THE LIVED EXPERIENCES OF WATER INSECURITY: SPATIAL NARRATIVES FROM THE KATHMANDU VALLEY, NEPAL

by

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DISSERTATION ABSTRACT

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According to the United Nations, around 2.1 billion people lack access to safely managed drinking water services. In Nepal's Kathmandu Valley, domestic water insecurity is persistent and widespread as households often struggle to access enough clean water. Without the ability to trust and rely on basic services, like piped water provision, urban residents take on heavy burdens to care for their households and larger communities. In addition to understanding these burdens, questions remain as to how people in their daily lives make sense of and respond to the insecurities of development. This dissertation examines the spatial narratives of water insecurity in the Kathmandu Valley's city of Patan. By following water relations between households and institutions which shape everyday life in Patan, this dissertation reveals socio-spatial conditions which reproduce and transform experiences of (in)security. This dissertation makes four contributions to critical development geography.

First, I developed and piloted a story-mapping technique as a relational means of attending to ethnographies of water security and development. Story-mapping frames research as narrative-building and employs geovisual tools to craft spatial narratives. If political ecology is a form of narrative, then story-mapping supplies a means of attending

to construction, representation, and analysis of narrative. Second, I advance a capabilities approach for political ecology to argue that the abilities of households to address water insecurities rests on spatial, technological, and social freedoms. I develop a framework around these freedoms to reveal the ways power relations within and between households negotiate water security. Third, while households are sites of exploitation in the larger urban political economy, I show how the social infrastructures of households work for life in ways which both sustain and transform the social and material fabric of the city. Fourth, I humanize political ecologies of security to find that regardless of a household's ability to be water secure, the feeling of insecurity is pervasive because of moral imaginaries about water and development. By eliciting these socio-spatial relations of water and development, this dissertation innovates spatial narrative as a tool and heuristic for performing geographic research and building theory.

This dissertation includes previously published co-authored material.

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CHAPTER I

INTRODUCTION

Research Problem

Universal access to enough clean water, or domestic water security, remains a critical development problem. Globally, 2.1 billion lack access to safely managed drinking water (JMP, 2017) and four billion live with severe water scarcity for at least one month a year (Mekonnen & Hoekstra, 2016). In Nepal's Kathmandu Valley, widespread and persistent issues of water insecurity speak directly to frustrations with the goals and processes of development. Between the Millennium Development Goals set in 2000 and the Sustainable Development Goals set in 2015, the Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) shows that urban Nepal's access to safely managed drinking water decreased from 35 to 34 percent. Why do so many live with water insecurity despite decades of development efforts, and what do these development conditions mean for daily life? Furthermore, how do households make sense of, and respond to, water insecurity over time and space?

This dissertation examines spatial narratives of domestic water security. Water security functions as the vehicle for this dissertation – the medium through which I examine broader questions of development, exploitation, and possibility. Essential for life, water holds multiple meanings and forms, creating interdependencies and relations between people, places, objects, imaginaries, and experiences (Bakker, 2012; Hastrup & Hastrup, 2015; Krause & Strang, 2016; Linton, 2014). Yet, water security as a term and practice of development all too often divorces those relations, particularly in their spatiality. As reviews of the concept show, the term "water security" has ascended in development

discourses around parameters of water quantity, quality, and access at various scales and towards different ends, including: survival, economic prosperity, and national security (Cook & Bakker, 2012; Gerlak et al., 2018; Jepson et al., 2017; Lankford, Bakker, Zeitoun, & Conway, 2013; Wutich et al., 2017). However, the parameters of these framings (securing water) and goals (security) are often abstract and conflated, resembling the ways similar concepts of resilience end up focusing on coping mechanisms rather than systems (Kaika, 2017). Political ecology critique of environmental security, like, adaptation, sustainability, resilience, vulnerability, find that seemingly new paradigms fall into old traps that at best, fail to address the drivers of injustices and at worst, create or perpetuate violent conditions (Deitz & Meehan, 2019; Kaika, 2017; Laurie & Shaw, 2018; Perreault, Bridge, & McCarthy, 2015). While critical geographers have done well to show the risks of deterministic and neoliberal logics of development that are carried through concepts like water security, questions remain as to how people in their daily lives define their experiences of water (in)security (Buechler, Hanson, Liverman, & Gay-antaki, 2017; Hawkins et al., 2015; Jasanoff, 2010; Jepson et al., 2017; Liverman, 2015; Mehta, 2014; Perreault, 2014). In response, this dissertation advances existing relational approaches (Elwood et al., 2017; Hoffmann & Metz, 2017; Jepson et al., 2017) to make sense of water security as a concept and experience through spatial narratives.

If water security is relational, then addressing those relations demands attending to the construction of spatial narrative. In this dissertation, I present spatial narratives as a tool and heuristic to help make sense of the relations which matter to how people reproduce, subvert, and transform conditions of insecurity to not just get by but build a better life. As I show in the pages below, spatial narratives draw connections between the dynamic

conditions of households, neighborhoods, cities, and other spaces which shape human experience. Looking between households and offices as critical sites of water management, I argue that understanding and addressing the uneven effects of development, like water insecurity, demands a socio-spatial relational approach (Elwood, Lawson, & Sheppard, 2017; Hart, 2004; Hoffmann & Metz, 2017; Jasanoff, 2010; Jepson et al., 2017; Kaika, 2017).

Narratives are a system of stories that can include cartography, art, prose, and poetry. As geographers and other scholars have long argued, narratives are fundamentally relational both in plot and content, and also in the process of drafting (Caquard & Cartwright, 2014; Cronon, 1992; Dear, Ketchum, Luria, & Richardson, 2011; Gregory, 1994; Hawkins, 2015; Ingold, 2011; Pratt, Johnston, & Banta, 2017; Robbins, 2012a; Ryan, Foote, & Azaryahu, 2016). In other words, narrating and narrative helps to make sense of the unfolding of experiences over time and space. From reading landscapes as a text and fieldnotes as geographical imaginaries, spatial narratives as discourse are foundational to geographic analyses and theories of power (Dixon, 2010; Dixon, Hawkins, & Straughan, 2012; Duncan & Gregory, 2002; Tuan, 1991). Nevertheless, as Cameron (2012) argues through a review of the role of story in geography, scholars often poorly attend to the ways they create narratives and what those narratives do in the world.

Political ecologists and other critical geographers have done well to evaluate dominant narratives about development and human-environment interaction; yet, in focusing directly on power and politics the resulting narratives neglect the humanistic, experiential, and cultural meanings of place. On the other hand, while endeavors between geography and the humanities, or the geohumanities, have theorized and created spatial

narratives in ways that exceed politics, the role of story, story-telling, and narrative analysis are all too often treated as a panacea. While Hulme (2015, p. 324) argues that "change is often inspired through stories of meaning and purpose embodied and lived out in communities, neighbourhoods and networks" this dissertation critically investigates the relations which fuel change through the co-construction of spatial narrative. I find the environmental humanities dedication to our meaning-making capacities and environmental values productive towards advancing political ecology perspectives of insecurity and transformation. Moreover, I am inspired by the participatory uses of creative methods with mapping and story-telling to engage diverse publics and the mess of daily life, or the everyday (Cameron & Gibson, 2005; Martina Angela Caretta & Riaño, 2016; Gibson, Bird Rose, & Fincher, 2015; Hawkins, Marston, Ingram, & Straughan, 2016). Thus, this dissertation is a concerted effort to synthesize political ecology and geohumanities.

In my research, story-mapping is more than the usual combination of grid maps with stories about place collected from the world or the analysis of space and place in narratives. Instead, I build spatial narratives with research subjects by actively describing and making sense of our experiences together over time and space through an iterative and reflective process. I use story-mapping to describe, synthesize, and analyze the visual, textual, and sensory information of research – the photographs, interviews, observations of encounters with people and places. I also use story-mapping as a way of tracing movement; explicitly, the entanglement of experiences between subjects and spaces of research, which includes myself and the mediums through which I integrate information. Here, I bring together feminist and postcolonial theory to make visible the process of research and the complexities of people and places. Doing so, I respond to calls from the geohumanities for

research that engages with place as ongoing and in process and questions how to represent human experiences of place while recognizing the ways researchers' creative engagements intervene in that knowledge (Hawkins, 2015).

Research Objectives

Development geographies have long shown that people often are intervening in a world that is not their choosing, and in doing so, are actively rebuilding it all the time. However, there is space not only to examine the humanistic ways people address these insecurities but moreover, build research tools to engage with relational processes. This research asks, what does it mean to perform research as a process of building spatial-narratives? And in what ways can spatial narratives intervene in development geographies? Through the spatial narratives that emerge from rooms, roofs, and roads, I engage with difficult questions about why water insecurity so persistent and prevalent despite decades of development investment; the uneven ways living in a state of insecurity impacts capabilities and human development; and how people subvert and transform their living conditions to build more secure lives.

Specifically, I focus on water managers – the people in households and institutions who tend to the water needs of others – to ask, *1) How do household water managers experience water insecurity? 2) How do household water managers build water security? 3) What are the relationships between the water narratives of households and processes of urban development?* My goals are to understand the role of households in urban development and the disparities between the abilities of urban residents to respond to insecurities and build security. I do this by focusing on the ways water managers make sense of water insecurity. Here, to *make sense* of an issue speaks to the relational meaning-

making practice of narrating experience, which I attend to through the story-mapping process. Table 1 outlines the objectives of the research.

Table 1. Research objectives and methods

Method	Analysis	Participants
Objective 1: Story-map how households build water security over time		
Semi-structured and unstructured interviews Photographs Observation	Database and narrative analysis to build story-maps of participant water practices. Notes and transcripts from each session n=159, photographs n=560, and spatial coordinates n=325	47 participants by the end of the study period Strategy: Convenience and purposive sampling by area in study
Objective 2: Understand how households make sense of water insecurity		
Semi-structured and unstructured interviews Photographs Observation	Narrative and discourse analysis (same as above) to form story-maps of participant water practices.	Same population as above.
Objective 3: Examine how participant experiences relate to the practices and narratives of decision-makers (government, inter-governmental, non-governmental, corporate)		
Semi-structured and unstructured interviews Observation	Content and discourse analysis Notes and transcripts from interviews institutional water managers=31 and household story-maps=53, collected documents n=168, news stories n=382, photos n=1,284	31 decision-makers (7 from KUKL[a] and KVWSMB[b], 2 from LMC[c], 7 general experts, 8 from NGOs, 4 from companies, 3 from donors and IGOs) Strategy: Snowballing and purposive sampling

[a] Kathmandu Upatyaka Khanepani Limited (public water company)
[b] Kathmandu Valley Water Supply Management Board (regulator of KUKL)
[c] Lalitpur Metropolitan City (local government of Lalitpur/ Patan)

To attend to spatial narratives, this study innovates methodological tools through the elaboration of the story-map method. I examine spatial narratives of water security from two perspectives: the first, from the perspective of the household; and the second, from the perspective of groups that control the flow of water to households, such as engineers and bureaucrats. To build these spatial narratives, I use ethnographic methods to examine how

research participants understand the felt, political, cultural, and material dynamics of water service provision and contradiction, particularly in a rapidly changing and uncertain urban environment. The purpose of my analysis is to elicit a spatial and relational understanding of how people build new worlds in which they might thrive, despite incredible odds.

This paper presents story-mapping as a research technique for co-constructing narratives about individual and collective experiences. I developed and piloted the technique in Nepal's Kathmandu Valley. Here, I sampled households within the defined urban area and water service area of Patan to allow for in-depth study of the diverse tactics of living (Robinson, 2011; Roy, 2015). In Patan, I recruited individuals who secure water for their families or household water managers. To understand the spatial relations of water, I followed flows between households and sources by walking along pipelines, getting lost in Patan neighborhoods, visiting water sources and stores, reading reports and policy documents, meeting with people who influence the waterscape as sellers, managers, providers, critics, and administrators.

Drawing inspiration from work in the geohumanities, the process of story-mapping engages in "the assumptions, feelings, articulated beliefs, and expressed emotions that people draw on to make their own lives, and those of others, matter" (Hawkins et al., 2015a, p. 221) to create and relate human stories of water security. Story-mapping is an ethnographic technique that integrates observations, collected materials (photographs, news articles, flyers, and development reports), and interview transcripts into spatial and visual narratives. The outputs of this technique include individualized story-maps of participant experiences as they navigate changes in water availability throughout the year and thematic story-maps that summarize household experiences and reveal cross-cutting issues.

Story-mapping iteratively synthesizes and represents information from observations, interviews, collected documents, and photographs to build spatial, temporal, and visual narratives. Specifically, I built story-maps with people responsible for their household's water provision over the year and ask how they secure water, understand water insecurity, envision water security, and invest in future water security. Story-mapping visualizes how those narratives and practices of water security transform over time. I then relate participant experiences within the interface of research, policy, and development work on water security in the area through thematic story-mapping. In these ways, story-mapping responds to calls for geohumanities research that can link human experiences of place with abstract processes of widespread environmental change.

I used ArcGIS Online Story Maps to build narratives over four research phases, following the same procedures with each participant to allow for comparison. The Esri Story Map interface allowed me to link narrative text with associated photographs of objects, technologies, places, and maps of spatial relationships. Each draft gathers feedback from relevant participants as a means of verifying, expanding, and reflecting on the story map (Martina Angela Caretta & Riaño, 2016). Insights and discussion from story-mapping led to further collaborations and discussion. Chapter III, "The pain of water: a household perspective of water insecurity and inequity in the Kathmandu Valley" (Molden, Khanal, & Pradhan, 2018), is a result of the story-mapping process.

Context

This research is set in the Kathmandu Valley, Nepal's largest and fastest-growing metropolitan area. Please note that in this dissertation, I will sometimes refer to Kathmandu and the Kathmandu Valley interchangeably. Surrounded by forested hills, the Kathmandu

Valley is situated between snow-capped Himalaya in the North, which extends into the Tibetan Plateau and the Indo-Gangetic Plain or *terai* in the South (Figure 1). Like other lower elevation regions of the Central Himalaya, residents of the Valley rely predominantly on the seasonal monsoon (Immerzeel, van Beek, & Bierkens, 2010). Rainfall feeds the Bagmati River and its tributaries, which originate in the Valley's Northern forested hills. In addition to the collection of water from rainfall, streams, and interflow, residents rely on water from shallow aquifers and, with increasing frequency, deep aquifers, thanks to boring technology which can drill hundreds of meters below the surface (Shrestha, Roth, & Joshi, 2018; Thapa, Murayama, & Ale, 2008).

