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# **Timescapes of Himalayan Hydropower: Promises, Project Life Cycles, and Precarities**

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# **Timescapes of Himalayan Hydropower: Promises, Project Life Cycles, and Precarities**

## **Water, Timescapes, and Himalayan Hydropower**

In the Himalayan region, where the mountainous geological accretions of millennia are continually being reshaped by the erosive power of monsoon hydrologies, water carries a tremendous kinetic energy. For more than a century, a diverse set of actors have proposed and designed projects to harness the potential energies of Himalayan rivers for electricity generation – invoking the potential of a vast frontier of hydraulic possibilities. While dams have consistently remained at the forefront of nationalist discourse and public consciousness in the Himalayas, hydropower development plans and policies have waxed and waned considerably – in response to rising energy needs, the remapping of geopolitical geometries, fluctuating patterns of aid and investment, technological innovation, ‘natural’ disasters, and hydrological and climatic variabilities. As forecasts of South Asian growth mix with global and regional climate change anxieties, the Himalayan region is simultaneously presented as one of the last frontiers for hydropower, framed as a reliable source of ‘clean and green’ energy at a carbon-critical time (Ahlers et al, 2015; Erlewein & Nüsser, 2011; Rasul & Sharma, 2016; Yumnam, 2012), and as the melting ‘water towers of Asia’ (Bolch et al, 2010; Immerzeel et al, 2010; Wester et al, 2019; Xu et al, 2009).

In this paper, we review the growing body of social science scholarship on hydropower development in the Himalayas using an interpretive lens attuned to issues of time and temporality. Several thoughtful analyses have explicitly theorized the spatial politics of Himalayan hydropower development, at multiple scales (e.g. Akhter, 2015; Baruah, 2012; Drew, 2017a, 2018; Dukpa et al, 2019; Forbes, 1999; Gergan, 2017, 2020; Gyawali, 2003; Huber & Joshi, 2015; Lord, 2014, 2016; McDuie-Ra, 2011; Murton & Lord, 2020; Suhardiman & Karki, 2019). Here, we highlight major themes regarding time and the temporal politics implicit in the existing literature to form a conceptual framework for understanding the *timescapes* of Himalayan hydropower. Through our analysis, we ask the following: In what ways are Himalayan hydrosapes – understood as shifting assemblages of sites, plans, projects, financial

flows, experts, and electricity users focused on hydropower development – temporally defined? What are the temporalizing practices and techniques that hold the promises and projects of Himalayan hydropower together? How do the timescapes of Himalayan hydropower articulate and intersect with broader sociopolitical, economic, and environmental timescapes?

Sociologist Barbara Adam (2004) defines a *timescape* as a “cluster of temporal relations” where “the notion of ‘scape’ ... indicates, first, that time is inseparable from space and matter, and second that context matters” (p.143). We organize our analysis using this conceptual framework – first developed by Adam (1998, 2004) and rejuvenated by anthropologist Laura Bear (2016) – for multiple reasons. First, a timescapes perspective foregrounds the various ways that time is apperceived, schematized, valued, and reconfigured – highlighting the ways that humans rework the temporalities of landscapes through various forms of skillful “labor in/of time” (Bear, 2014: 489). Hydropower development – multiply defined, contested, and laden with value judgments – is a fundamentally temporal and temporalizing concept, since it seeks to fundamentally “redistribute resources across time” (Bromber, 2014: 290). Mapping the timescapes of Himalayan hydropower helps focus critical attention on “the tensions between multiple and overlapping temporalities that suffuse the making and imagining of resources” (Ferry & Limbert, 2008:12) across spaces being reimagined as hydropower frontiers. In short, thinking with the heuristic of timescapes illustrates how managing water resources and making energy infrastructures also requires remaking and managing time.

Second, the notion of timescapes complements and articulates with a broad gamut of scholarship on the social dimensions of water and water resource management. Foremost, we are referring to the body of scholarship which considers the ways that ‘waterscapes’ (Swyngedouw, 1999; cf. Acharya, 2015; Baviskar, 2007; Donahue & Johnston, 1997; Sultana, 2013) or more specifically, Himalayan “hydroscaapes” (Lord, 2014; Nüsser, 2014, 2017) are historically, socially, and technologically constituted. Similarly, the notion of timescapes also connects with the concept of “hydrosocial cycles” which are shaped by shifting social rhythms and situated political economies (Linton & Budds, 2014; cf. Clark et al, 2017; Linton, 2014; Schmidt, 2014; Swyngedouw, 2009). Our framing of the timescapes of Himalayan hydropower also articulates with recent scholarship focused on the contested futurities of water and/or the anticipatory

politics of modeling watery horizons of (in)sufficiency (Ballestero, 2019; Randle & Barnes, 2018).

Third, the concept of timescapes was originally developed to highlight “the disjuncture between the spatially oriented politics of nation-states and the complex temporal features of socio-environmental hazards” (Adam, 1998: 15). Thinking with timescapes helps us trace how the sociotechnical ‘time-maps’ (Gell, 1992; Bear, 2014) that diverse actors use to organize, coordinate, and implement plans for Himalayan hydropower development become entangled with and disrupted by non-human temporalities and rhythms, reshaping landscapes of risk and vulnerability. Critically, hydropower projects and the infrastructures they require are subject to seasonal hydrologies, meteorological rhythms, geological processes, and other non-human temporalities that quite literally shape the Himalayas. As Clark et al (2017) have argued, water is a “time-substance” vested with multiple possibilities and agencies.

