility, AFD executives can refuse to fund it. This is something AFD staffers, who have worked hard with their counterparts to propose a project, want to avoid. In practice, though, anecdotal evidence suggests that many irrigation projects are labeled as "climate compatible" regardless of their GHG emissions, on the basis of a loose association between irrigation (which enhances water control) and climate adaptation (Hydroconseil and Agriate, 2019: 39).

## **Interlude: Scaling the *Prek(s)***

Despite Norman Long's (2001) worry that structural approaches deprived people of agency, structure did not simply vanish in his actor-oriented approach. The focus on negotiations at the interface simply loosened its hold. This made it possible to perceive room for maneuver in particular situations. Local contexts were seen as embedded within global systems, not unlike a Russian doll. As in Wilson and Inkster's (2018: 530) notion of 'nested sovereignty,' the fundamental dichotomy between micro and macro was maintained.

Quite a similar imagination is at play when Linton and Budds (2014: 174) take the 'hydrosocial cycle' as an entry point for understanding "wider processes" like capital accumulation, uneven development, and social inequality. Others depict hydrosocial situations as structured by global capitalism (Swyngedouw, 2004; Damonte and Boelens, 2019), leaving this enormous black-box closed shut. While this allows for 'pockets of resistance' (Vos et al., 2019), the likelihood that any truly alternate hydrosocial formation can get traction beyond the local always appears slim.

An alternative is provided by the STS analytics of networks of humans and nonhumans (Callon and Latour, 1981; Jensen, 2007). It is not simply that the room for maneuver is slightly increased while the walls of structure are left intact. Instead, networks and enactments fill the lacunae of structure with proliferating sequences of more or less extended and durable relations. It follows that the scale—size and importance—of actors and projects are all at stake in enactments (Yates et al., 2017). Realities grow and shrink.

From one angle, almost nothing seems to change. Clearly, ministries and corporations generally have an easier time materializing their favored realities than researchers, and the knowledges of scientists and engineers are usually invested with more authority than those of farmers. But in another sense, the implications are radically different. If power is the effect of the ramifying relations that constitute enactments, it can be traced *the whole way* without ever encountering a wall of structure that stops everything in its tracks. And this meshwork of relations can be examined for gaps, weak points, and openings—not just discursive but also deeply material—from which different relations might be spun, leading to alternative enactments, scales, and forms of ontological politics that might, who knows, *also* grow in size and influence.

In preceding sections, we have described how enactments of *preks* in several sizes and shapes co-exist both in- and outside the mosaic landscape. As part of irrigation enactments set in motion by civil engineers, infrastructural devices like sluice gates and changing water flows give material scale to the *prek(s)*. But those scales change when *prek(s)* are evoked in comparisons with Vietnam's agricultural landscapes, or become elements in global delta management discourses. Rather than located at different levels (micro, meso, or macro) within a given structure, enactments generate *different scales*.

Interference patterns make the complexities of scale-making “grow exponentially” (Mol, 2002: 151).

With the advent of the WAT4CAM project, co-funded by AFD and the E.U., there are new opportunities for new actors to get involved in enacting the *prek(s)* of Kandal. This provides the context for a final discussion of our own ontological politics. *The aim is to create room for the enactment of prek(s) as a socionatural mosaic capable of sustaining multiple human and more-than human actors and practices.*

### **Room for Other Enactments?**

Working in Kandal’s *boeungs* or along canals, people wear broad-rimmed hats to protect themselves against the sun while fishing, growing rice, harvesting vegetables, switching diesel pumps on and off, or spraying pesticides. In Phnom Penh offices, engineers draw sluice gates and economists calculate potential rates of return on the basis of *prek* calibrations and agricultural development scenarios. Hydrologists measure water levels on iron scales and report them in excel sheets. Workers from construction companies pour iron-reinforced concrete to build sluice gates and use excavators to dig canals, often with scant attention to engineering blueprints. Meanwhile, neither water nor sediment flows behave like planned. Some sluice gates and banks collapse due to floods or the vagaries of unknown underground water flows. Farmers and village officials complain while others request further improvements. Along dusty roads, campaign posters display past achievements and promise future infrastructure development.