Figure 1. Map of the Kathmandu Valley topography highlighting the Patan area (Google Earth)

Around three decades ago, officials set in motion a massive inter-basin water transfer project, "Melamchi," that will link urban residents with the glacier and snow-fed rivers of the Himalaya. A which project aligns Nepal with the development trends of other metropolitan areas globally (McDonald et al., 2014). Nevertheless, the added water from the project is unlikely to address the city's persistent issues of water insecurity, nor the

associated inequities and injustices of water access (Domènech, March, & Saurí, 2013; Rest, 2018). This is because Nepal's water issues are bound to unjust processes of governance, which I define as the political, social, economic and administrative systems of governmental and non-governmental actors that influence, develop, and manage resources and services (Bakker & Morinville, 2013; Neal, Lukasiewicz, & Syme, 2014; Perreault, 2014).

This research characterizes the entanglement of Kathmandu's water and development injustices through four contradictions. First, contrary to Nepal's recognition as being one of the wealthiest nations in water resources, drying water sources and contamination jeopardizes the livability of its urban areas (Bhushal, 2015; Ng, 2017; "Water in Kathmandu," 2017). Second, despite long-term investments directed towards improving water security, like Melamchi, insecurity has arguably worsened since the inception of those projects and two-thirds of the population lack enough safe water for their needs (Raina, Gurung, & Suwal, 2018). Third, government institutions perceive the abilities of urban residents to cope as resilience, which feeds a cycle of apathy, blame-avoidance, and apathy (Ching, 2018). Fourth, although water and water places are sacred to the peoples living in the region, they are heavily polluted and exploited by households, industries, agriculture, and development projects (Colopy, 2012; Drew, 2016).

These contradictions are not only popular narratives in media and research about Kathmandu, they are also part of daily conversation in Kathmandu as people talk about *paani ko dukha,* "water problems/pains," and the struggle for *bikas,* "development." The city's water problems thus are entangled in debates about poverty, poor government capacity and corruption, the 2015 earthquake, rapid population growth, changing lifestyles,

and political turmoil. The institutional narrative of Kathmandu's water issues in governmental and intergovernmental reports favors a sanitized and aggregated view of water issues punctuated by one-dimensional stories of poverty. Such narratives about the city and its water problems neglect the messy and bloody cultural and political histories of Kathmandu and Nepal (Rademacher, 2011). Despite Blaikie's well-read critique of the theory of Himalayan Environment Degradation through a study of soil erosion in Nepal, deterministic and technocratic narratives about environmental struggles persist in the region (Blaikie, 1985; Blaikie & Muldavin, 2004; Gergan, 2016).

In the paragraphs below, I provide a brief overview of the Kathmandu Valley – its site, situation, and history – to contextualize the research. As I explain in Chapter II, I conducted this research within the urban area of Patan (*Yala* in Nepal Bhasa), which is the historic center of the larger Lalitpur Metropolitan City. Divided by the Bagmati River from Kathmandu in the North, Patan is a historically distinct city in the Valley because it once was its own kingdom, as shown in Figure 2. In Chapters III and IV, I include a more in-depth explanation of the Valley's contemporary water issues as they relate to its development histories. As I show throughout this dissertation, given the Valley's complex and dynamic geologic and cultural histories it is challenging to generalize about the social or physical landscape of the entire Valley or even large areas like Patan. Yet, it is this tension, between place-based diversity and the wider conditions of development, that make the case of Patan relevant to not only the larger Kathmandu Valley but the heterogeneity that characterizes urban areas globally (Ren & Luger, 2015; Robinson & Roy, 2015).

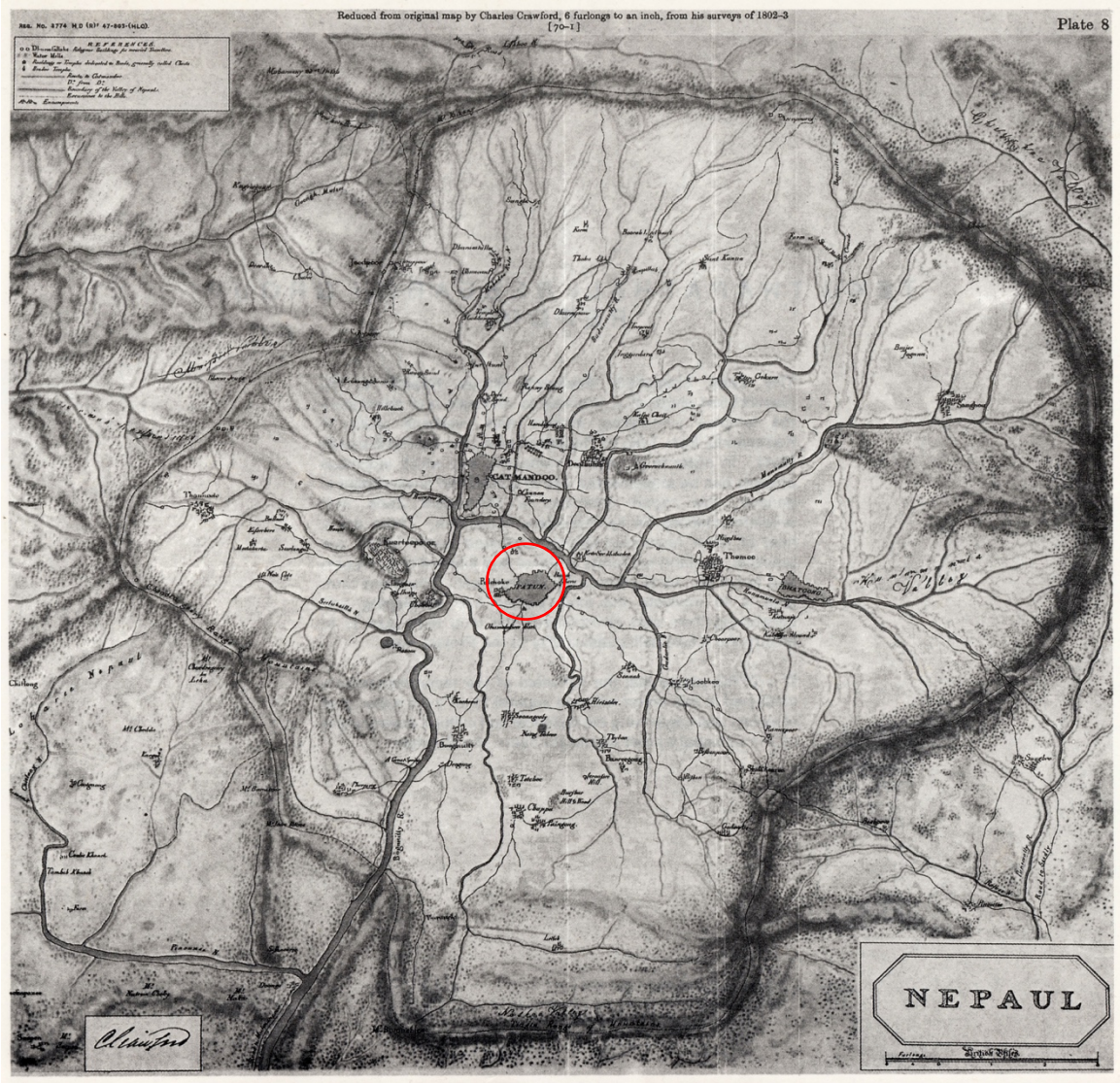


Figure 2. Map by Charles Crawford from 1802 of the Kathmandu Valley, or Nepal as it was known before Gorkha appropriation (from Wikmedia Commons, 2012).

As spatial and temporal variations in the design of ancient waterways indicate, historic cities in the Valley, like Patan, developed around complex socio-ecological systems (Tiwari, 2001). Compared to other areas of the Valley, remaining ancient waterways in Patan appear to be more functional thanks to strong community groups and local hydrogeology (Joshi & Shrestha, 2008; NGO Forum for Urban Water & Sanitation, 2009; UN-HABITAT, 2008). Although much of Patan is located on top of a clay aquitard base (Figure 3), the presence of sand and gravel subsurface in Lalitpur make the area one of

the Valley's main recharge areas (Dixit & Upadhya, 2005; Sangam Shrestha, Semkuyu, & Pandey, 2016; Warner, Levy, Harpp, & Farruggia, 2007). Rainwater harvesting and recharge efforts are growing in Patan, especially given knowledge about its local water storage potentials. Dixit and Upadhya (2005) estimate that given the annual average precipitation of 1,500 millimeters, the Valley could capture 500 million cubic meters of rainfall to supplement water supply, especially in the drier months which usually fall between late September to early June. However, as the timing and intensity of the monsoon alter with climate change, rainwater harvesting and water storage are all the more difficult and necessary (Neupane, White, & Alexander, 2015).

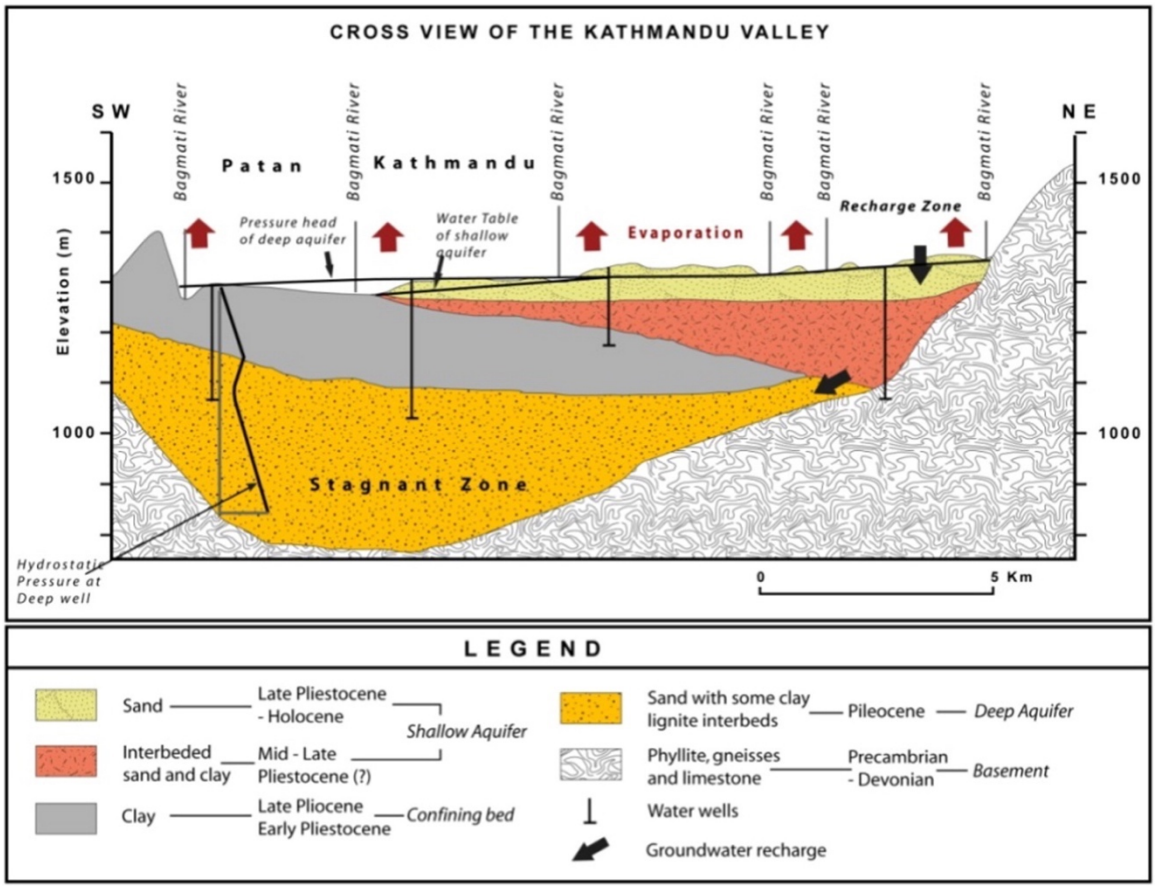


Figure 3. Cross section of Kathmandu's subsurface hydrogeology (Sangam Shrestha et al., 2016, p. 24).

Patan like the rest of the Kathmandu Valley is rapidly developing – its green spaces

quickly turning into cement. A recent study of land use change in the Valley estimates that over the past three decades urban area expanded up to 412%, which also has impacted groundwater recharge (Ishtiaque, Shrestha, & Chhetri, 2017). With a population growth rate of 4.3 percent per year, the Kathmandu Valley is one of the fastest growing areas in Nepal and South Asia (Muzzini & Aparicio, 2013). Nevertheless, with only 17 percent of the country's 26 million living in urban areas, the country still remains predominantly rural and agriculturally based (Central Bureau of Statistics, 2012). As of the last census in 2011, the Valley's population was 2.5 million; in 2001 the population was around 1.6 million. Since the 1990s there has been massive rural to urban migration both in the country and to other cities globally and in 2008 around migrants represented 51% of the Valley population (Muzzini & Aparicio, 2013). In addition to the estimated population of 3 million in 2015, there is an addition floating population of around 2.5 million who are temporary residents (Chemjong, 2017; "Kathmandu Valley Development Authority," n.d.). This floating population is the backbone of Kathmandu's economy – representing both skilled and unskilled labor (Muzzini & Aparicio, 2013). Those who fly out from Kathmandu to migrate to other countries send home remittances, which make up one-third of the country's gross domestic product (Maher, 2018). Nepal's pattern of urbanization follows major political and economic shifts that have taken place in the country, particularly during and after the civil war (1996-2006) when thousands came to the Valley seeking refuge (Ishtiaque, Shrestha, & Chhetri, 2017; Thapa & Murayama, 2010).

The Kathmandu Valley has long held political and economic power in the region as a center of arts and crafts, trade, knowledge, and worship. From the Licchavi (400-750 CE) to Malla rulers (1200-1768 CE), different clans have conquered the Kathmandu Valley and

incorporated preexisting social systems, such as the language Nepal Bhasa and conduit water systems. During the Malla Dynasty, rulers split the Valley into three kingdoms: Kathmandu, Patan, and Bhaktapur. In 1768 CE Prithvi Narayan Shah, the king of Gorkha, conquered those kingdoms which allowed him to unify the county and create a Hindu State. In this nation-building process, Gorkhali rulers appropriated names and symbols from the people of the Kathmandu Valley in their own name, such as the name "Nepal" and the flag. At the same time, they restructured preexisting social systems to gain control through the creation of new infrastructures and social systems, for example, the creation of new ethnic groups and caste hierarchies (Gellner, 1986; Mulmi, 2017; Rademacher, 2011; Shrestha, 1999). Nepal Bhasa speakers became "Newars" while the language of the Shah rulers, Khas, became Nepali. Despite this transformation, Newa (Newar) peoples remain concentrated in the Valley and the city continues to grow around the historic Newa Kingdoms. For example, Newa peoples make up around 39% of Lalitpur Metropolitan City's 226,728 people (Central Bureau of Statistics, 2012). Although codified as one indigenous ethnic group, Newa clans can be Buddhist and Hindu and fall along complex caste lines depending on historic societal roles (Gellner, 1986).