As three scholars who have each spent years conducting research on hydropower in the Himalayan region – focused on Uttarakhand, Nepal, and Sikkim – we have each considered some of these temporal dynamics in the context of our own research sites. In this review, we undertake a broader and collective examination of the temporal dimensions of hydropower development across the Himalayan watersheds of India, Pakistan, Nepal, and Bhutan. Our review of the literature draws mainly from the fields of anthropology, development studies, and geography – paying specific attention to the work of scholars hailing from the Himalayan region. Our analysis also incorporates and is informed by recent research by glaciologists, hydrologists, climate change researchers, and ecologists that helps us contextualize and substantiate our descriptions about the shifting timescapes of Himalayan environments. However, since we are social scientists, we focus on the ways that human subjects and institutions, experience and interpret environmental changes in temporal terms – rather than making any specific or technical claims about shifting hydrologic regimes, geologic time, or climatic rhythms.

We divide our analysis into three thematic sections. The first reviews how promises of hydropower potential are woven together with the official plans, development objectives, and temporal narratives of nation-states, foregrounding the central role of temporal politics animated by historical narratives and anticipation work. The second examines the life cycles of Himalayan

hydropower projects, focusing on specific practices of *temporalization* – understood simply as the ways “we make, through our acts, the time we are in” (Munn, 1992: 94) – that shape how these projects are imagined, orchestrated, negotiated, and unevenly experienced. The third considers the ways that the indeterminate rhythms and temporalities of hydrological and geological processes shape the timescapes of Himalayan hydropower, highlighting new uncertainties and unknowns emerging in the context of anthropogenic climate change. Collectively, we argue that the Himalayan region is a fecund place from which to analyze and theorize the temporal politics of water and energy in the current historical moment – unevenly imagined as the early 21st century, the Asian Century, a critical time to act in the face of an uncertain yet near climate crisis, or a moment within an epoch some call the Anthropocene.

## **1. Temporalities of Nation-Building and Anticipation**

As “gigantic manifestations of state power” (Werner, 2014: 125) large dams have long been used to enact centralized visions of historical progress and orient a variety of national teleologies focused on maximizing resource potentials, bolstering economic prosperity, or achieving energy self-sufficiency (Gutierrez et al, 2019; Klingensmith, 2007; Swyngedouw, 1999). The social imaginaries that support Himalayan hydropower seek to reframe relationships between pasts, presents, and futures in specific ways – like other resource imaginaries, they “propose or preclude certain kinds of time reckoning; they inscribe teleologies; and they are imbued with affects of time” (Ferry & Limbert, 2008: 4). Put differently, hydropower development, as a socio-technical and material process, is an ongoing and imperfect effort to reckon and synchronize the asynchronous temporalities of waters, technologies, and nation-states (Menga & Swyngedouw, 2018).

In the Himalayan region – where geographical and geopolitical knots are particularly dense – dam construction has invoked a variety of discursive and ideological conflicts over competing visions of development (Dharmadhikary, 2008; Drew, 2017a; Gyawali, 2003; Khagram, 2004; Nüsser, 2014) as well as an array of situated debates about transboundary water conflicts and water sharing agreements (Crow & Singh, 2009; Gamble, 2019; Gyawali & Dixit, 1999; Hanasz, 2015; Hill, 2017). At the same time, official forecasts of abundant energy futures and national

prosperity via dam construction have always been tempered by hydrological, geological, meteorological, and epistemological complexities that famously produce “uncertainty on a Himalayan scale” (Thompson et al, 1987; cf. Gyawali & Dixit, 2001; Ives 2003). In response, large dams have frequently been presented as a symbol of the triumph of human ingenuity and engineering over unruly waters (Amrith, 2018; D’Souza, 2008) – understood as ‘technological hydroscares’ (Nüsser, 2014) or simply “mountains of concrete” (Dharmadhikary, 2008). Despite significant issues of human displacement (Asthana, 2012; Baruah, 2012) and ecological risks in mountainous regions known for their biodiversity (Bhandyopadhyay, 1995; Grumbine & Pandian, 2012; Xu et al, 2009), governments, planners, and private developers continue to map dams across the Himalayas (Alley et al, 2014).