We have described these heterogeneous practices as multiple enactments of *prek(s)*: as irrigation infrastructure, as pathway to intensive rice production, as armature of modern Cambodian state-making, and as climate (in-)compatible intervention. While each provides its own form of logic and relative coherence, the aggregate is not a whole. As enactments mutually interfere, “tensions follow erratic lines and run right through the constituent parts” (Mol 1998: 283). No “standard” or “natural” *prek* is available for consultation, and since “no environment is normal” (Canguilhem 1994: 354), no *prek* is inherently “abnormal” either.<sup>18</sup> Situated amidst such multiplicity, how can we orient ourselves?

In a discussion of the “Zimbabwean bush-pump,” de Laet and Mol (2000) offered a model for thinking about this issue. They argued that this particular pump succeeded where others failed because *fluidity*—an openness that allowed other actors to tinker and make new relations with it—had been designed into it. Taking inspiration from their willingness to let *appreciation* for fluidity infuse description, we try our hand at articulating an alternative ontological politics for the *prek(s)*, oriented to multiplicity.

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<sup>18</sup> In contrast with Choi’s (2021) appealing discussion of Korean tidal flats (*getbol*), the landscape *itself* does not specify its own “slippery ontology.”

Each of the enactments we have examined involves many elements. Each generates varied effects, interferences, and scales. We have also observed, however, that most of the actors involved are not particularly *oriented* to this variability and multiplicity *in their practices*. Might taking multiplicity as a starting point enable a different ontological politics?

Some attempts to deal with the variability of *preks* allow us to open this question. Recently, a typology of *preks* was elaborated by a senior engineer involved with the technical assistance teams. Based on three main criteria (the elevation and slope of the land, the source and direction of water flows, and the degree of connection with other water sources than the Bassac), he identified five types of *preks*, and recommended tailoring rehabilitation to each type. The guiding imagination is firmly based in engineering but the typology provides *preks* with a degree of complexity. Even though simplification remains important, as characteristic of development projects, *preks* cease to be totally generic.

In parallel, the technical assistance teams for WAT4CAM have begun to argue for a “cluster approach.” Simply put, this means considering groups of adjacent *preks* *together*. AFD supports the idea since problems with the previous *ad hoc* approach have become plainly visible. Some say that ministry staffers also welcome it. So here are potentials for yet another enactment of the *prek(s)*. The starting point is still engineering, but engaging the *preks* as a network rather than as a set of individual, separate, channels changes the possible form and scale of intervention. Rather than invariably focusing on excavation, the network as a whole might be improved by rehabilitating a road, say, or by building new canals that connect different *preks*. Still, the emphasis on hard infrastructural solutions aligns with the dream of poldering the whole floodplain, which looms in the background.

This alignment opens many questions. At a moment when the Vietnamese government itself has begun to express uncertainty about its focus on rice intensification (MDP, 2013; Socialist Republic of Vietnam, 2017), we can think of several reasons why Cambodia should not glance south with a degree of envy.

Due to different economic situations, infrastructural requirements, and rampant climate change, it is unlikely that Kandal will ever resemble a Vietnamese rice landscape. In fact, international organizations and donors are in broad agreement about the problems of going down that route. While building ever-higher dikes may limit the impacts of floods in some areas of the floodplains, it simply displaces the risks and possibilities of harm to other parts. Meanwhile, conversion of the remaining bits of flooded vegetation into rice fields will further disrupt already dwindling small-scale capture fisheries. And as floods stop carrying the sediments crucial for regenerating soil fertility into the *boeungs*, rice cultivation will require constantly increasing amounts of fertilizer and pesticides. In a negative spiral, pollution will further impact both fisheries and people.

In this context, the early colonial depictions of *preks* as *unique multi-purpose systems* and JICA's (1998, 112) observation that "colmatage farming has many advantages for conducting agriculture harmonized with natural systems" appear freshly relevant. They elicit a vivid contrast between heavy-handed strategies for agricultural development through infrastructure and what can be described as learning to care for a multi-faceted socio-natural landscape. This means engaging *prek(s)* as far more decentered and encompassing ways than enactments that reduce the landscape to a grid-type network of channels. It means embracing the scalar potentials of ontological pluralism (Jensen and Morita 2020, Yates et al., 2017). Beyond irrigation and agricultural intensification, we are thus interested in scaling-up *prek(s)* as a *socionatural mosaic*.