After the Shah dynasty (1768-90) the Kathmandu Valley was the epicenter of major political and economic shifts for the country. The following Rana regime (1846-1951) ended with democracy movements (1951-60) and then the rise of the Shah monarchy again with a Panchayat system (1960-90) and constitutional monarchy (1990-2008). Dissatisfaction with existing socio-political systems and the concentration of wealth and power in Kathmandu motivated a Maoist uprising and civil war (1996-2006). During this decade, development projects and economic growth suffered. Peace talks and the *lok tantra*

democracy movement of 2006 led to the abolishment of the monarchy and after elections in 2008, Nepal became a Federal Democratic Republic with the Maoist party voted into power. Political instability continued following 2008 with frequent changes in leadership and concerns over the creation of an inclusive secular democracy. Drafting of the new 2015 constitution spurred protests over discriminatory citizen provisions and a six-month blockade along the India border right after the devastating 2015 Gorkha earthquakes. During my fieldwork period in 2017, people were feeling hopeful thanks to political and economic changes since the start of 2016. Namely, the country held legislative and provincial elections after twenty years, allowing meaningful local representation for the first time. Nepal's economy also grew by over six percent in 2017, which is the highest it has been since the 1990s ("Nepal eyes fastest economic growth rate in 23 years," 2017).

Despite growing investments in the country, Nepal has a relatively low human development index (0.57) for the Asian region ("Nepal," 2017). Poverty and failed development are rooted in modern histories of development. Development practices often support systems of crony capitalism and reproduce spatial inequities and discrimination, especially along lines of gender and caste (Blaikie, 1985; Einsiedel, Malone, & Pradhan, 2012; Leve, 2007; Macfarlane, 1990; Metz, 1995; "Why Nepal is a crony capitalist state," 2017). Although caste-based discrimination is illegal, caste hierarchies (Figure 4) still shape Nepal's political economy. For example, despite attempts to improve gender and caste/ethnic representation Khas Arya (Brahmin and Chhetri) men continue to dominate the country's political leadership (Bista, 1991; Limbu, 2018; Shneiderman, Wagner, Rinck, & Lord, 2016; The World Bank and the Department For International Development, U.K, 2006). Daily water practices and in the spatiality of water infrastructure are particularly

revealing of inequities. As Figure 4, indicates, social hierarchies are policed by ideas of purity; given the tight-coupling of water, culture, and purity (Amatya, 2006), how people use, share, and "touch" water often reflect those power relations and cultural politics (Clark et al., 2017; Nightingale, 2003; Tamang, 2016).

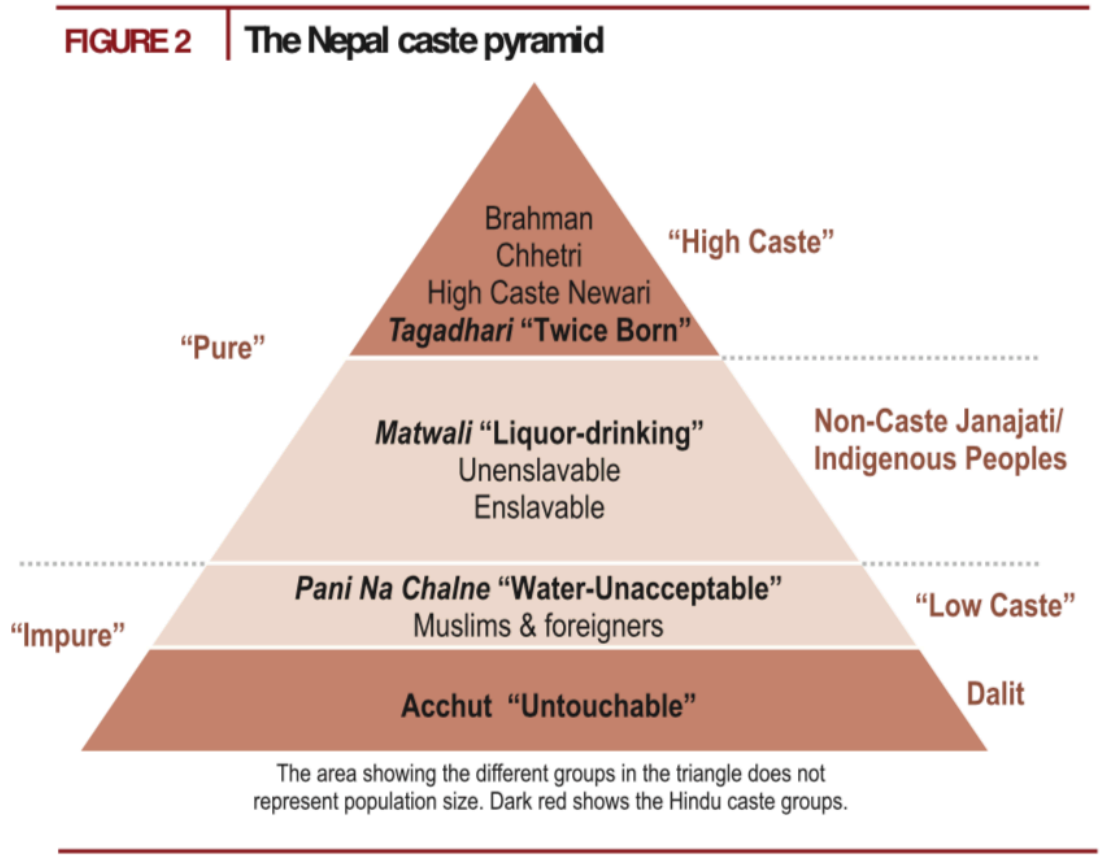


Figure 4. The Nepal caste pyramid (The World Bank and the Department For International Development, U.K, 2006, p. 6)

Caste, gender, and class divisions in contemporary Kathmandu have been shaped by the development practices of Shah and Rana rulers who consolidated powers within Brahmin, Chhetri, and some high-caste Newa families through reorganizing authority, property, industry, and infrastructure in the name of state-making (Figure 4). As historian Amish Raj Mulmi explains (2017), the Hindu elite that emerged from Shah rule built the

nation in their own image:

> This history of Nepal as we've been taught ignores the nature of Gorkhali rule in the new territories they had conquered. It reduces a mammoth campaign of expansion to a story of valor in the face of adversity (Balabhadra Kunwar's story comes to mind), or of territorial hunger by a malicious 'enemy' (the East India Company). This history, handed down to us royally approved, ignores the complexities of empire building, and its impact on the various peoples and their cultures. This does little justice to the Gorkhas' political and military acumen and to the pre-existing cultures that the Khas-Arya Gorkha empire eventually subsumed within itself. Lastly, the white-washed version ignores the undercurrents of the many divisions that currently plague Nepal and find their roots in this story of imperial proportions.

To further add to Nepal's contradictions, attempts to address Nepal's "failed development" overlook local moral economies (Leve, 2007) and empower elite Kathmandu families and a multilayered system of corruption (Bell, 2015; Macfarlane, 1990).

Histories of conquest and shifting power arrangements continue to unfold in the city's water infrastructure. While the Shah kings adopted many Newa systems and traditions, the Ranas attempted to create an urban waterworks of the likes of Europe. Opening the country to foreign affairs after decades policing the border from the British, the Ranas created reservoirs and imported metal pipes for elite household supply and standposts for the public (Colopy, 2012; Regmi, 2005). Through urban development projects, the Ranas set in motion the dispossession of Newa clans and other historic residents from their lands which broke down *guthi* social trust systems in addition to water sources and places of water collection and worship (Dangol, 2010; UN-HABITAT, 2008). Throughout the 1990s the government allowed for the construction of industrial estates, schools, and other industries and services directly on top of ancient ponds, recharge areas, and stone spouts. That trend continues today as road widening efforts demolish historic homes and community spaces despite mass protest. In my earlier research on the

contemporary use and management of ancient Newa waterways, particularly stone spout infrastructure, I found that despite this destruction a significant portion of the population continues to use and rely on this historic infrastructure in ways that extend beyond their basic needs (Molden, 2015).

In my master's research, I argued that the movement of Newa communities around traditional infrastructure functions as a way for historic residents to reclaim urban space and processes of development. I found that a combination of dissatisfaction with government development trajectories, a desire for local autonomy, and cultural preservation motivated community attempts to revitalize and protect ancient water sites (Molden & Meehan, 2018). Moreover, I found that governmental and non-governmental support of these community groups were tied to a combination of personal memory and nostalgia, cultural pride, and familial relations in the city (Molden, 2015). Yet, a combination of conflicts and overlaps in the responsibilities of the mayor, urban planners, the archeology department, and the water provider (KUKL) led to inaction from state actors and reliance on informal processes, particularly community clubs (Molden, Griffin, & Meehan, 2016). Despite the best efforts of community groups to transform their local landscapes with new water systems, management structures, and revitalized ancient water sites, a lack of adequate protection and support from government actors and services means that local infrastructures will continue to run dry as sub-surface water flows are diverted and groundwater levels drop.

My master's research planted the seeds for this dissertation. As I went to talk to people who used ancient water infrastructure in these areas with new community managed systems, I was fascinated by the household and the ways families responded to water issues

and created their own water systems. I noticed that household water practices vary between household members and by different tasks, such as worship, cooking, cleaning. Those water practices also shifted in response to events, like, the end of a rainy season, the start of a festival or the installation of a new pipeline. I also noticed that the comments of leaders of the community, non-governmental, and governmental groups I was talking to often contrasted with what I observed and heard from households. Thus, by examining the practices and perceptions of household members over time and space, this research aims to understand better these lived experiences of water security and how changes in those experiences take place. Here, the notion of *taking place* is significant. My dissertation directly attends to the spatial understandings and practices of people as they address insecurities and attempt to build more secure futures.

Literature Review

This dissertation aims to advance theoretical contributions in the field of development geography. Development geography has long surrounded questions of quality of life, particularly in relation to issues of environmental change and urbanization, which this dissertation examines through the lens of water security. Geographic critique of mainstream theses, models, and indicators of development (such as demographic transition, modernization theory, gross domestic product, poverty, Theory of Himalayan Environmental Degradation) have made important contributions towards explaining the uneven harms and benefits of development, in both its thought and practice. From the conditioning of development subjects to the violence of postcolonial development, critical development geographies contribute nuanced ways of approaching and explaining uneven processes of development across multiple scales and sites (Gibson-Graham, 2006;

Glassman, 2011; Gregory, 2004; Hart, 2004; Li, 2005; Marston & Smith, 2001; Mitchell, 2002; Peet & Watts, 2004; Robinson & Roy, 2015). I expand the possibilities of spatial narrative in the toolkit of critical development geographies as a relational means of attending to the co-production and transformation of power, knowledge, technology, and place between households and cities. Toward that end, the project draws on scholarship from feminist political ecology, postcolonial studies, cultural geography, and science and technology studies (STS). As I explain below, the synthesis of these kinds of literature calls for work in the geohumanities, or the blending of geographic explanation and humanistic approach, including the use of stories and creative methods that start with human meanings of place (Dear, 2015; Dear et al., 2011; Hawkins, 2015; Hawkins et al., 2015; Jasanoff, 2010).

Feminist Political Ecologies

A central argument employed in development agendas is that empowering women and including women in water management can improve domestic water supply and sanitation (O'Reilly, 2010). These discourses are supported by empirical evidence that women are often in charge of gathering water for their homes and take care of household-level health and hygiene (Geere & Cortobius, 2017; Seager, 2010; Sorenson, Morssink, Campos, Abril, & Campos, 2011; Wutich et al., 2017b). Research also shows that women are more vulnerable to water insecurity (O'Reilly, Halvorson, Sultana, & Laurie, 2009; Sultana, 2009; Wutich, 2009). Despite initiatives to address these issues, women remain peripheral in both development and research projects on water access, while the gendered dimensions of water practices remain understated (Adams, Juran, & Ajibade, 2018; Ahlers & Zwarteveen, 2009; Buechler & Hanson, 2015; O'Reilly et al., 2009; Truelove, 2011). In

part, this is because much of women's water-related work remains 'invisible' due to the amount of work that takes place informally and in private spaces (Buechler & Hanson, 2015). Additionally, men often claim titles to land and water rights and have official roles in decision-making processes and as a result, women are often excluded from water access and management (Zwarteveen & Meinzen-Dick, 2001). The lack of data on the gendered dynamics of water and sanitation, particularly statistical data for comparison (Buechler & Hanson, 2015; Seager, 2010), indicates these issues of visibility and the lack of sensitivity to gendered dynamics in research tools. Thus, despite attempts to address gendered inequities in water resource issues, women often lack adequate access to, and representation in, science and policy.

Geographic research inspired by feminist theory has made important contributions to situate water resource management issues through a focus on the everyday, quotidian, and mundane. This is because looking through lived experiences and daily relations can reveal the diversity and complexity of people's behaviors and beliefs, especially since these processes are often concealed or simplified into taken for granted categories (Painter, 2006). For example, development reports cite data that show improvement in water supply and sanitation and assume similar improvements in the lives of women, yet a focus on everyday practice reveals the ways processes of development marginalize women (Narain, 2014; O'Reilly, 2010). O'Reilly (2006), for example, found that development schemes meant to empower women and improve sanitation created new constraints. Truelove (2011) found that the legalization and improvement of water sources in Delhi made life more difficult for economically disadvantaged women. Similarly, while reports tend to cast gender roles according to certain stereotypes, peering into everyday spaces and routine

necessarily illuminate the ways gendered interactions with water transform (Buechler & Hanson, 2015; Sultana, 2009), such as with neoliberal shifts in governance and the privatization of resources (Roberts, 2008). Overall, a focus on the "gendered ideologies, structural power relations, and processes of both local and global change" (Truelove, 2011, p. 145) that produce, and are produced by, everyday life illuminate the power inequities that extend from gendered dynamics of access to, and control over, water resources.

This dissertation engages with the lived experiences of families to bring to life temporal and spatial patterns of water access that are missing in literature on domestic water provision. Given that water sources often form an overlapping "meshwork" of infrastructure and political systems, static representations of water sources that differentiate populations using formal and improved structures are inadequate and misleading (Schwartz, Luque, & Rusca, 2015). Moreover, while historical analyses reveal why patterns of domestic water access vary between different political periods, we know less about how and why people switch between different sources in a day or between days. Relatedly, many categories for water sources poorly capture the complexity of water systems within a household or what a household means in terms of water provision for household members (Wutich et al., 2017). Thus, patterns of water access relate to complex socio-spatial relationships that extend beyond people directly interacting with a particular type of infrastructure (Truelove, 2011). This project, therefore, examines the temporal and spatial patterns of domestic water access, as contextualized within larger social relations and norms.