While the history of hydropower development in South Asia began, in fact, with small projects built in the Himalayas – in Darjeeling (1897) and near Kathmandu (1911) – early scholarship on Himalayan hydropower built from previous analyses of the politics of dams in India (Baviskar, 1995; Fisher, 1995; Roy, 1999). In the first half of the twentieth century, dams were implemented, to a modest degree, across lands under British colonial rule in India (Akhter & Ormerod, 2015; Amrith, 2018; D’Souza, 2006). After Indian independence was achieved in 1947, Prime Minister Jawaharlal Nehru embarked upon a campaign of modernization and industrialization that aimed to eliminate perceived infrastructural weaknesses and build a bright new post-colonial future – famously referring to dams as temples of modern India (Baviskar, 1995; D’Souza, 2008; Kaika, 2006; Morrison, 2010). Between 1947 and 1980, India would build nearly four thousand large dams (Amrith, 2018: 177) and similar promises of nation-building via hydraulic improvement and energy independence began to circulate in Pakistan (Akhter, 2015; Mustafa et al, 2013) and Nepal (Gyawali, 2003; Lord, 2014, 2016; Rest, 2012). In the late 20<sup>th</sup> century and early 21<sup>st</sup> century, large-scale hydropower projects have become veritable postcards of nationalist development achievements across the Himalayas – while their absence is commonly invoked as proof of a nation’s unrealized development potential. In short, Himalayan dams have always been central to the “politics and poetics” of infrastructural aspiration and ambition (Larkin, 2013; cf. Anand et al, 2018), and the timelines of the most ambitious projects are central within the imagined timescapes of nation-states.

Over time, the networks of actors, institutions, and discourses that have enabled Himalayan hydropower dreams have shifted in response to broader geopolitical struggles, changing patterns and priorities of development aid, and new forms of “hydrocapitalism” reshaping the global hydropower sector (Gyawali et al 2016; McCully, 1999; Mitchell, 1999; Pritchard, 2012; Sneddon, 2015). In the post-war era, states and donor agencies focused on building multi-purpose reservoir projects that could capture and redistribute the immense volumes of the Himalayan monsoon to growing populations and support agricultural intensification (Baviskar, 2015; Gyawali, 2003; Khagram, 2004) – recently reframed in terms of the “water-energy-food nexus” (Rasul, 2014). In the 1970s and 1980s, Himalayan hydroelectricity was presented as a critical asset for nation-states seeking energy security, particularly significant during the decades of global oil and gas price fluctuations. Over the same period, the World Bank and other international financial institutions invested heavily in the hydropower sector – propagating narratives of deregulation and privatization that shaped global and Himalayan energy policies in the 1990s (Forbes, 1999; Huber & Joshi, 2015; Pandey, 1996

In 2000, the World Commission on Dams – convened partly in response to anti-dam contestations in the Narmada Valley of Central India (Fisher 1995; Roy 1999) and the Arun Valley of Nepal (Gyawali, 2003; Rest, 2012; Pandey, 2015) – reoriented global hydropower discourse and policy around issues of socioenvironmental justice, and temporal concerns with sustainability, forcing nation-states to address these concerns in their plans and rationalizations for continued hydropower development (WCD, 2000; cf. Dixit & Gyawali, 2010; Sculz & Adams, 2019). In the wake of the WCD, as World Bank and other financial institutions limited their involvement in global hydropower, an array of new private sector actors entered the arena (Zarfl et al, 2015) – in particular state-backed Chinese hydropower developers, intent on expanding outside their domestic sphere (McDonald et al, 2009; Murton et al, 2016; Tilt, 2015). The recent launch of China’s ‘Belt and Road Initiative’ and the creation of the Asian Infrastructure Investment Bank are also reconfiguring the financial and technical networks of Asian hydroscaapes, particularly in Nepal and Pakistan (Akhter, 2018; Murton & Lord, 2020). In the early 21st century, global climate change impacts and the need for carbon emissions reduction, catalyzed a comeback for hydropower as a clean, renewable source of energy (cf. Ahlers et al, 2015; Erlewein & Nüsser, 2011). Seen in this light, the logics and parameters of



national Himalayan hydropower schemes are increasingly shaped by broader temporal framings and forecasts, discursively situated at the intersection of explosive energy demand across South Asia and a global climate crisis.

At the time of writing, more than four hundred large dams with a total generation capacity exceeding 200 GW are planned in the Himalayan regions of India, Nepal, Bhutan, and Pakistan (Hussain et al, 2019). If these projects come to fruition, there will be a dam every thirty-two kilometres, making the Himalaya the most heavily dammed region in the world (Amrith, 2018: 300). This achievement might eventualize as the Government of India continues working to expand the South Asian grid and create new markets for multilateral transboundary electricity trade (McDuie-Ra & Chettri, 2020). While Nepal has recently resolved chronic conditions of energy scarcity, the government and private sector continue to struggle toward a long-deferred dream of becoming a “hydropower nation” (Lord, 2014, 2016; cf. Dixit, 2008; Dixit & Gyawali, 2010; Gyawali, 2003; Rest, 2012; Sovacool et al, 2011). In Bhutan, hydropower is a cornerstone of the national economy and sustainable development strategies (Tshering & Tamang, 2004) with more large projects under construction and planned with Indian assistance (Premkumar, 2016; Saklani & Tortajada, 2019). In Pakistan, longstanding debates over water security and transboundary waters continue to unfold (Akhter, 2015; Khalid & Begum, 2013; Mustafa et al, 2013) alongside protracted energy crises (Kessides, 2013) and only 12% of national hydroelectric generation potential has been harnessed to date (Hussain et al, 2019).