In such a landscape, floods carry sediments, slowly raising land and maintaining fertility, while flooded shrubland in the *boeungs* provides refuge and spawning grounds for migratory fish and serve as carbon sequestration sinks. People engage in mixed forms of sustainable fisheries and agriculture, which provide them with a degree of protection against fluctuations in global commodities prices and rainfall.

### **Fluid Objects for a Mosaic Landscape**

The socionatural mosaic sits at the back of our minds as we link the *prek(s)* to academic discussions of global delta management with a view to influencing AFD's project practices. Far from Kandal, we aim to scale-up the *prek(s)* as a counter-point and alternative to dominant approaches that want to achieve full water control by hard infrastructure (Wesselink et al., 2015). The aim is to enact *prek(s)* as successful, living examples of what is currently discussed as nature-based engineering (UNESCO and UN-WATER, 2018). This effort is also potentially important back in Kandal. Because, while there are sharp power differentials between government and local Cambodians, the question of what would be "best to do" with the mosaic landscape is still *somewhat open*. To get inspiration, donors and ministry staff even occasionally consult the views and recommendations of global research networks. By discursively scaling the *prek(s)* up on the outside, it might be possible to materially re-scale them back on the inside.

Back in the mosaic landscape, breathing life into a socionatural mosaic *prek(s)* requires objects sufficiently fluid to support heterogeneous human and more-than-human actors. Curiosity and experimentation are sorely needed. What might happen, for instance, if people living in Kandal and enacting the *prek(s)* in their own ways had more of a voice in discussions about rehabilitation (Wilson and Inkster 2018)? The interfaces, interferences, and scale-making capacities of *prek(s)* would all change, but we do not know how.

Our research begun to explore that question by co-developing "serious games" about agriculture and water management in the *prek* mosaic. We envisioned these games—

played with fishermen, farmers, traders, and officials—as hybrid knowledge forums for collective learning about contentious issues and dynamics, and for making alternative visions for *prek rehabilitation*. The games were complemented with “alternative maps” that brought together land-cover and agricultural practices analysis with local knowledges.

With inspiration from these efforts, AFD staff have begun to imagine their own more-or-less fluid objects. As part of WAT4CAM, we find a hydrological study of the Cambodian floodplains and the development of a “*prek* master plan.” Those may seem distant from—or even opposed to—a focus on empowerment and the support of more-than-human lives. A hydrological study will hardly represent the voices of local people, but it can support the design of infrastructure more attuned to changing river flows. And the “master plan” can be designed with local people alongside engineers and experts, something we quietly support in the background. Thus, we view the games, the maps, the hydrological study, and the master plan as an experimental suite of fluid objects, all of which potentially play a role in enacting the socionatural mosaic.

## **Conclusion**

This paper has offered a detailed examination of multiple enactments of the *prek(s)* of Kandal. While the WASP project enacted *prek(s)* as irrigation infrastructure for intensifying *chamkar* agriculture, other versions proliferated: sites for rice intensification, materializations of Cambodian state-making, clientelist politics, climate (in-)compatible infrastructure. And, in our hands, *prek(s)* became a socionatural mosaic and a tentative model for new kinds of delta planning and living in interference with modernity.

Each of these enactments performs place, livelihoods and relations differently, and with variable consequences. Each scales the *prek(s)* differently. Since no passive object in the middle awaits the application of different *perspectives*, nature and culture are not there to be bridged. We are in a realm of constitutive hybridity and considerable surprises.

As the passive object in the middle disappears, two versions of the *prek* go with it. There is no *original prek* to which one might look back nostalgically. The purportedly first excavation by a Cham leader vividly described in French colonial reports was itself an experimental enactment, which generated its own considerable surprises. But the *natural prek* evoked by scientists and engineers is an enactment in equal measure; the outcome of gauging stations, measurements, and equations fed into models.

Thus, *prek(s)* end up as channels storing water more or less efficiently to enhance *chamkar* agricultural productivity. At the same time, different *prek(s)* are integral to agricultural comparisons with Vietnam, national state-making campaigns, French climate development policies, and international debates about nature-based engineering and delta planning. In our own enactment, they morph into an encompassing socionatural mosaic supportive of diverse multi-species practices and beings.