Cultural Geography and Spatial Narratives

Water and matters of water access are fundamental to development (White,

Bradley, & Anne, 1972). The production of modern water and its associated infrastructure systems has functioned as a heavily in political ecology critique, revealing of the power geometries of larger environmental struggles (Banister & Widdifield, 2014; Kaika, 2006; Kooy & Bakker, 2008; Lave, 2014; Linton, 2008; O'Reilly, 2006). Feminist political ecology texts have focused on water to gain insight into the gendered implications of natural resource management and the intersection of gendered struggles and other subject positions, like class and ethnicity, in environmental change (O'Reilly, 2006; Rocheleau, Thomas-Slayter, & Wangari, 1996). Here, the body, household, intimate spaces, and local interactions are seen as situated within larger political and economic processes (Elmhirst, 2011). Nightingale (2011, p. 153), for example, draws on her ethnography of rural Nepal "to explore the ways in which boundaries between bodies, spaces, ecologies and symbolic meanings of difference [i.e. gender, caste, and class] are produced and maintained relationally through practices of work and ritual." For Sultana (2011a, p. 163) analyzing the emotional geographies of water access enables "(feminist) political ecology to further explain and illuminate the ways that resource struggles and politics are not only economistic, social, or rational choice issues, but also emotive realities that have direct bearing on how resources are accessed, used, and fought over." Through emotional geographies, Sultana analyzes resource struggles as more than the resource itself or larger socio-political power relations to examine the way that feelings influence people's everyday practices and decisions. Drawing inspiration from Nightingale's intersectional analysis and Sultana's call to look beyond the resource itself towards people's meaning-making capacities, this research analyzes human meanings of place in relation to everyday water access. The kinds of cultural and humanistic geography discussions around human

meanings of place –as compared to place as location, or the relational production of space and subjectivity– remain underdeveloped in political ecology analyses.

Critical geographies analyze claims to culture and place to reveal power geometries and injustices. For example, Donahue and Johnston (1998, p. 56) in *Water, Culture, Power: Local Struggles in a Global Context* ask, "How are some social actors able to impose their definition of water on other social actors with different but equally legitimate definitions? In other words, how is power used in the service of one or another of the cultural definitions of water?" This set of questions also sits at the heart of many studies of indigenous water relations (Gibbs, 2010; S. Jackson, 2006; McLean, Lonsdale, Hammersley, O'Gorman, & Miller, 2018; Roberts & Phillips, 2018). Perreault (2008), for example, draws on a case study of a Bolivian irrigator's movement to show how essentialized claims to custom and culture transformed social power against a neoliberal turn in water management. While this movement in its reconfiguration of water governance enhances the abilities and claims of rural irrigators, it deprived other groups and residents. These examples highlight the power of cultural referents in attempts to reorganize social relations and conditions for what hydrosocial relations should look like, often in ways which are not necessarily just, sustainable, or enhancing of people's lives. As Tuan (2008, p. 733) cautions, culture is "not only what all or most people do, but also what a few individuals do exceptionally well, with lasting consequences—good and ill—for their fellow humans."

In contrast to these studies about the boundary-making of culture, other political ecology research has examined how relationships with, and imaginaries about, certain places are central to how people develop social connections and transform landscapes, and

thus shape environmental politics (Cheng, Kruger, & Daniels, 2003). In particular, there is growing literature on amenity migration, place-based collaborations, and community-based management where certain ideas about local community and local environmental features, like a nearby watershed and forest, shape people's decision-making, investments, and networking (Berkes, 2004; Gosnell & Abrams, 2011; Molden, Abrams, Davis, & Moseley, 2017). Meanwhile, literature focused on indigenous and local environmental knowledge has expanded understanding about place in terms of the ways different ontologies, or worldviews, and cultural identities relate to shared practices and beliefs that are tied to particular landscapes or environmental features (Boelens, 2013; Cruikshank, 2012; Gibbs, 2009; Jasanoff & Martello, 2004; Salick, Byg, & Bauer, 2012; Verran & Christie, 2011). These studies tend to focus on the role of local knowledge in environmental decision-making and governance, and increasingly, the ways expertise and academic theorizing are also rooted locally within certain places and place-based meanings despite appearing uprooted from culture and place.

Following calls to analyze the relationships between knowledge, power, and place , this research draws on Tuan's (1975, p. 152) definition of place as a "center of meaning constructed by experience" that range from the "points in a spatial system" to "visceral feelings" embedded in our subconscious. As people assign meaning to certain sites –many of which are not explicitly named– like a home, mythological mountain, or country, those interactions and imaginaries reflect how different people make sense of the world and themselves (Cheng et al., 2003; Tuan, 1975). Thus, this project focuses on human meanings of place through story and practice as a part of environmental knowledge, recognizing that all knowledge is situated, partial and value-laden but also composed of

many epistemologies and ontologies (Nightingale, 2016; Yeh, 2015).

This research aims to contribute to feminist political ecology and resource governance by analyzing the intersection of place meanings, environmental knowledge, and subjectivity of the people who take care of their family's water needs. Building on this body of literature, this research engages in the entanglements of place, technology, knowledge, and power in the struggles to define and build desirable urban futures. Here, I examine culture, not as a social classification, but an everyday negotiation of values or an interweaving of stories that take place (Ingold, 2011) in a world of social and material interdependencies (Massey, 2005). I take inspiration from the way Hoffman and Metz (2017) advance the conceptualization of human development through an *Ubuntu* ethic. They draw on an African theory of ethics, not as something representative of African cultures or all ethical thought in Africa but as a productive framework to engage Anglo-American intellectual traditions with intellectual contributions from the Global South. Similarly, the experiences and imaginaries of Kathmandu residents are not representative of a culture, but function to expand the ways in which we can think about water security and development.

Geohumanities

In recent years there have been calls for more linkages between geography and the humanities, or the geohumanities (Dear, 2015; Hawkins et al., 2015). Research in the geohumanities starts with human meanings of place (Dear, Ketchum, Luria, & Richardson, 2011) to ask "timeless questions of what it is to be a human, and what our humanity entails cognitively, morally, aesthetically, and practically" (Hawkins et al., 2015, p. 221). These scholars argue that interpretive geohumanities approaches not only help reveal social

injustices but also promote new ways of approaching social inequities that engage broader publics and different ways of knowing to initiate reflexive change (Castree et al., 2014; Dixon et al., 2012; Hulme, 2011; Jasanoff, 2010).

Researchers have examined stories to understand how change takes place and how intimate and everyday struggles are articulated within processes of capitalist development (Buechler & Hanson, 2015). Here, focusing on story in research opens possibilities for the integration of many ways of knowing, particularly from those who have been historically marginalized, to question assumptions about environmental struggles, like the idea of water scarcity or the category of water itself (Buechler & Hanson, 2015). To engage diverse publics and analyze environmental knowledge, research in feminist geography has utilized creative methods with mapping, literature, and visual arts (Gibson, Bird Rose, & Fincher, 2015). However, questions remain as to what it "means to understand place as ongoing and in process" and how to represent those understandings of place while recognizing the ways researchers' creative engagements intervene in that knowledge (Hawkins, 2015a, p. 252). Questions of representation remain for research that draws on local environmental knowledge (Alcoff, 1988; Hall & Sanders, 2015; Nightingale, 2016; Roy, 2009; Yeh, 2015), especially in terms of how to "retain the subaltern (in whose activity gods or spirits present themselves) as the subjects of their histories?" (Chakrabarty, 2000, p. 77).

Narratives are a form of story-telling where events are organized into a plot (Adger, Benjaminsen, Brown, & Svarstad, 2001; Wiles, Rosenberg, Kearns, & Kearnst, 2005) through visual, textual, auditory or other means of communication (Riessman, 2008). Geovisual narratives or story maps are a powerful mode of communicating spatial information (Caquard, 2011). Online mapping software has become a popular medium for

creating and telling story-maps with data graphics, videos, photographs, interactive maps, or other visual components. These tools have been used to story-map information from a variety of sources including, literature, large datasets, and personal experiences. Creative practices around story are also of growing interest and include digital mapping, participatory art, and landscape analysis. However, in this dissertation, I am careful not to romanticize story-telling. Instead, I ask what happens when we perform research as a process of narrative building? Compared to the usual promotion of stories, maps, and story-maps for research dissemination and outreach, I show how the process of creating story maps can also function a mode of research in this dissertation.

Relations over space and place, wayfaring (Ingold 2011), and spatiotemporal events (Massey, 2005) are central to story-telling. Mental maps, oral histories, cartography, the plots of stories, and GIS are expressions of the many ways in which people map and interpret maps as narratives (Caquard & Cartwright, 2014). Yet, the role of narrative in scholarship, map or text, often lacks critical reflection and is more often employed as data or anecdote than a mode of research (Atkinson & Delamont, 2006; Braun, 2008; Cameron, 2012). Space and place are integral to narrative and by extension the co-production of knowledge.

To understand spatial narratives, this study innovates methodological tools through the elaboration of the story-map method. This research brings together creative geographic methods with feminist and postcolonial theory to emphasize the co-production of knowledge between participants and researchers (Caretta & Riano, 2016). Specifically, this approach integrates participant observation, participatory photography and mapping, and semi-structured and unstructured interviews to encourage multiple forms of conversation

and expression between participant and researcher; reflect on participant's multiple representations and knowledges; make visible the complexity of lived experiences; and focus on place-based relations and meaning-making through story-telling (Alcoff, 1988; Hawkins, 2015; McLees, 2013; Ybema, Yanow, Wels, & Kamsteeg, 2009). Analysis of visual, spatial, and textual information gathered further involves participant feedback and reflection to bring to light the "diversity economic, social, cultural and political subjectivities that comprise any one subject" (Cameron & Gibson, 2005). This research generates story-maps for each participant as a way to bring together these multiple representations and subjectivities as a narrative to place "the assumptions, feelings, articulated beliefs, and expressed emotions that people draw on to make their own lives, and those of others, matter" (Hawkins et al., 2015, p. 221). Chapter II expands these points and details the story-mapping technique.

Explanation of Dissertation Format

This dissertation consists of five academic journal style manuscripts (Chapters II to VI). Below, I summarize each of those chapters.

In Chapter II, I present narrative-building as a mode of research through story-mapping. In this chapter, I have expanded my Short Take manuscript, "Story Mapping Experiences," for the journal *Field Methods* to explain how the story-mapping technique performs political ecology as a kind of text. Drawing on feminist and postcolonial theory, story-mapping responds to the challenge of comparative research given the diversity and dynamism of urban experiences between people over time and space. This chapter details the use of story-mapping as a research technique which incorporates multiple methods and data sources to build spatial narratives of individual and collective experiences. The goals

of story-mapping are to 1. Iteratively synthesize the collection, analysis, and representation of spatial, visual, and textual information as a narrative; 2. Enable meaningful participation of research participants; and 3. Generate a visually compelling product that facilitates dissemination. This paper details the motivation, methods, and procedures for story-mapping based on research in the Kathmandu Valley, which investigated the water-related practices, feelings, and observations of people who secure water for their families.

Chapter III, "The Pain of Water: A Household Perspective of Water Insecurity and Inequity in The Kathmandu Valley," is published in *Water Policy,* with co-authors Anoj Khanal and Nita Pradhan. Anoj Khanal provided policy responses to this paper and Nita played an instrumental role in helping me create story-maps and analyze trends. I include its abstract here: This paper draws on participatory research with 47 household water managers over the dry, pre-monsoon, and monsoon season, alongside expert knowledge of water management in the Kathmandu Valley. Doing so, it presents the perspectives of water managers to highlight three dimensions of water security that existing approaches often overlook. First, experiences of water security vary between households over the year, even within a small geographic area. Second, social connections and landownership play an important role in mediating these experiences. Third, coping with poor water supply places a burden on certain household members. This paper argues that addressing water inequities and insecurities demand research, development, and policy responses to look beyond the main pipe network and engage with a variety of ways in which households secure water.

Chapter IV, "Building Water Security in The Kathmandu Valley: A Capabilities Approach," expands a relational understanding of both water security and human development. This paper examines the disparate abilities of household water managers to

cope with water insecurity. I bring together political ecology and a capabilities approach to understand the water practices of people responsible for their household's water needs. I do so because water insecurity in the Kathmandu Valley is often exploitative and embedded within layered systems of exploitation, where the capabilities of a few benefit from the deprivation of others. Findings for this paper come from an analysis of the relations between the changing water practices and perceptions of household water managers with the water practices and perceptions of urban water providers, decision-makers, and institutions. I show that household water security is more than a matter of access to clean water, but a matter the abilities of household water managers to secure, move, store, and treat water. The spatial, technological, and social freedoms of household managers to access water at each of these steps shapes capabilities and furthermore is revealing of systemic forms of inequality and injustice in the city. These findings inform a framework for thinking about household water security and at the same time, illustrate the power of a capabilities approach in understanding layered forms of exploitation.

In Chapter V, "The Social Infrastructures of Water: Household Water Work in the Kathmandu Valley," I reconsider the concept of the domestic uncanny from the experiences of households in the Kathmandu Valley. In this article, a relational approach reveals the ways government and development projects devolve responsibilities to the unpaid labor of women and other household members who care for the needs of others. To cope with the uncertainty of water access, urban residents transform the social and material infrastructures of their households and communities. In this paper, I detail the social infrastructures – the role of mobs, rooftop socializing, gifts, gossip, local membership, and other social interactions – which make water available for domestic provisions. I do so by

drawing on story-mapped experiences of Kathmandu residents over the dry and wet season. Through story-mapping, I drafted narratives with research participants, linking infrastructures and places with associated stories and practices. Story-map narratives in these ways are revealing of the ways participants both navigate and transform the spaces and norms of households. I find that while exploited, social infrastructures subvert and transform the conditions of urban development. Following efforts to provincialize urban theory, I draw attention to the cultural and political histories of households beyond an individualized model to question the domestic uncanny.

Chapter VI, "Imagining a Water-secure Life in a State of Insecurity," synthesizes political ecologies of insecurity with cultural and humanistic geographic approaches. I argue that political ecology narratives have poorly engaged with moral imaginaries and meaning-making under conditions of insecurity. In this article, I show that the benefits of water services are spatially and temporally uneven in the Kathmandu Valley, meaning some households and neighborhoods enjoy greater comforts than others. To examine these disparities, this paper draws on the diverse experiences of household water managers – individuals who secure water for their family –in Patan through a participatory and iterative narrative-building process, or story-mapping. From story-mapping, I find that Kathmandu residents regardless of their personal state of water security, feel insecure because of the injustices of water relations which persist in the landscape. Moving beyond the usual emphasis on practices and accesses in water security narratives, this paper focuses on how household managers make sense of water insecurities and imagine the future. Doing so, this research finds that household water managers define water security through moral frameworks, which directly challenge existing issues of exploitation and inequality in ways

which hold the government accountable. This paper presents these imaginaries of water security in relation to the promises and realities of development to argue for a humanistic approach in political ecologies of resource management.