As hydropower projects spread across the Himalaya, they create ‘economies of anticipation’ (Cross, 2015) for a diverse set of national and sub-national actors – zones where various modes of anticipation weave together and “the present is governed, at almost every scale, as if the future is what matters most” (Adams et al, 2009: 248). These expectations of development and modernity (cf. Ferguson, 1999; Pigg, 1992) are frequently propelled by social anticipations, aspirations, and desires for economic and material improvements to everyday life that hydropower promises (McDuie-Ra, 2011; Rangan, 2000; Rest, 2012). Hydropower proponents also frequently use temporalizing narratives that invoke dark pasts and bright futures to shape public opinion, to conjure and shape anxieties about being stuck in a ‘backwards’ state while others advance or ‘become developed’ – such as Nepali politicians who speak publicly about fears of “an entire generation growing up in the dark” (Lord, 2014: 112).

Critically, many citizens of Himalayan nation-states do not support hydropower development – citing concerns ranging from land loss or resettlement, lack of ‘free prior and informed consent’ with local communities, uneven distribution of environmental and social risks, and even the desecration of sacred landscapes (Chettri, 2017; Drew, 2013; Dukpa et al, 2019; Gergan, 2017a; Huber & Joshi, 2015; Kipgen, 2017). In many ways, the people of Himalayan hydropower frontiers are “unimagined communities” outside of official narratives of progress – populations who have long been subject to rule from afar or below, who are “physically unsettled and imaginatively displaced, evacuated from place and time and thus uncoupled from the idea of a national future and a national memory” (Nixon, 2010: 62). In Sikkim, for example, Lepcha anti-dam activists specifically protested extralocal attempts by the state to “dam(n) their future” (Arora, 2009: 103).

Scholars have repeatedly shown how citizen responses to hydropower development are incredibly uneven across the imagined hydropower frontier (Drew, 2017; Dukpa et al, 2018; Huber & Joshi, 2015; Lord, 2016; Rai, 2005; Suhardiman & Karki, 2019), suggesting the Himalayan region is a site where the “pluralization and fragmentation in the transnational movement against dams” becomes apparent (Pfaff-Czarnecka, 2007: 448; cf. Forbes, 1999; Jones, 2012; Sikor et al, 2018). Internal divisions within project-affected communities are common – shaped by contestations over who exactly should be consulted, whose claims are legitimate, and how differently impacted groups should be compensated (McDuie-Ra 2011; Rai, 2005; Shrestha et al, 2016; Ete, 2017). Because the reasons for these contestations are site-dependent and multi-scalar, scholars have repeatedly highlighted the need for greater attention to national histories of centre-periphery relations, subregional political dynamics, and legacies of political exclusion (cf. Akhter, 2015; Drew, 2017b; Forbes, 1999; Gergan, 2017, 2020; Ghale & Ghale, 2018; Hanasz, 2015; McDuie-Ra & Chettri, 2020; Murton & Lord, 2020; Suhardiman et al, 2018), foregrounding the ways that the timescapes of Himalayan hydropower are sedimented by uneven historical trajectories.

For instance, writing about the Tarbela Dam in Pakistan, Akhter (2015: 860) argues that poorly formulated nation-building projects can catalyze new forms of “hydraulic regionalism” – in this case, a Sindhi regional identity was catalyzed against the politically dominant Punjabi elite. In the Indian Union Territory of Jammu & Kashmir, Kashmiris have repeatedly accused the central

state and the National Hydropower Production Company (NHPC) of “stealing” electricity from their rivers and limiting their sovereignty (Bhan, 2014). Similarly, in the Eastern Himalayas, where energy produced by these projects will be used almost entirely outside the region, many locals have recognized a “great unevenness in the distribution of potential gains and losses” that contributes to a “serious legitimacy deficit” in the Indian state’s commitment to its borderlands (Baruah, 2012: 41). In sum, these critiques from peripheries foreground subnational desires for development and “regional modernities” (Sivaramakrishnan & Agarwal, 2003) that are not always in sync with the developmental dreams of nation-states, highlighting the need to consider situated and historical inequalities when tracing the contours of contemporary timescapes

## **2. The Life Cycles of Himalayan Hydropower Projects**

In this section, we highlight the work of coordination and orchestration required to build a hydropower project, and the ways that project life cycles are shaped by an unruly tangle of different temporalities that intrude on and reconfigure project timelines, work calendars, and production schedules of hydropower planners and builders. Hydropower projects – as global assemblages of equipment, labor, capital, and expertise (Gutierrez et al, 2019) – require a significant amount of work to design, build, operate and maintain over time. And while a great deal of time, energy, and imagination goes into forecasting and mapping resource futures (Ferry & Limbert, 2008; Ferry, 2016; Mathews & Barnes, 2016; Randle & Barnes, 2018) these futures can only ever come into being piece by piece, project by project.

In the Himalaya, as elsewhere, the life cycles of hydropower projects are often temporalized (Mun, 1992) into a series of successive phases – i.e. surveying, planning and design, construction, and generation or ‘commercial operation’. Each phase in turn requires different patterns of orchestration, attuned to the temporalities of specific tasks – navigating bureaucracies and paperwork, conducting large-scale earthworks in a riverine environment, or synchronizing with the broader rhythms of grid management. This fractal array of work plans is charted on “time maps” (Bear, 2014; Gell, 1992) that distil, abstract, and re-present the social and material complexity of hydropower timescapes into canalized project timelines, creating what others have referred to as “project time” (Carse & Kneas, 2019). Time maps facilitate coordination between

project developers, financiers, and regulators – enabling multiscale processes of planning, helping coordinate the logistical processes of construction, and scheduling the flow of capital, while feeding back into models and forecasts.