*Prek(s)* are all these things, but not in the same manner or to the same degree. The *manner* varies with the enactment. And the *degree* varies with its success in *gaining a material hold in reality*, not least through infrastructure. Here ontological politics and scale-making converge. While ontological politics in STS has mainly been evoked for diagnostic purposes, critical water studies (e.g. Yates et al., 2017) remind us of the importance and urgency of *experimenting with alternative enactments*.

So here we are, trying to scale-up the decentered, still only partially existing more- than-human *prek mosaic* as an alternative model for delta planning and living, attempting to breathe some life into it—in Kandal and elsewhere.

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### **References**

- Ballesteros A (2019) *A future history of water*. Durham, NC & London: Duke University Press.
- Bakker K (2002) From state to market? Water mercantilización in Spain. *Environment and Planning A* 34(5): 767–790.
- Bakker K and Bridge G (2006) Material worlds? Resource geographies and the 'matter of nature'. *Progress in Human Geography* 30(1): 1-23.
- Barnes J and Alatout S (2012) Water worlds: Introduction to the special issue of *Social Studies of Science*. *Social Studies of Science* 42(4): 483-488.
- Barthelemy R (1915) *Premières études des colmatages du Mékong*. Archives Nationales du Cambodge, résidence supérieure : Phnom Penh
- Biggs D (2011) *Quagmire: Nation-building and nature in the Mekong Delta*. Seattle, WA: University of Washington Press.
- Blake DJH (2019) Recalling hydraulic despotism: Hun Sen's Cambodia and the return of strict authoritarianism. *Austrian Journal of South-East Asian Studies* 12(1): 69-89.
- Bolding A, Mollinga PP and Straaten KV (1995) Modules for modernisation: Colonial irrigation in India and the technological dimension of agrarian change. *The Journal of Development Studies* 31(6): 805-844.
- Callon M and Latour B (1981) Unscrewing the big leviathan: How actors macrostructure reality and how sociologists help them do so. In: Knorr Cetina K and Cicourel A (eds)

- Advances in Social Theory and Methodology: Toward an Integration of Micro and Macro Sociologies*. London: Routledge and Keagan Paul, pp.277-303.
- Canguilhem G (1994) *A vital rationalist: Selected writings from Georges Canguilhem*. New York: Zone Books.
- Carse A (2012) Nature as infrastructure: Making and managing the Panama Canal watershed. *Social Studies of Science* 42(4) 539–563.
- Carse A (2017) An infrastructural event: Making sense of Panama’s drought. *Water Alternatives* 10(3): 888-909.
- Choi YR (2020) Slippery ontologies of tidal flats. *Environment and Planning E: Nature and Space*. Online first. <https://doi.org/10.1177/2514848620979312>
- Clarke A and Montini T (1993) The many faces of RU486: Tales of situated knowledges and technological contestations. *Science, Technology and Human Values* 18(1): 43-78.
- Damonte G and Boelens R (2019) Hydrosocial territories, agroexport and water scarcity: Capitalist territorial transformations and water governance in Peru’s coastal valleys. *Water International* 44(2): 206-223.
- Goldman MJ, Nadasdy P and Turner MD (2011) *Conversations at the intersection of political ecology and science studies*. The University of Chicago Press: Chicago and London.
- de Laet M and Mol A (2000) The Zimbabwe bush pump: Mechanics of a fluid technology. *Social Studies of Science* 30(2): 225–263.
- Deligne A (2013) *Réseaux sociotechniques et politiques de gestion des systèmes irrigués au Cambodge*. PhD Thesis, Université Catholique de Louvain, Belgium
- Gad, C, Jensen CB and Winthereik BR (2015) Practical ontology : Worlds in STS and anthropology. *NatureCulture* 3 : 67-86.
- Ghiotti S (2018) *Analyser et comprendre les territoires hydro-sociaux en Méditerranée et ailleurs -Application au complexe lagunaire et aux zones humides de l’étang de l’Or (Hérault, France)*. Mémoire d’Habilitation à Diriger les Recherches – Volume 3. Ecole Normale de Lyon.
- Götz J and Middleton C (2020) Ontological politics of hydrosocial territories in the Salween River Basin, Myanmar/Burma. *Political Geography* 78. [https://doi.org/10.1016/j.polgeo.\(2019\).102115](https://doi.org/10.1016/j.polgeo.(2019).102115).
- Ivars B and Venot JP (2018) Entre politiques publiques et matérialité : Associations d’usagers et infrastructures d’irrigation au Cambodge. *Nature, Sciences, Sociétés* 26(4): 383 – 394.
- Harris LM and Alatout S (2010) Negotiating hydro-scales, forging states: Comparison of the Upper Tigris/Euphrates and Jordan River Basins. *Political Geography* 29: 148-156.