CHAPTER II

METHODOLOGY

This chapter includes material from a revised manuscript for publication in *Field Methods.*

Introduction

Sujata, a young mother of two and recent migrant to the Kathmandu Valley, was much happier when I visited her at the start of the rainy season. She had just finished doing laundry with her friends in the entryway of the house where she rents a room. She and other "renters" can collect water here from the homeowner's tap when it is available. Sujata is what I call a household water manager – an individual who takes on the responsibilities of managing and securing water for their family and household.

I met Sujata during the weeks when farmers divert piped water to plant rice, which means piped water supply decreases to twice a month. Despite this, Sujata said she was happy to have moved because usually, the water comes twice a week, supplying more than the 300 liters she needs weekly. Sujata's only complaint is carrying the water up several flights of stairs. However, as she pointed out, this situation is still much better than her previous living conditions at the industrial grounds where her husband works. When I had met her at that workshop in the dry season, she was miserable after spending hours of her day waiting in lines to carry water from either a free community tap or illegal water seller. Sujata makes up Kathmandu's floating population – a large group of people who are often outside the purview of urban research, planning, and politics, yet are also critical to its development.

Although Sujata's new situation has lessened her stress and freed her time, she still worries and feels like there is little she can do, especially as a renter. As she explained,

> Everything is in the government's hand. If the government thinks ‘water is essential to all so we should give water to everyone,’ then water might come. But if the government thinks ‘even if people are paying, we can send them water in schedules’ then it will be like that. If they want, they can provide water.

Sujata’s observation is accurate. The government remains inert while the social and material fabric of households and neighborhoods are in a state of constant flux. Urban residents are either on the move, like Sujata, or adjusting their living arrangements. Meanwhile, the public water company, KUKL, and state officials rely on this instability through the coping abilities and investments of households. Officials can profit from intermittent water supply through investments in or kickbacks from water tanker and bottle companies. Several engineers from the KUKL office also talked about how it is easier for them to leave pipes in a state of disrepair (more than 40% of piped water leaks) than make repairs. Residents have come to rely on water sellers and water saving techniques (Figure 5). Like other residents I spoke with, Sujata does not know her rights or the details of mismanagement, yet she recognizes systemic injustices in the city’s state of water insecurity.

When residents cannot rely on communal or private water suppliers, water provision is a household matter. In the Kathmandu Valley, Sujata and other household water managers play a critical role in sustaining urban life. This is because, in the absence of development, management, and regulation, the government has devolved its responsibilities of ensuring water access to companies, communities, households, and interpersonal relations. Given these conditions, experiences of water security vary within and between households over time, with some individuals better situated to address insecurities than others. Sujata, for example, has secondary rights to piped water and urban space as a renter. As reviews of water and infrastructure research show, Sujata’s situation

in Kathmandu speaks to broader issues of development and urban governance (e.g. Bakker & Morinville, 2013; Gerlak et al., 2018; McFarlane & Rutherford, 2008; Sultana & Loftus, 2015; Wutich et al., 2018; Zwarteveen et al., 2017).

Figure 5. A water tanker with the words, "Water water everywhere try to save it if you care" painted on its sides.

In this paper, I argue that understanding dynamic experiences of Sujata and her neighbors to thrive and survive under precarious conditions of urban development demands a relational approach (Elwood et al., 2017; Roy, 2009). As a helpful starting point I extend a relational approach to water security, which looks beyond the materiality of access to water towards questions of what people are securing with and through water, how, and why (Jepson et al., 2017). Water insecurity thus functions as a vehicle to understand the power relations which condition the possibilities of urban life and the subtle ways in which people subvert and transform those conditions. To perform a relational study of water insecurity, I developed and piloted a story-mapping technique which uses ethnographic methods to build spatial narratives.

Rationale

Building on feminist theory and Marxist dialectics, Elwood, Lawson, and Sheppard (2017, p. 758) articulate a geographic approach to relationality for understanding poverty as

> 1) a [socio-spatial] ontological stance in which spaces and subjects are constantly crystalized, remade, grounded, assembled, and transformed
>
> 2) an epistemological stance that integrates multiple causal processes as they interrelate differentially across time and space and sees explanations as always spatialized
>
> 3) a politics of possibility emerging from challenges to existing knowledge hierarchies, expanding the sites and subjects that produce knowledge, innovation, and transformation, engaging in learning across boundaries and pursuing forms of academic activism that make space for these practices

I draw on this theorizing to extend the potentials of a relational approach to water security. First, water (in)security is more than a matter of hydrosocial relations or relations between people or societies and water, but following Harvey's (2010, p. 195) reading of Marx, is constituted through a dialectic framework of technology, relations to nature, mental conceptions of the world, social relations, modes of production, and reproduction of daily life. Second, following Massey (1994), water security is more than a set of experiences in place (e.g. the household, city, or country) or of a culture, but fundamentally a socio-spatial process that is in flux. Third, understanding the constitution, reproduction, and transformation of water security demands methods that do more than measure, compare, and individualize but engage in creative boundary-crossing processes of learning and building knowledge. On this note, I turn to the possibilities of ethnographic techniques.

Ethnography, generally, is a "methodological and practice-based approach to understanding and representing how people – together with other people, nonhuman entities, objects, institutions, and environments – create, experience, and understand their

worlds" (Till, 2009, p. 626). Ethnographic approaches are diverse but often draw on multiple methods through an iterative, reflexive, and interpretive process that attends to the construction of a text about the world (Crang, 2005; Till, 2009). Because of the ways ethnographies unfold, the approach is well-suited to examining situated knowledges, lived experience, and the everyday: "the messy and fleshy" (Katz, 2001) realities of daily practices which make the world (Loftus, 2012). While ethnographies attend to the chaos of living they are not necessarily relational, which is why Desmond (2014, p. 574) argues for a relational approach "that takes as its object configurations of connections, transactions, and unfolding relations" rather than distinct groups, places, and preconceived categories. A relational approach for studying water security, poverty, and development (Desmond, 2014; Elwood et al., 2017; Hoffmann & Metz, 2017; Jepson et al., 2017), demands a relational ethnographic approach.

To build this relational approach, I take inspiration from the contributions of Gibson-Graham (2008, 2014) on the role of ethnographies of everyday life for rethinking the economy around the ways people make-do, build a future, and juggle different values. In writing about the details of life and living, ethnography is simultaneously a text and mode of theoretical development. For Gibson-Graham (2014) who draw on Geertz, ethnography is more than a way of seeing the world, but a performative ontology. Gibson-Graham engage with the tension between describing the nuances of everyday life and explanation of theory about the larger forces to make small facts speak to large concerns and make room for multiple realities and possibilities. As a mode of explanation and theoretical development, ethnographies attend to the relations involved in the movement and re(production) of knowledge, power, and place (Roy, 2012; Till, 2009).

Ethnographic studies are particularly well suited to relational studies of water security and other forms of resource struggles and vulnerability. In the field of water security, ethnographic scholarship "describe[s] the intersecting factors shaping the lived experiences, water-related health concerns, household coping mechanisms, and cultural roles and knowledges involved in water insecurity at individual, household and community levels" (Wutich et al., 2017, p. 5). Within political ecologies of water and water infrastructure, ethnographies build narratives about how people and groups relate to water in their daily lives and negotiate how others interact with water in its multiple forms and meanings (Anand, 2017; Buechler & Hanson, 2015; Drew, 2013; Hastrup & Hastrup, 2015; Mcfarlane, Desai, & Graham, 2014; Rademacher, 2015; Ranganathan, 2014; Truelove, 2011). Those narratives, moreover, often challenge and rewrite prevailing narratives about development and environmental change. For example, research into the lived experiences of water access has challenged prevailing discourses about water security all too often see households as percentages of a population lacking certain kinds of water access rather than agents of change (Buechler & Hanson, 2015; Loftus, 2015; Meehan, 2014). Studies of water moreover show that issues of water access and infrastructure development are more than concrete and metal, but that the material environment can be read as texts (Banister & Widdifield, 2014; Furlong & Kooy, 2017; Molden & Meehan, 2018).

Reading at the intersections of ethnography, political ecology, and relational approaches this dissertation engages in a critical reflection of the research process as a form of narrative-building. Arguably, the process of research is one of reading and writing texts (Crang, 2005; Dixon, 2010; Robbins, 2012). Text and narrative are critical to ethnographic

techniques of writing up and describing field observations and encounters (Hinchman & Hinchman, 1997; Ingold, 2011; McAlpine, 2016; Moen, 2006). Narratives are systems of stories, which bring together multiple characters, plot lines, and settings to create a socially meaningful whole. Because narrative is central to experience, forms of narrative inquiry have been central to the social sciences (Polkinghorne, 1988; Riessman, 2008).

In geography, ethnography, discourse analysis, and cartography speak to the critical role of story and narrative in the discipline broadly. Following the cultural turn in geography, story, and more fundamentally discourse, became a site to examine entanglements of power, knowledge, and space (Cameron, 2012); for example, Gregory (1994, 1995) drawing on Said's imagined geographies has critically examined narratives of exploration, war, and colonialism to reveal imaginative geographies of Orientalism. However, with a proliferation of story and story-telling in geographic research since, Cameron (2012) outlines the role and future of narrative in geography. In response to Cameron and the growing interest around the geohumanities and promises of story, this dissertation innovates the role of spatial narrative in geography.

To elicit a critical understanding of water relations, this dissertation innovates the story-map technique as a means of ethnographic writing from observation, interviews, and document analysis. I argue that story-mapping is a mode of research, centered around the construction, analysis, and representation of geovisual narratives. I explain the process of story-mapping in my research below in the objectives (Table 1) and Figure 6. The story-mapping procedure allowed me to work with participants to build narratives about their experiences using photographs, maps, and text from interview transcripts and observational notes collected over our meetings from the dry to wet seasons. By directing attention to the

construction of spatial narratives in the research process, story-mapping provides both a tool and heuristic for performing research about human-environment relations. As Ingold (2011, p. 160) argues, "stories always, and inevitably, draw together what classifications split apart." In other words, telling stories and constructing narratives helps to make sense of the relationships between people and objects in motion over time and space.

Narrative-building as Research

Narratives are a system of stories where events are organized into a plot or structure (Adger, Benjaminsen, Brown, & Svarstad, 2001; Wiles, Rosenberg, & Kearns, 2005), be that visual, textual, auditory, or other means of communication (Riessman, 2008). Narrative is fundamental to experience and by extension, knowledge because we can only "understand the nature of things only by attending to their relations, or in other words, by telling their stories" (Ingold, 2011, p. 160). In parallel, Cronon (1992, p. 1349) argues that historians tend to tell stories as a way of telling history because "narrative is the chief literary form that tries to find meaning in an overwhelmingly crowded and disordered chronological reality."

For geographers, narrative helps find meaning in a messy spatial reality. For example, maps (in all expressions) are narratives while the process of mapping is central to story-telling spatial knowledges and meanings (Caquard, 2011; Chen, 2013). Creative interventions (Dixon et al., 2012), participatory mapping (Hohenthal, Minoia, & Pellikka, 2017; McLees, 2013), mapping narrative (Caquard, 2011), eliciting narratives (Adger et al., 2001), narrative theory (Ryan et al., 2016), poetic analysis (Steacy, 2017), narrative analysis (Gergan, 2016; Paschen & Ison, 2014), and analysis of literature (Wenzel, 2006), are examples which illustrate the diverse role of narrative and story in human-environment

geographies.

The rise of interactive digital mapping and spatial story-telling through applications, like Odyssey, Esri Story Maps, MapStory, or Story Map JS, opens possibilities to attend to narration of spatial knowledge in research. These tools are often employed for education and learning, disseminating findings, data visualization, communicating information, or sharing a personal story (Antoniou et al., 2018; Baker, 2015; Berendsen, Hamerlinck, & Webster, 2018; Caquard & Fiset, 2014; Egiebor & Foster, 2018; Szukalski, 2018). In addition, these applications can facilitate the digitization and analysis of spatial information, and thus feature heavily in the Digital GeoHumanities (Crang, 2015; Dear, 2015). Many of these online tools are free (albeit often within certain parameters or institutional licenses) and are easy to learn, making story maps popular for student learning and public engagement, for example with citizen science projects (Egiebor & Foster, 2018; Janicki, Narula, Ziegler, Guénard, & Economo, 2016; Kerski, 2015). Taking a cue from collaborative and educational uses of Story Map tools, I use these tools to support the process of performing story-mapping as a research.

The role of narrative in research, however, is often framed as an input or output of the research process, for example, a mode of public engagement, data for analysis, or anecdote (Atkinson & Delamont, 2006; Cameron, 2012). For Cameron, geographers need to do more than incorporate story, particularly following Braun's (2008, p. 674) provocation about how to "evaluate and reflect upon our *narration*" about personal experience. By examining geographic work at the boundaries of story Cameron (2012, p. 586) argues, "geographers would do well to sharpen their abilities to critique each others' stories, not just on the grounds of what those stories represent (and distort), but also for the

becomings such stories might nourish, and those which they might undermine." As Gibson-Graham (2008, 2014) argue, the stories we engage with and the stories we tell are powerful and productive of alternative realities.

Such arguments lie at the heart of political ecology's definition as a kind of text (Robbins, 2003). Political ecology texts challenge and rewrite dominant narratives about human-environment interaction. Robbins (2012, p. 98) sees text and narrative as powerful because "all of us think in texts" and "radical changes in the terms of a debate, in the images associated with an idea, or in the making intuitive the counter-intuitive, are all the work of text." Nevertheless, research practices all too often focus on the role of narrative as a site of analysis, form of data or anecdote, or mode of representation via public or academic dissemination (Caquard, 2011; Paschen & Ison, 2014; Ryan et al., 2016).

To construct and co-produce spatial narratives of water insecurity with Kathmandu participants I utilized a story-map technique. The Story Map is a geovisual tool, developed by Esri, that allows users to integrate text with online interactive maps or other visual and auditory mediums (depending on the application). This dissertation is one of the first in Geography to use the Story Map as an ethnographic research tool. While Story Map technology has been used in instructional settings and to illustrate anecdotes and stories by public users, my development of the technique as a *research tool* is the among the first efforts in the social sciences and humanities.

This paper forwards story-mapping as a systematic process of narrative building which attends to the co-production of knowledge, both in terms of the ways researchers create a text from participant engagement and stories (Caretta & Riaño, 2016) and the ways those texts express ideas of what is and what ought to be (Jasanoff, 2004). In these ways,

story-mapping is a systematic process of narrative building which attends to the construction and representation of spatial knowledge between researcher and participant. In these ways, story-mapping overlaps with the goals and procedures of participatory mapping, participatory photo mapping, and photovoice (Dennis, Gaulocher, Carpiano, & Brown, 2009; Hohenthal et al., 2017; McLees, 2013). Here story-mapping brings together photographs, stories, and participant feedback to examine experience over time and space with the goal of creating a socially meaningful geovisual narrative. Additionally, through this iterative and reflective process of narrative building story-mapping attempts to unlearn water security (Lawhon, Ernstson, & Silver, 2014; Leitner & Sheppard, 2016; Sundberg, 2014). Story-mapping is thus both a *dialogue* and *doing* (Hawkins, 2011).