The temporal dimensions and rhythms of “project time” reflect the broader temporalities of planning work (Abram, 2014) that shape the practices of hydraulic bureaucracies the world over (Molle et al, 2006). Formulated to fit together with broader energy policies, programs of infrastructural investment, or water resource management plans, the time-maps of hydropower generation are epistemic and practical tools that “turn flowing water into hydrologic data, cash flow statements, political will, and truckloads of concrete” (Lord, 2014: 115). In recent years, scholars have shown how project plans and life cycles are heavily contoured by the anticipatory temporalities of finance – by tracing the global circulation of ‘green’ capital (Ahlers et al, 2015; Erlewein & Nüsser, 2011; Huber, 2019) or chronicling the rapid proliferation of the ‘shareholder model’ in Nepal, where more than one-million Nepalis have bought shares in hydropower IPOs (IFC, 2018; Lord, 2016, 2018; Lord & Rest, *in press*). Both trends index broader shifts in the timescapes of capital accumulation that reshape imagined hydropower frontiers.

Because people living in the ‘project-affected areas’ are unevenly impacted and implicated over the life cycle of hydropower projects, local discourse often revolves around who should expect what, and *when* exactly? Scholarship on Himalayan hydropower repeatedly shows that local positions and responses to hydropower development vary *in time* and *over time* – ranging from desires for development and economic opportunity (McDuié-Ra, 2011; Rest, 2012; Ete, 2017), to outright resistance and contestation (Drew, 2014; Menon, 2019; Dukpa et al, 2019), to more qualified or negotiated forms of endorsement or acceptance (Drew, 2017a, 2017b; Lord, 2016; Sikor et al, 2019; Dukpa et al, 2018). Put simply, a “local community’s desire for development should not be viewed as something static, or unchanging over time” (Suhardiman & Karki, 2019: 529). Rather, these timely shifting positionalities and tactics are part of the “practice of politics” (Huber & Joshi, 2015: 15) which have tangible effects on project timelines and life cycles.

Before a project even begins, the *timing* of communications (formal or informal) between hydropower developers and local populations can shape future trajectories of project

development – for both the presence and absence of information can shape local economies, opinions, and political alliances (Koirala et al, 2017; Menon & Kohli, 2015; Suhardiman & Karki, 2019). Waiting, in all its different forms, sometimes seemingly interminably, emerges as a common experience across the timescapes of Himalayan hydropower – shaping subjectivities and expectations at a variety of scales (Drew, 2018; Rest, 2012; Murton & Lord, 2020). This liminal temporality is particularly acute for communities displaced from land acquired by project developers or those awaiting resettlement (Baruah, 2012; Koirala et al, 2017) but also for the gamut of local merchants and investors involved in new patterns of speculation along the imagined Himalayan hydropower frontier (McDuie-Ra & Chettri, 2020; Murton et al, 2016).

Once construction begins, new temporal patterns and practices emerge. Local residents quickly become familiar with the rhythms of hydropower development, procedures of stakeholder engagement, and the ecosystem of contracts modulating project timelines (Lord, 2016; Rai, 2005; Sikor et al, 2018). Aggrieved locals or project workers use a variety of temporally-oriented tactics to slow or interrupt the progress of projects - ranging from roadblocks and labor strikes to sit-ins and hunger strikes – forcing companies to recognize their demands and negotiate (Arora, 2014; Dixit & Gyawali, 2010; Drew 2017a; Menon, 2019). Project developers, in turn, attempt to avoid frictions and project delays by initiating “benefit sharing” programs (Balasubramanya et al, 2014; Pandey, 1996; Shrestha et al, 2016) or other forms of community investment under a post-WCD banner of ‘corporate social responsibility’ (Ahlers et al, 2015; Bhan, 2014). These programs are temporally calibrated with project construction timelines, the temporalities of project finance, and local expectations.

However, despite the best-laid plans of project proponents, large dam projects around the world are chronically delayed and completed beyond the original timelines (Ansar et al, 2014; Gutierrez et al, 2019) or suspended in a liminal state, “unbuilt and unfinished” (Carse & Kneas, 2019: 9). Several ‘national priority’ hydropower projects have been delayed for decades in Nepal – most notably the Arun 3 (Forbes, 1999; Gyawali, 2003; Rest, 2012) and the Upper Karnali (Suhardiman & Karki, 2019). In Sikkim, a handful of projects have been postponed or cancelled in response to local protests (Gergan, 2020; Huber & Joshi, 2015; Dukpa et al, 2019), while a series of scientific debates over the impacts of the Lower Subansiri Dam in Arunachal Pradesh

have clouded the future of the project (Huber, 2019; Menon, 2019; Rahman, 2019). Many hydropower projects were damaged or delayed by the 2015 Gorkha earthquake in Nepal (Butler & Rest, 2017; Lord, 2017, 2018; Rest et al, 2015) while some projects in Uttarakhand lie abandoned in the wake of the 2012 and 2013 floods (Drew, 2014, 2017a; Agrawal, 2013). These moments of apparent breakdown and failure, when project timelines are disrupted or forced to come to a screeching halt due to disasters, can also establish new pathways of critique and democratic contestation (Drew 2017b; Gergan, 2020; Huber & Joshi, 2015; Ete 2017).