- Harvey P, Jensen CB and Morita A (eds) (2016). *Infrastructures and social complexity: A Companion*. London & New York: Routledge.
- Hydroconseil and Agriate. (2019) Evaluation rétrospective des interventions de l'AFD dans le secteur de l'irrigation. Paris: AFD.
- Japan International Cooperation Agency (JICA) (1998). The agricultural development study of the Mekong flooded area in Cambodia-Final report. Sanyu Consultant.
- Jensen CB (2007) Infrastructural Fractals: Revisiting the micro-macro distinction in social theory. *Environment and Planning D* 35(5): 832-850.
- Jensen CB (2017) Amphibious worlds: Environments, infrastructures, ontologies. *Engaging, Science, Technology, and Society* 3 : 224-234.
- Jensen CB and Morita A (2020) Deltas in crisis: From systems to sophisticated conjunctions. *Sustainability* 12(4): 1322.
- Kohler R (1994) *Lords of the Fly: Drosophila, genetics and the experimental life*. Chicago, IL: University of Chicago Press.
- Latour B (1986) The Powers of association. In: Law J (ed) *Power, Action, and Belief: A New Sociology of Knowledge?* London: Routledge and Keagan Paul, pp. 264-280.
- Latour B (1987) *Science in action*. Cambridge, Mass.: Harvard University Press.
- Linton J (2010) *What is water? The history of a modern abstraction*. Vancouver: UBC Press.
- Linton J and Budds, J (2014). The Hydrosocial cycle: Defining and mobilizing a relational-dialectical approach to water. *Geoforum* 57: 170– 180.
- Long N (ed.) (1989) *Encounters at the interface: A perspective on social discontinuities in rural development*. Wageningen: Agricultural University of Wageningen.
- Long N (2001) *Development sociology: Actor perspectives*. London & New York: Routledge.
- MAFF (2018) Annual report for agricultural forestry and fisheries (2017)-(2018) and direction (2018)-(2019). MAFF: Phnom Penh.
- Massuel S, Riaux J, Molle F, Kuper M, Ogilvie A, Collard AL, Leduc C and Barreteau O. (2018) Inspiring a broader socio-hydrological negotiation approach with interdisciplinary field-based experience. *Water Resources Research* 54: 1-13.
- MDP (2013) Mekong delta plan. Hanoi, Vietnam: The socialist republic of Vietnam and the Kingdom of the Netherlands
- Mol A (1998) Lived reality and the multiplicity of norms: A critical tribute to Georges Canguilhem. *Economy and Society* 27(2/3): 274-285.
- Mol A (2002) *The body multiple: Ontology in medical practice*. Durham, NC: Duke University Press.
- Mollinga PP (2014) Canal irrigation and the hydrosocial cycle: The morphogenesis of contested water control in the Tungabhadra Left Bank Canal, South India. *Geoforum* 57: 192-204.