Story-mapping aims to 1. Iteratively synthesize the collection, analysis, and representation of spatial, visual, and textual information as a narrative, 2. Facilitate participation of research participants throughout the project, and 3. Generate a visually compelling product that facilitates cross-cultural learning and general comprehension of the research. Below, I present the step-by-step procedures for story-mapping based on my research.

Research Procedures

To develop spatial narratives—as opposed to individual narratives—I moved between spaces of water production, distribution, and use: including households, streets, offices, and water processing facilities. Understanding the water work of people like Sujata's requires understanding the processes and actors which mediate water flows and norms of use. As such, I followed water flows between users and sources. This led me not only to distant reservoirs and treatment centers for piped water, tanker water, and bottled

water, but it also led me to offices throughout the Valley (Figures 6 and 7). In these movements, I attend to the relational experiences of individuals and situate those experiences within a larger web of spatial relations.

Figure 6. During the monsoon, I visited a site where one participant goes to order a tanker from KUKL.

Figure 7. I also followed the flows of Lalitpur's piped water supply from its sacred source, to reservoir, to treatment facility, to various offices which manages KUKL water, and key openings along the pipes.

Additionally, I immersed myself within Patan and the city. I moved from my family's home along the slopes of Godavari where the locally managed water supply is plentiful to live with a family living in a newer home on the periphery of town by the Bagmati River. Here, I paid for a water tanker, accidentally emptied the storage tank, watched rainstorms from the roof, drank jar water, and listened to my host complain about the water situation. Water ran out several times and piped water sometimes came once a week, but my hosts said they only collect around 200 to 300 liters.

I returned to Godavari several times to meet with tanker companies. I did so because many people I met with buy their jar and tanker water from companies that say they collect from Godavari's sacred spring and fresh forest water, or *kunda* (Figure 8). I found out that several tankers were pumping water from the lake below the *kunda,* which is full of trash and soap suds from public bathing and laundry. Locals here complained that the tanker companies and downstream towns kept putting their pipes at sources higher up the Pulchowki Hill and taking of the mountain spring water.

Figure 8. The Godavari *kunda* or sacred spring and the lake below where tanker companies have inserted their pipes for collection.

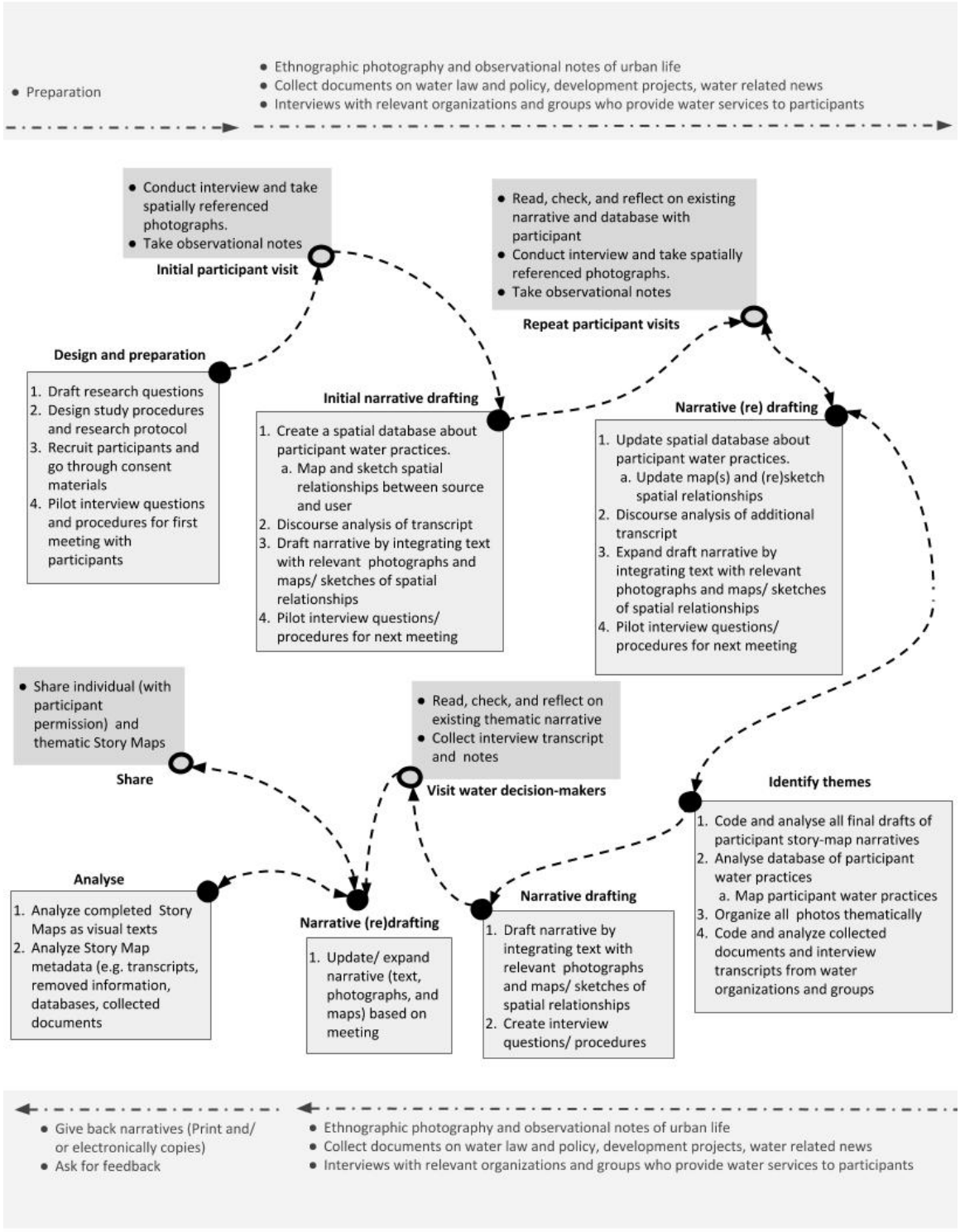
Between my visits to households, offices, and water sites, I would walk around, taking photographs and notes about my observations about the city's changes. Even when I rode in the microbus back up to Godavari I listened to gossip about water. From restaurants

to stores, it seemed that chitchat about the city's *paani ko samasya* or "water problem" was as ubiquitous as small talk about the weather. Gossip about piped water supply was especially popular; I heard plenty of gossip about neighborhoods that receive more tap water, farmers cutting pipes, people beating or bribing the "key man" who opens the pipes, and secret handshakes between water suppliers and industries. It is this kind of talk which informs Sujata and other residents about the schedule of piped water delivery and the completion status of "Melamchi," the government's long-standing promise of a new water grid system that will "wash the roads clean" with mountain water from the Melamchi River. As the government waits for Melamchi to arrive, it has done little to address existing water infrastructures. In these movements, I found water stories everywhere.

Medium: Using Story Maps for Spatial Narratives

The development of the story-map technique is inspired and shaped by participatory methods, feminist research, and geovisual tool development (Antoniou et al., 2018; Berendsen, Hamerlinck, & Webster, 2018; Sébastien Caquard, 2011; Dennis, Gaulocher, Carpiano, & Brown, 2009; Egiebor & Foster, 2018). Using the Esri Story Map interface, I incorporated different perspectives of hydrosocial relations from multiple methods to create a narrative. Working with household water managers, I built narratives with participants about their water relations. To draft individualized narratives, I synthesized interview transcripts, photographs, observational notes, and spatial references after each meeting with a participant. As I outline in Figure 9, drafting story-maps took place in several stages with household and institutional participants (Table 1).

Figure 9. Flowchart of story-map decisions and procedure.


• Preparation
• Ethnographic photography and observational notes of urban life
• Collect documents on water law and policy, development projects, water related news
• Interviews with relevant organizations and groups who provide water services to participants
Design and preparation
1. Draft research questions
2. Design study procedures and research protocol
3. Recruit participants and go through consent materials
4. Pilot interview questions and procedures for first meeting with participants
Initial participant visit
• Conduct interview and take spatially referenced photographs.
• Take observational notes
Initial narrative drafting
1. Create a spatial database about participant water practices.
a. Map and sketch spatial relationships between source and user
2. Discourse analysis of transcript
3. Draft narrative by integrating text with relevant photographs and maps/ sketches of spatial relationships
4. Pilot interview questions/ procedures for next meeting
Repeat participant visits
• Read, check, and reflect on existing narrative and database with participant
• Conduct interview and take spatially referenced photographs.
• Take observational notes
Narrative (re) drafting
1. Update spatial database about participant water practices.
a. Update map(s) and (re)sketch spatial relationships
2. Discourse analysis of additional transcript
3. Expand draft narrative by integrating text with relevant photographs and maps/ sketches of spatial relationships
4. Pilot interview questions/ procedures for next meeting
Identify themes
1. Code and analyse all final drafts of participant story-map narratives
2. Analyse database of participant water practices
a. Map participant water practices
3. Organize all photos thematically
4. Code and analyze collected documents and interview transcripts from water organizations and groups
Narrative drafting
1. Draft narrative by integrating text with relevant photographs and maps/ sketches of spatial relationships
2. Create interview questions/ procedures
Visit water decision-makers
• Read, check, and reflect on existing thematic narrative
• Collect interview transcript and notes
Narrative (re)drafting
1. Update/ expand narrative (text, photographs, and maps) based on meeting
Analyse
1. Analyze completed Story Maps as visual texts
2. Analyze Story Map metadata (e.g. transcripts, removed information, databases, collected documents
Share
• Share individual (with participant permission) and thematic Story Maps
• Give back narratives (Print and/ or electronically copies)
• Ask for feedback
• Ethnographic photography and observational notes of urban life
• Collect documents on water law and policy, development projects, water related news
• Interviews with relevant organizations and groups who provide water services to participants

Nita and I met with household participants over the course of Nepal's winter (February-March), spring (May-April), summer/ monsoon (June-August), and autumn/festival (September-November) seasons. With each meeting, we transformed the narrative about the participant's water world based on our discussion about the existing storyline and added to the narrative with new insights. Here, narrative content does not necessarily come from narrative elicitation, but a folding together of different texts, some of which are stories. By the last meeting, we organized narratives into three sections: water practices over the time we met, memories of the past, and thoughts about the future. Additionally, by building the narrative iteratively over time, descriptions of the built environments, things, practices, and imaginings which constitute places become dynamic forces in the narrative.

In these ways, I 'mapped' the story-map content, organizing the narrative by spatial and temporal relations, supplemented by photographs of places and objects alongside mental maps and grid maps for visualization of spatial relationships (Caquard, 2011; Ryan et al., 2016). Figure 10 is an example of a database of participant water practices. Figures 11, 12, and 13, provide examples from Sujata's story map.

	A	D	E	F	G	H	I	J	K	L	M	N	O	P
1	No.	Description	Name	Source	Management	Distribution	Technology Type	Modification	Function	Use	Years of use	Cost per unit	Capacity per unit accessed	Cost per mor
2	0	Black tank outside	Tanki	KUKL	Household	Self	Plastic tank		Storage	Storage in case of scarcity	4	-	200 liters	0
3	1	Household well	Inar	Groundwater	Household	Pipelines	Well	Pump	Source	Water source	10	20000	1000 liters	0
4	2	Rainwater barrels	Akash ko pani	Rainwater	Household	Pipelines	Plastic tank	Lye	Source/ Storage	Cleaning and sometimes wa	10	1300	400 liters	0
5	3	Cement reservoir	Reservoir	KUKL/ Tanker	Household	Pipelines	Underground tank		Storage	Reservoir	10	-	6000 liters	0
6	4	Rooftop distributio	Tanki	Groundwater	Household	Pipelines	Plastic tank	Lye	Storage	Cleaning, bathroom, laundry	10	11000	1000 liters	0
7	5	Rooftop distributio	Tanki	KUKL/ Tanker	Household	Pipelines	Plastic tank		Storage	Drinking, cooking, bathing	10	11000	1000 liters	0
8	6	Water filter	Euroguard	KUKL	Household	Self	Filter		Filter	Drinking and cooking	5	4000	-	-
9	7	Pipeline meter	Dhara	KUKL	KUKL	Pipe network	Grid	Pump	Source	Water source and gardening	4	150	300 liters	150
10	8	Tanker	Tanker	Tanker	Company	Tanker	Tanker		Source	Water source	7	1300	6000 liters	1300
11	9	Dhunge dhara	Washa hiti	Stone Spout	Community	Self	Stone spout	Filter	Source	Water source	19	30	40	120
12	10	Household well	Inar	Groundwater	Homeowner and n	Self	Well		Source	Water source	19	0	18 liters	0
13	11	Filter	Filter	KUKL	Household	Self	Filter		Filter	Drinking and cooking	-	-	-	-
14	12	Buckets	Baitin	KUKL/ Dhunge Dh	Household	Self	Vessle		Storage	Drinking and cooking, and tl	-	-	50-75 liters	0
15	13	Buckets	Baitin	Groundwater	Household	Self	Vessle		Storage	Toilet	-	720	15-20 liters	0
16	14	Barrel	Drum	KUKL	Household	Self	Plastic tank		Storage	Drinking and cooking, and tl	-	-	100 liters	0
17	15	Household tap	Dhara	KUKL	KUKL	Self	Grid	Pump	Source	Water source	19	0	54-72 liters	0
18	16	Jar	Jar	Store	Company	Self	Bottle	Filter	Source/ Storage	Drinking	3	50	20 liters	100
19	17	Washa hiti	Washa hiti	Stone Spout	Community	Self	Stone spout		Source	Water source	9	10	30 liters	40
20	18	Household well	Inar	Groundwater	Homeowner and n	Self	Well	Phit kiri	Source	Water source	8	0	90 liters	0
21	19	Buckets	Baitin	KUKL/ Dhunge Dh	Household	Self	Vessle		Storage	Drinking, cooking, and bathi	3-4 years	150	120 liters	220
22	20	Buckets	Baitin	Groundwater	Household	Self	Vessle		Storage	Toilet and laundry	3-4 years	0	85 liters	0
23	21	Pipeline	Dhara	KUKL	KUKL	Pipe network	Grid	Pump, cement pi	Source	Water source	10	25	60 - 100 liters	100
24	22	Washa hiti tap	Washa hiti	Stone Spout	Community	Pipe network	Grid	Pump, hose	Source	Everything	5	200	200-400 liters	200
25	23	Community tanker	Tanki	Tanker	Community	Hose	Plastic tank		Source	Everything	5	120	200 liters	300-400

Figure 10. Snapshot of a database of all participant water practices based on spatially referenced photographs and interview notes. Individual participants also have their own databases.