Further, as several scholars have highlighted, the lives of infrastructures are contingent on constant maintenance and repair to prevent malfunction, disconnection, and ruination (Anand et al, 2018; McDuie-Ra & Chettri, 2020). This is especially the case for hydropower projects and other infrastructures in the Himalayan region, which are frequently interrupted or damaged by earthquakes, landslides, and other geohazards (Bilham et al, 2001; Ives, 2004; Schwangart et al, 2019) and where the erosive power of rivers laden with sediment infamously introduces massive uncertainties (Amrith, 2018; Cortesi, 2018; Thompson et al, 1986). Sedimentation often abbreviates the expected life of reservoir dams, and hydropower turbines and project components are under constant assault from the elements in the Himalaya (Gyawali & Dixit, 2001; McCully, 1999). The time it takes turbines to degrade or the time it takes for a dam to backfill with silt are uncertain temporal horizons that should be, but often are not, a source of consideration and anxiety. At some point, the life cycle of all hydropower projects will come to an end, and the need to decommission or remove dams will arise – a practice, itself often contested, that is becoming increasingly common in other parts of the world (Sneddon et al, 2017).

Within official development plans, the hydropower sector, and within the academic literature, comparatively little attention has been given to the *afterlives* of projects. Overall, it seems there is a fundamental slippage between the time horizons of finance or project management and the material temporalities of dams themselves. Unfortunately, very little planning seems to occur beyond the time horizons of profitability and liability that a typical Build-Operate-Own-Transfer contract focuses on (~25-30 years), or the political careers of project proponents – though of course ‘project-affected populations’ and future inhabitants of these regions must live with impacts and risks that linger. As global climate change brings new patterns of climactic

volatility, disaster, and investment to the Himalayan region, more critical thinking about the senescence, mortality, and afterlives of Himalayan hydropower projects will also become necessary.

### **3. The Temporalities of Disaster and Climate Change**

The timescapes of Himalayan hydropower are fundamentally shaped by non-human rhythms and environmental *indeterminacy* – understood as a “permanent condition (of uncertainty), where some aspects cannot be resolved in principle” (Brown & Damery, 2009: 82) – which is a key characteristic of the geology, hydrology and ecology of the Himalayan region (Gergan, 2019; Gyawali & Dixit, 2001; Lord, 2019; Thompson et al, 1987). At the same time, poorly designed dams can also introduce considerable environmental and socio-technical risks into “Himalayan hazardscapes” (Huber, 2019; cf. Baruah, 2012; Butler & Rest, 2017; Gergan, 2020; Huber et al, 2017; Lord, 2017, 2018; Mustafa, 2013). In this section, we reflect on the ways the cascading indeterminacies inherent within the geology and hydrology of the Himalayan region *intersect* with new uncertainties set in motion by anthropogenic climate change and the imposition of industrial or technocratic time.

The Himalayas are understood to be both enduring and in rapid flux; temporally ‘young’ in geological time, these mountains are still on the move with the Indian tectonic plate slowly slipping under the Eurasian plate, making the region prone to seismic activity (Bilham et al, 2001). Himalayan mountains also bear the brunt of the temporal cycles of the monsoon rains, triggering landslides and flash floods that annually wreak havoc on downstream populations (Amrith, 2018; Cortesi, 2018; D’Souza, 2006; Gohain, 2008). While Himalayan communities have long struggled to adapt to, predict, manage, and ultimately survive the vagaries of the monsoon and ecological uncertainties (Ives, 2003; Thompson et al, 1987) climate change presents an unprecedented set of hydro-temporal challenges. As several recent studies have described, the Himalayan region is a climate change hotspot where an intensification of global warming effects has resulted in shifting monsoon patterns, unseasonal flooding, glacial lake outbursts and other geohazards – creating new and uneven patterns of risk and vulnerability for mountain populations (Immerzeel et al, 2010; Wester et al, 2019).

Hydropower projects and their infrastructures are vulnerable to disasters as well as the impacts of climate change. First, hydropower infrastructures are directly vulnerable to geohazards – such as earthquakes (Butler & Rest, 2017; Huber et al, 2017; Lord, 2018; Rest et al, 2015); landslides (Lord, 2017; Schwanghart et al, 2018); or floods caused by extreme precipitation events or glacial lake outbursts (Dharmadhikary, 2008; Drew, 2017a; Gohain, 2008). A recent study showed that over 25% of Himalayan hydropower projects have been impacted by landslides (Schwanghart et al, 2018), and both landslides and glacial lake outbursts are expected to become more frequent with climate change (Immerzeel et al, 2010; Wester et al, 2019). Second, the function of hydropower projects will also be directly affected by climate change – as the volume and timing of river flows change and as the timing and intensity of the monsoons becomes increasingly erratic, with unknown effects (Agrawal et al, 2003; Dixit, 2019; Laghari, 2013; Ray et al, 2018). Additionally, the futures of Himalayan glaciers, a source of water especially critical in dry seasons, are also deeply in question (Bolch et al, 2010; Immerzeel et al, 2010; Xu et al, 2009).