- Mosse D (2005) *Cultivating development: An ethnography of aid policy and practice*. London: Pluto Press.
- Obertreis J, Moss T, Mollinga P and Bichsel C (2016) Water, infrastructure and political rule: Introduction to the Special Issue. *Water Alternatives* 9(2): 168-181
- Pickering A (1995) *The mangle of practice: Time, agency, and science*. Chicago, IL: University of Chicago Press.
- Povinelli EA (2001) Radical worlds: The anthropology of incommensurability and inconceivability. *Annual Review of Anthropology* 30: 319-334.
- Royal Government of Cambodia (2013) Cambodia climate change strategic plan (2014)-2023. Royal Government of Cambodia: Phnom Penh.
- Ross R and Chang H (2020) Socio-hydrology with hydrosocial theory: Two sides of the same coin? *Hydrological Sciences Journal*. Published ahead of print DOI: 10.1080/02626667.(2020).1761023.
- Scott JC (1998) *Seeing like a state: How certain schemes to improve the human condition have failed*. New Haven, CT & London: Yale University Press.
- Sivapalan M, Savenije HHG and Blöschl G (2012) Socio-hydrology: A new science of people and water. *Hydrological Processes* 26(8): 1270-1276
- Srinivasan V, Sanderson M, Garcia M, Konar M, Blöschl G and Sivapalan M (2017) Prediction in a socio-hydrological world. *Hydrological Sciences Journal* 62(3): 338-345.
- Socialist republic of Vietnam (2017) Resolution on sustainable and climate-resilient development of the Mekong delta. Prime Minister resolution 120. Hanoi, Vietnam: Prime Minister Office.
- SOFRECO (2018) Project review report. Water & Agriculture Sector Programme (WASP) – Package 2. Technical Assistance for the implementation of Preks of Kandal Component (TA-Preks). Phnom Penh, Cambodia: SOFRECO.
- Star SL and Griesemer JR (1989) Institutional ecology. "Translations" and boundary objects: Amateurs and professionals in Berkeley's museum of vertebrate zoology. *Social Studies of Science* 19(3): 387-420.
- Swyngedouw E (2004) *Social power and the urbanization of water: Flows of power*. Oxford: Oxford University Press.
- Swyngedouw E (2009) The political economy and political ecology of the hydrosocial Cycle. *Journal of Contemporary Water Research and Education* 142(1): 56-60.
- Transparency International (2008) Global corruption report 2008: Corruption in the water sector. New York: Cambridge University Press.
- UNESCO and UN-Water (2018) The United Nations world water development Report (2018): Nature-Based Solutions for Water. Paris: UNESCO.
- UNESCO and UN-Water (2020) United Nations world water development report (2020): Water and Climate Change. Paris: UNESCO.

- Venot JP and Fontenelle JP (2016) *Politique de l'irrigation au Cambodge: Articulations et enjeux des interventions de l'AFD*. Paris: COSTEA.
- Verran H (2002) "Transferring" strategies of land management: The knowledge practices of indigenous landowners and environmental scientists *Knowledge and Society* 13: 155-183.
- Vincent LF (1997) *Irrigation as a technology, irrigation as a resource. A sociotechnical approach to irrigation*. Inaugural lecture. Wageningen: Wageningen Agricultural University.
- Vos J, Boelens R, Venot JP and Kuper M (2020) Rooted water collectives: Towards an analytical framework. *Ecological Economics* 173 (2020): 106651.
- Wanvoeke J, Venot JP, De Fraiture C and Zwarteveen M (2016) Smallholder drip irrigation in Burkina Faso: The role of development brokers. *The Journal of Development Studies* 52(7): 1019-1033.
- Wesselink A, Warner J, Abu Syed Md, Chan F, Dung Duc Tran, Huthoff F, Ngan Le Thuy, Pinter N, van Staveren M, Wester P, and Zegwaard A (2015) Trends in flood risk management in deltas around the world: Are we going 'soft'? *International Journal of Water Governance* 3(4): 25-46.
- Wesselink A, Kooy M and Warner J (2016) Socio-hydrology and hydrosocial analysis: Towards dialogues across disciplines. *WIREs Water* 4: e1196. <https://doi.org/10.1002/wat2.1196>.
- Wilson NJ and Inkster J (2018) Respecting water: Indigenous water governance, ontologies, and the politics of kinship on the ground. *Environment and Planning E: Nature and Space* 1(4): 516-538.
- Whatmore S (2002) *Hybrid geographies: natures, cultures, spaces*. London: Sage.
- World Bank (2006a) *Water management in agriculture. Ten years of World Bank assistance, 1994-2004*. Washington D.C: The World Bank.
- World Bank (2006b) *Reengaging in agricultural water management: challenges and options*. Washington, DC: World Bank
- World Bank (2007) *World development report. Agriculture for development*. Washington D.C: The World Bank.
- Yates JS, Harris LM, and Wilson NJ (2017) Multiple Ontologies of Water: Politics, Conflict, and Implications for Governance. *Environment and Planning D: Society and Space* 35(5): 797-815.