Figure 11. A section of Sujata's Story Map about her water situation in Asar (June/July)

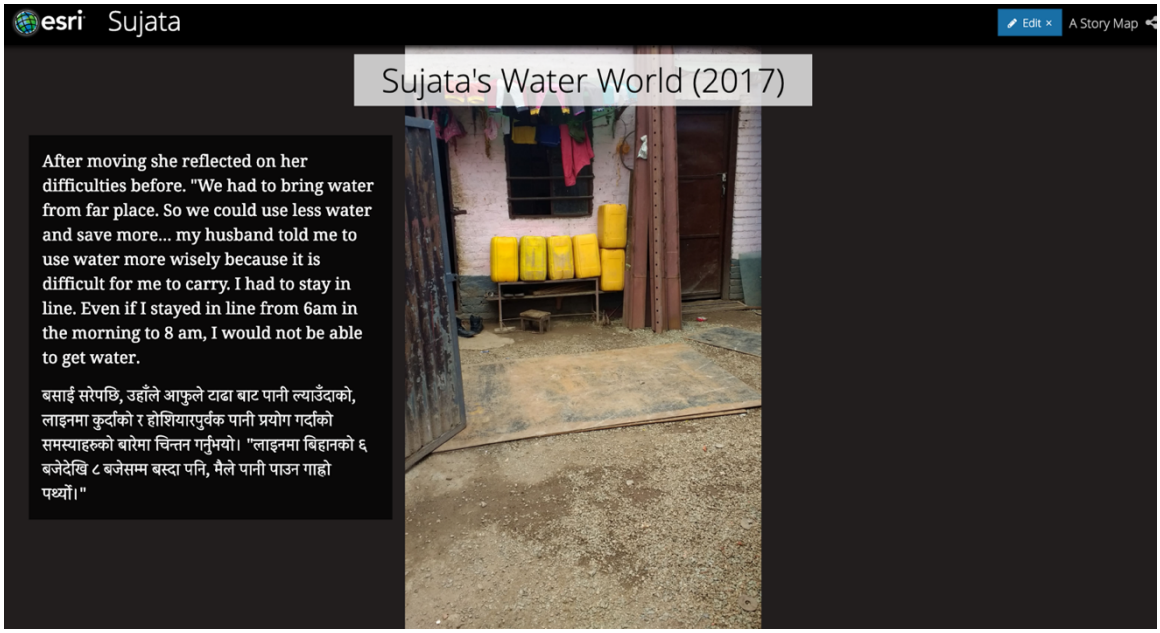


Figure 12. Another section of Sujata's Story Map about her water situation in Asar (June/July)

The purpose of constantly synthesizing visual, spatial, and textual information together reflected an attempt to see the "diversity economic, social, cultural and political subjectivities that comprise any one subject" (Cameron & Gibson, 2005, p. 325). Moreover, following the same research procedures and narrative style facilitated comparison between narratives to identify patterns and disparities. Analysis of individual

narratives in relation to the broader context of water and development in Patan provided content for thematic story-map narratives. I shared thematic story-maps with water supply and management experts and decision-makers to gather feedback and perspectives on our preliminary findings as an interview technique. In these ways, the story-mapping processes enable a means of sorting through the rich tapestry of water worlds between household water managers, urban water providers, and development efforts.

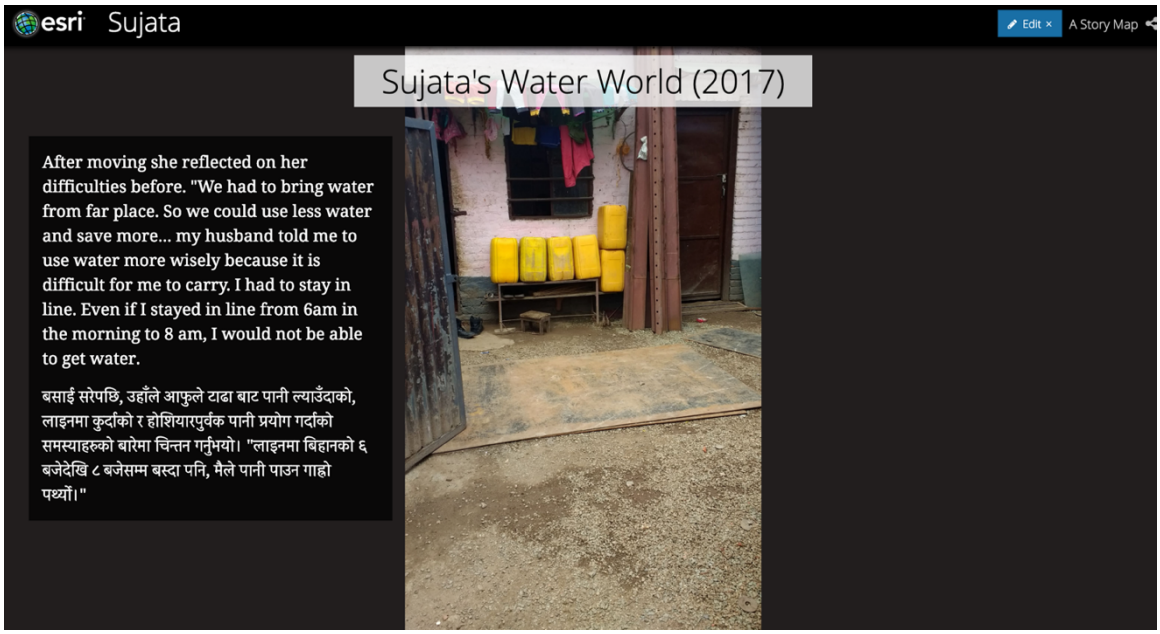


Figure 13. A section of Sujata's Story Map about the role of the government.

Latour (1999) in his study of soil science in the Amazon writes about the translations that occur in research from sampling to publication – the systematic forms of abstraction that as, Jasanoff (2000) explains, create representations of reality. The process of building story-maps, by extension, emerges through a series of translations. Translations occurred through notepads, recorders, computers, and the digital interfaces of ArcGIS online and the Esri Cascade Story Map App. In these translations, information transforms as it moves from a recorder to word document to Story Map to analysis software or from notes to databases to maps. By creating a structure for building narratives, the process aims

to make these translations more legible to both participant and researcher. Nevertheless, the medium of the message, including all the digital and physical interfaces involved in translating information, can limit certain kinds of expression, and reproduce particular world views (Crang, 2015; Elwood & Leszczynski, 2018). Future applications of the story-mapping technique thus can make room for alternative modes of crafting spatial narratives.

Other translations occurred on a more interpersonal level. For example, through the processes of language translation and exchange between myself, Nita, and participant as we tried to understand each other. Story-mapping is thus the product of subjective and place-based negotiations between participant, assistant, and researcher. Future applications of story-mapping could involve participants with the creation of research goals or more directly in the crafting of narratives (Lane et al., 2011). Regardless, questions of representation in the construction of narrative remain critical, especially given power differentials between research actors (Caretta & Riaño, 2016).

The Setting and Characters: Unit of Analysis

Research participants included two main groups of people: institutional actors and household users. Participants include 31 people I think of as water brokers or institutional water managers. These are individuals who are influential in the city's waterscape: decision-makers, experts, managers, policy-makers and water providers from non-governmental, governmental, community, and private groups. By physically turning a pipe key, setting schedules, owning or filling tankers, managing a water tank, or proposing new policies and projects, the individuals I met with worked for themselves, groups, and/in projects in ways which influence the movement and use of water between households.

I identified these water brokers or institutional participants from snowballing

techniques where I found the names of groups and contact information of individuals from household participants or other institutional participants. I also identified people and groups from a literature review of Kathmandu's water policy and existing research. Connections and knowledge from my master's research helped me make connections and build rapport. I recruited these participants via email and phone. I ended up meeting many of them multiple times to conduct follow-up interviews to gather more information on an issue that came up during my interviews with other participants. I also met a select group of influential decision-makers in institutions at the end of the research process to share preliminary research findings as an interview technique and means of gathering feedback.

Household water managers were a second focus. As feminist research shows the intimate spaces of everyday life are not just embedded within larger political and economic processes, but both productive and subversive of them (Buechler & Hanson, 2015; Elmhirst, 2011; Gibson, Head, & Carr, 2015; O'Reilly, 2006; Sultana, 2011; Truelove, 2011). By starting the story-mapping process from within the home, I examine the taken-for-granted and concealed labor of people in their daily lives who bear the burden of providing fundamental services that the government fails to provide. Doing so, story-maps tells a story of water security that moves between the private and public and the personal and collective. As Cameron (2012, p. 574) explains, "stories express something irreducibly particular and personal, and yet they can be received as expressions of broader social and political context, and their telling can move, affect, and produce collectivities."

I recruited household participants within a 1 to 1.5 km radius from Patan's central square. Doing so, I focused my research within one urban area and a government water distribution area. The purpose of focusing research within one area facilitated

understanding the diverse tactics of urban living (Robinson, 2011; Roy, 2015). The 47 individuals that remained in the study throughout the year are a diverse group (34 women, 13 men; 33 Newa homeowners or "locals", 14 migrants who rent or "renters") and fall between some of the wealthiest and poorest residents (Figure 14). In all their dynamic experiences and complex subjectivities, participants of the study make up the diversity of urban life that is the Kathmandu Valley.

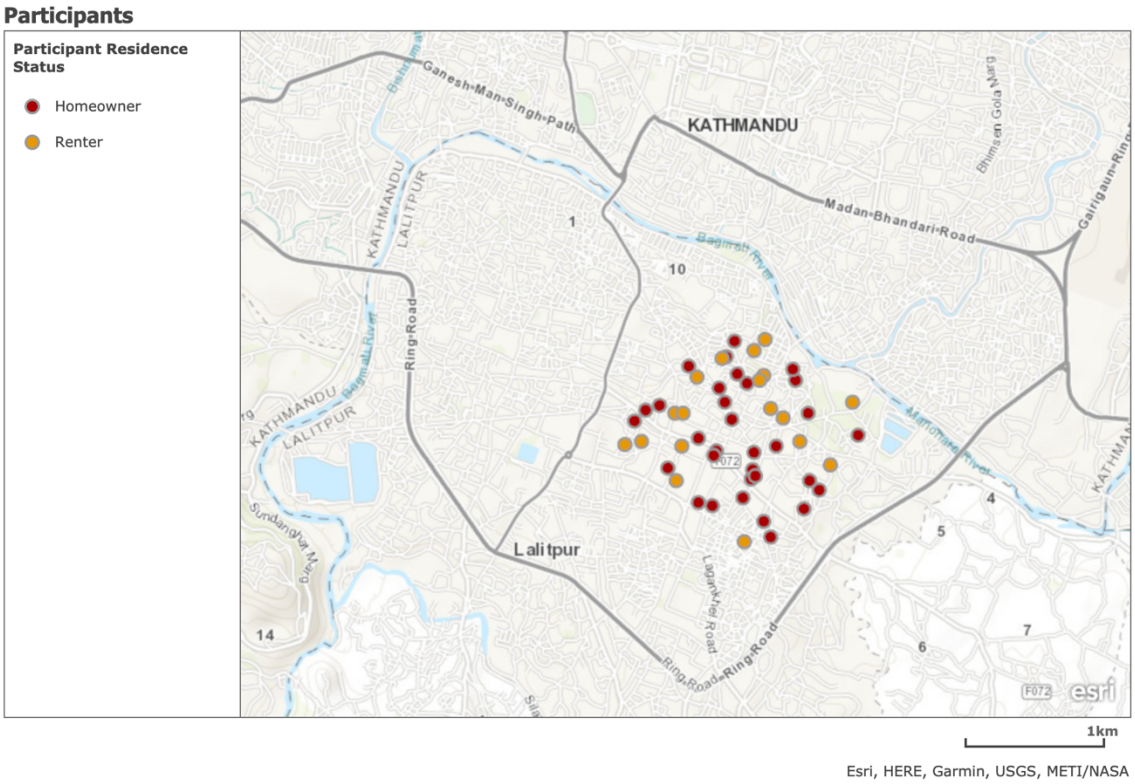


Figure 14. Map of the study area and household participants by homeownership status.

To build a relational understanding looking within the household or office is not enough given the far-reaching interdependencies between individuals, institutions, and places. As a result, my research took me to offices all over the Kathmandu Valley and key water distribution sites, such as Lalitpur's main reservoir. Gaining a greater understanding of this larger context is critical and not just as background information. Mapping out these

interconnections between individuals, institutions, and larger socio-environmental environment helps to reveal the conditions which create unevenness and disparity in the experiences of water security.

Plot and Content: Building Narratives in Phases

Existing literature states that water relations in Kathmandu vary seasonally. As such, I divided research into four phases: 1) winter, 2) summer, 3) monsoon, 4a) fall for story map finalization and 4b) meetings with decision-makers (Figure 9). After the first phase, we generated a first narrative draft in Esri's Cascade Story Map app. That narrative transformed in structure and content with each phase. For each phase, my research assistant, Nita, and I would prepare the same interview questions and procedures for all participants to ease comparison. We piloted techniques and instruments before each phase with one family, who would provide us with feedback so we could make changes before meeting participants. I used Esri Story Maps because of prior experience; however, it is also possible to use other tools which fold together different representations of temporal and spatial experience.

The first phase created the base narrative structure from collected photographs with spatial reference points, observational notes, and interview transcripts. During or after interviews, participants would show us what water places and objects to photograph, or if they felt comfortable to take photos themselves. The first draft included information from interview questions about the participant's current water situation, water routines (e.g. collection, storage, and treatment practices) and what they would like to do about their water situation.

The story-mapping technique created a structure for making sense of the

information gathered. As I processed observational notes, spatial data points, transcripts, and photographs I organized information into folders, databases, maps, documents, and Esri's Story Map App for each participant. To build databases I extracted spatial locations from photographs, organizing information by sources and storage units per participant into a database for analysis and visualization in ArcGIS. However, as participants could not easily read maps, I would also sketch these spatial relations. I then embedded text, sketches, photographs, and maps into the Story Map App as a draft narrative that introduced the person, their water situation, and water practices. While doing so, I took note of items for careful review and clarification. Following consent and recruitment materials, we filtered information inputted into story map drafts under the assumption that with permission we may share the story map. Working with the tools of story map applications aided in the organization, analysis, and representation of information into a narrative.

Over research phases, we reviewed draft narratives with participants and added to the storyline. First, Nita would go through the existing story map and ask for feedback, including specific questions I had noted for clarification. I would take notes of what needed to change. After review, we asked participants about their current water practices, what had changed since our last meeting, and then a set of new questions. In phase two, we asked in-depth questions about water practices, memories, hopes, and worries. In phase three, we incorporated scenarios, hypotheticals, and talked more generally about the past and future. With each meeting, we expanded notes, databases, maps, sketches, and files of photographs and collected documents. The following figures (15-18) further illustrate these story-map components.