Himalayan dams disrupt a variety of riverine rhythms – such as the life cycles of migratory aquatic organisms (Allen, 2010; Bandyopadhyay & Gyawali, 1994; Grumbine & Pandit, 2013) or the seasonal flux of sediment budgets, which can have significant effects on the downstream river course over time and intensify flooding events (Gohain, 2008; Huber, 2019; Rampini, 2017). Though hydropower proponents claim that floods and geohazards are a ‘natural’ outcome of the region’s geophysical makeup, critics argue that hastily commissioned projects exacerbate existing vulnerabilities while chipping away at social and ecological resilience (Kohli, 2011; Menon & Kohli, 2015). All of these uncertainties are compounded by the paucity of comprehensive data and long-term hydrological and geological studies of Himalayan river basins (Gyawali & Dixit, 2001; Grumbine & Pandit, 2013; Huber, 2019). This lack of data affects decision making and feeds into chronic failures of environmental governance in the hydropower sector (Vaghlikar & Das, 2010; Menon, 2019; Kohli, 2013). As Alley et al (2014: 54) suggest, the recent expansion of imagined Himalayan hydropower frontiers is intersecting with and occurring “in a time of regulatory decline.”



In recent years, several scholars have highlighted the ways that rapid and intensive hydropower development plans routinely fail to consider the temporalities of long-term risks, commenting on the hubris, collective denial, strategic ignorance, and/or manufactured uncertainty found in the hydropower sector (Butler & Rest, 2017; Gergan, 2019, 2020; Huber, 2019; Huber et al, 2017; Lord, 2017, 2018; Rest et al, 2015). In the past decade alone, three large-scale disaster events – the 2011 6.8 magnitude Sikkim earthquake, the 2013 “Kedarnath floods” in the Western Himalayan state of Uttarakhand, and the 7.8 magnitude Gorkha earthquake that devastated Nepal in 2015 – have directly impacted hydropower sites and resurfaced concerns about the vulnerability of dams within broader Himalayan hazardscapes (Huber 2019). These and other disaster events have ruptured the thin veneer of progress, order and structure that modern ‘industrial time’ is predicated on, revealing not just precarities and vulnerabilities, but also corrupt state practices and a lack of disaster preparedness (Drew, 2017a; Gergan, 2020). Writing about dam-related disasters, Huber et al (2017: 17) propose the term “capital-driven destructions” since this better encapsulates the idea that “disaster events are often the result of negotiations over risk acceptability among social groups with political and economic power asymmetries.”

In this vein, the concept of ‘hydro-hazardscapes’ (Mustafa, 2013: 68) highlights fundamental discrepancies between the technocratic “gaze of power” that interprets hazards based on what can be ‘seen’, as opposed to the long-term lived experiences of vulnerable communities. In some cases, disasters have led states to question plans for intensive hydropower development – most notably in Sikkim and Arunachal Pradesh, where dams are increasingly being seen as risk-laden endeavors and private developers have even withdrawn from ongoing projects (Rahman, 2014; Huber, 2019; Gergan, 2020). In other cases, disasters merely reinforced existing narratives of energy crisis and ultimately reinforced the hydropower ambitions of the developmentalist state – as in post-earthquake Nepal (Butler & Rest, 2017; Lord, 2017, 2018). For better or worse, the risk perceptions of states and citizens also evolve over time – as they have in the Garhwal region of Uttarakhand, in response to hydropower development conflicts and natural disasters (Drew, 2017a, 2017b, 2018) – as narratives of disaster change, people ‘forget’ about the impacts of disaster or the scope of potential risks, and/or other crisis narratives emerge and assume primacy.

Ultimately, these discrepancies between technocratic and local perspectives are shaped by different temporal orientations and concepts of time. Nixon's (2010: 8) framing of environmental violence is instructive here, because: "all environmental violence, needs to be seen – and deeply considered – as a contest not only over space, or bodies, or labor, or resources, but also over time." For Nixon (2010: 17) the upsurge of Indigenous resource rebellions, and we add here conflicts over Himalayan hydropower, arise from a "a clash of temporal perspectives between the short-termers who arrive (with their official landscape maps) to extract, despoil, and depart and the long-termers who must live inside the ecological aftermath and must therefore weigh wealth differently in time's scales" (17). The burden of nation-building infrastructure like hydropower, has always been borne unequally by the 'long-termers' – marginalized populations especially Indigenous groups, who have for centuries witnessed an erosion of their territorial and political rights, in service of the "greater common good" (Roy, 1999; Baviskar, 1995; Ghale & Ghale, 2018; Routledge, 2003).

Ways of knowing time in the Himalayas have long been shaped by the complex genealogies of colonial histories in South Asia, where hydraulic infrastructures built in response to the indeterminacy of the monsoons systematically subjugated local knowledges and disregarded place-based adaptations to the rhythms of monsoon hydrologies and flooding (Amrith, 2018; Baruah, 2012; Cortesi, 2018; D'Souza, 2006). Similarly, in the 21<sup>st</sup> century, Himalayan communities seeking assistance with mountain hazards and disaster risk reduction measures must also struggle to navigate policies and bureaucracies that operate on "technocratic time" (Gagné 2019). In these ways, "the uneven geographies of risk and infrastructural development in the Indian Himalaya form on historical terrains shaped not only by specific geologies but also by the powerful, unbroken legacy of colonial and postcolonial state rationality" (Gergan, 2019: 39). As the Anthropocene epoch unfolds, it is increasingly necessary to recognize the temporal orientations of those who carry embodied and place-based forms of environmental knowledge (Gergan, 2017, 2020; Kipgen, 2017), in the Himalayas and beyond.

## **Conclusions**

In this review of the existing literature on Himalayan hydropower, we have highlighted the tangled temporalities and temporal politics that shape Himalayan hydropower frontiers, both real

and imagined. Our analysis maps out some of the different techniques that planners and builders use to reckon, organize, and make time for hydropower development, as well as the different temporal tactics that critics and opponents use to interrupt, destabilize, and renegotiate the timelines of hydropower projects. We also showed how hydropower plans and projects –past, present, and future – are perpetually troubled by the temporal indeterminacies and contingencies of Himalayan environments. Weaving these concerns and contestations together, we have suggested that the conceptual framework of *timescapes* (Adam, 1998, 2004; Bear, 2016) can help scholars trace and untangle the multivalent issues of time and temporality that shape patterns of Himalayan hydropower development – and we hope that others might build from our provocations and analysis.

Over the past several decades, a broad array of researchers and academics have attempted to highlight the uneven and uncertain impacts of hydropower development in the Himalayas – variably calling for better planning and regulation, a more rigorous and nuanced full-cost accounting of impacts, or further critical thinking about the uncertainties that surround hydropower development futures. Given the scale and scope of planned hydropower development across the Himalayas as well as the pace at which climate change is impacting the region, this critical work is needed now more than ever. We would also add that the need for long-term and longitudinal studies of the impacts of Himalayan hydropower remains particularly important – for as our review of this expanding literature suggests, the timescapes of Himalayan hydropower development are inherently multiple and constantly in flux.

Critically, any analysis attuned to the timescapes of Himalayan hydropower must also attend to the ‘prognostic politics’ that shape resource-making projects and uneven forecasts of environmental futures (Mathews & Barnes, 2016; Ferry, 2016). Unavoidably, all efforts to manage Himalayan waterscapes – for energy, irrigation, drinking water, flood control, or other water uses – will, as elsewhere, entail the work of triaging between differently imagined and “fluid futures” (Randle & Barnes, 2018). These decisions will also require theories about the best ways to organize and manage socioenvironmental “uncertainties on a Himalayan scale” (Thompson et al, 1987; Gyawali & Dixit, 2001) that are rapidly changing due the context of climate change. We argue that recognizing these challenges means returning to and

reformulating fundamental questions of *temporal ethics* –re-examining how ethical frameworks shape the ways people orient themselves in time and vice versa (Adam, 1998; Adam & Groves, 2007; Bear, 2014, 2016; Gell, 1992; Munn, 1992). Investigations of temporal ethics can help us reconsider the ways we perceive, delineate, and organize problems, priorities, and proposed solutions, in time.

In *Future Matters: Action, Knowledge, Ethics*, Adam and Groves (2007) argue that scholars must take a critical and ethical stance toward future-making and its processes. Thinking with timescapes, we argue, can help critical scholars of hydropower do the work of re-embedding the imagined or possible futures of our uneven present moment within broader historical contexts, so that “the futurity of matter and the aspirations of others as well as future peoples’ needs and rights begin to re-emerge from the shadows” (Adam and Groves, 2007: p.15). Similarly, Karine Gagné has recently highlighted how in the Buddhist Himalayas, water is produced through ethical actions, calling for greater attention to the ways people orient themselves within sacred landscapes, moral ecologies, and multispecies assemblages (Gagné, 2020). Another way of highlighting ethical concerns and sorting out priorities is to shift our attention from a politics of crisis or immediate energy needs to the pernicious *longue durée* of colonial and neocolonial violence and erasure that has worked itself upon the marginalized – and especially the Indigenous residents of the Himalayas (Gergan, 2017; Ghale & Ghale, 2018; Dukpa et al, 2019; Kipgen, 2017; Rahman, 2014). This shift requires emphasizing dams as just one of many techniques of power within development regimes that create winners and losers, redistributing resources and agencies in time. By highlighting the temporal ethics that guided the future-making and future-consuming projects of people in the past, we also show how “our present is their created future, their commodified future and their colonized future” (Adam and Groves, 2007: 13).

As the Anthropocene unfolds – unevenly, multiply, contested, and undetermined as it is – new and old questions emerge that are especially critical in the Himalayan region: *What* does ‘development’ mean, over what timespan and for *whom*? Whose rights and ethical frameworks matter, and *when*? *Why* do we value or discount certain futures over others, and *how* might alternative futures be imagined? Critically examining the past, present and future timescapes of

Himalayan hydropower with questions like these in mind, we argue, can help bring renewed and critical attention to the temporal ethics of development and future-making in the Himalayan bioregion more generally – an agenda which seems both crucial and timely within this increasingly uncertain historical moment.

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