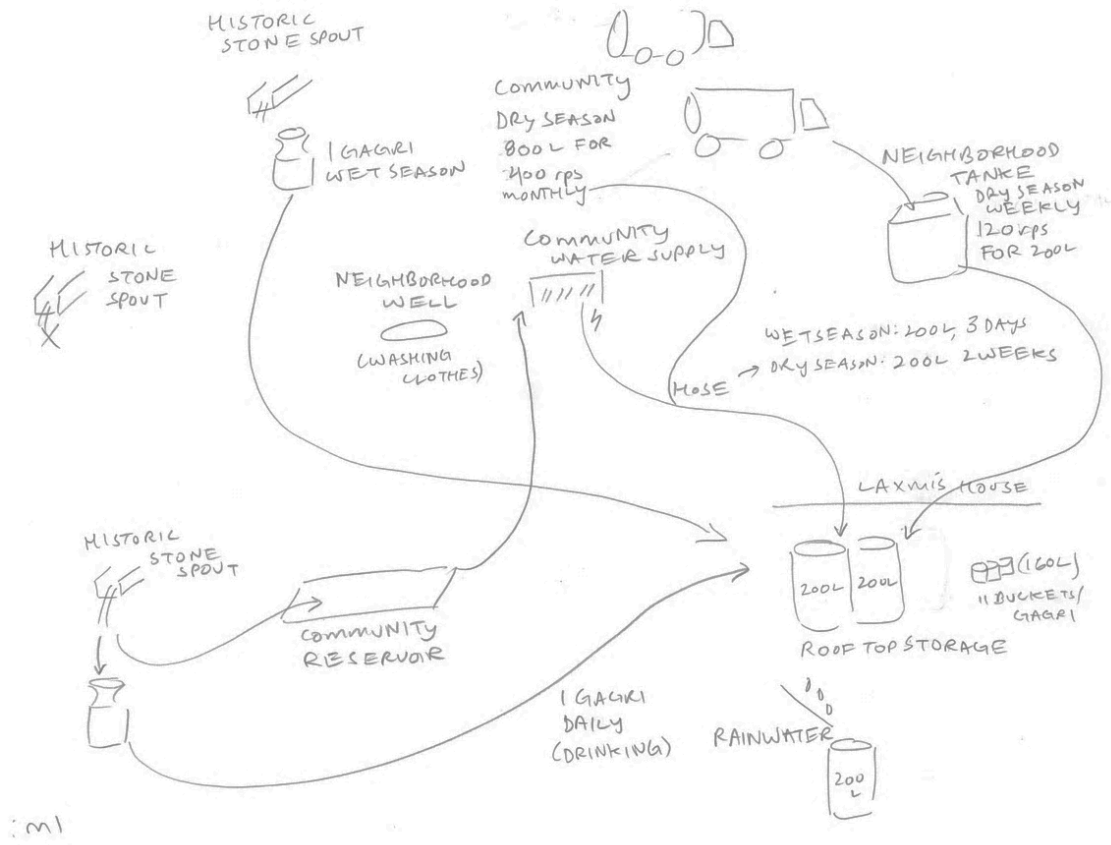


Figure 15. Sketch of participant water practices for the story-map narrative

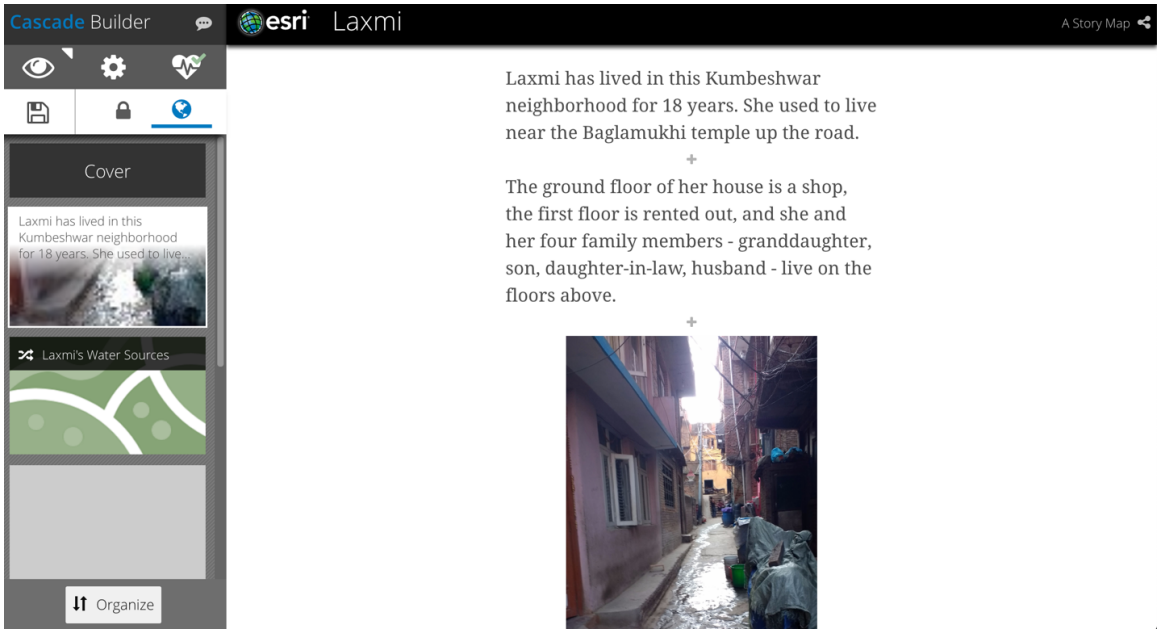


Figure 16. Introduction to a participant's story-map narrative

The purpose of iteratively synthesizing visual, spatial, and textual information

together reflected an attempt to see the “diversity economic, social, cultural and political subjectivities that comprise any one subject” (Cameron & Gibson, 2005, p. 325). For future research, story-mapping can incorporate other methods and frameworks to add depth to narratives. Additionally, there is room for greater involvement of participants in the creation of narratives.

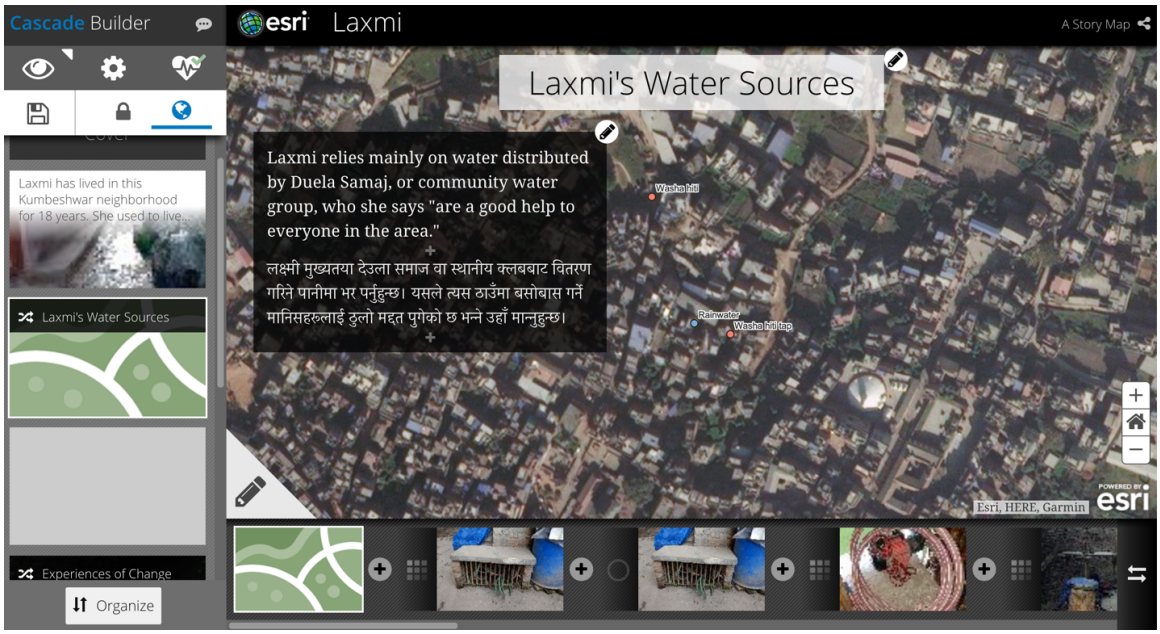


Figure 17. Narrative section about a participant’s water situation during the research period

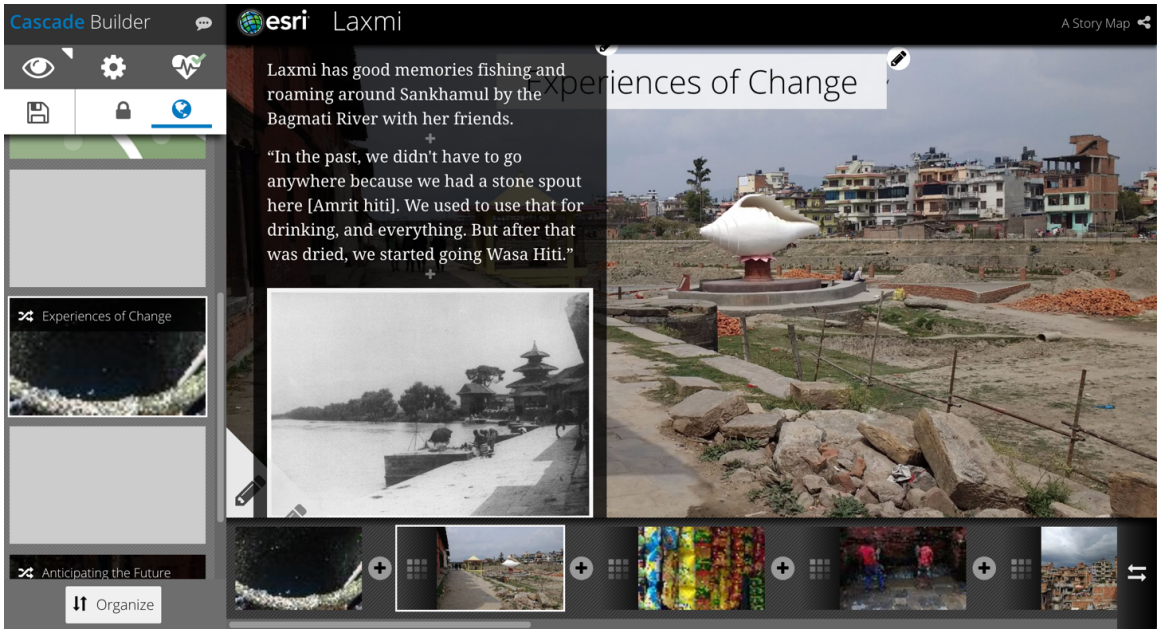


Figure 18. Narrative section about a participant’s experiences of change

Representation: Sharing Narratives

With the information collected from the dry to wet seasons, we asked for their feedback on the final draft of their private story map during the fourth phase. We also asked if we could share the narrative after making suggested revisions. If they agreed, I provided them with a URL link. I also handed all participants printed copies of individual and thematic story maps. With the rise of smartphones and internet access, many participants were familiar with reading digital material. However, reading ability – text or map – is an important consideration for story-mapping and future applications should consider other modes of communication, like participatory video or performance, so long as they are suited to the study population.

During the fourth phase, I also created thematic story maps. Thematic story maps drew on preliminary findings from the comparison of participant narratives and aggregated databases, interviews with water providers, and relevant collected documents, such as news articles, research articles, and institutional reports, policies, and procedures. I shared these with participants and used them during interviews with individuals working in government, non-governmental, inter-governmental, and academic posts who influence water provision and management. These interviews disseminated findings while also gaining perspective and added contextual information from more powerful water brokers in the study landscape. The multiple research sites and stages, moreover, helped me understand place and experience "as ongoing and in process" (Hawkins, 2015b, p. 252).

Story maps, thematic or individual, are texts for both dissemination and analysis. They are also open narratives, which can be supplemented or transformed. Moreover, the metadata of story maps or the objects, places, practices, perceptions, feedback, draft

iterations, and databases which make up the narrative are sites for analysis. In these ways, story-mapping is a research process, product, and source of information for analysis.

To view participant and thematic Story Maps created from this research process please go to omolden.blogspot.com.

Conclusion

Narratives are social phenomena, not social facts (Atkinson & Delamont, 2006, p. 202). Performing research as narrative-building with the tools of story maps attend to the ways knowledge emerges, translates, and travels in relation to its social contexts. Here, the characters, plot and content, and medium are all critical aspects of story-mapping. First, the iterative process of building story-mapping demands critical reflection into the production of narrative between researcher, assistants, and participants, especially with issues of translation and power relations. Second, story-mapping synthesizes information into a storyline which folds together visual (photographs, maps, sketches) and textual (quotes, description, explanation) information from multiple methods over time to add depth to the representation of experience and place. Third, the medium of the message (ArcGIS and other digital interfaces) shapes the construction and representation of stories (Crang, 2015; Elwood & Leszczynski, 2018). Because digital interfaces can limit ways of being and knowing the world, there is room for experimentation with other mediums and processes (Caquard, 2011; Elwood & Hawkins, 2017; Elwood & Leszczynski, 2018; Hawkins, 2015; Yeh, 2015).

CHAPTER III

THE PAIN OF WATER: A HOUSEHOLD PERSPECTIVE OF WATER INSECURITY AND INEQUITY IN THE KATHMANDU VALLEY

This chapter includes a previously published article with co-authors Anoj Khanal and Nita Pradhan. The article is not yet in print but available online at,

https://iwaponline.com/wp/article/doi/10.2166/wp.2018.116/64169/The-pain-of-water-a-household-perspective-of-water

Olivia C. Molden, Anoj Khanal, Nita Pradhan; The pain of water: a household perspective of water insecurity and inequity in the Kathmandu Valley. *Water Policy* wp2018116. doi: https://doi.org/10.2166/wp.2018.116

Introduction

Uma, a middle-aged woman, dreams of leaving Nepal's Kathmandu Valley to be in a village where there is flowing water. Like many residents, she summarizes the city's situation as "*paani ko dukkha"*: a painful struggle for water. After her marriage she moved from the periphery of the Valley to a central urban area, Patan; often also called Lalitpur, Patan is just south of the capital, Kathmandu. Like most residents of the Valley, she faces growing water insecurities. Although her neighbours receive tap water, Uma does not have access to the main water grid system. About 6 times a day she walks to a community-run water source to fetch 15 liters of water. For 90 liters of water, she pays 80 Nepali rupees (NPR) (around 1 US dollar). This is a challenging task; as she explains, "even when it rains, I have to go and get water and get all drenched. I have to carry water and walk. Now I am getting older and weaker." Uma is worried because groundwater is increasingly scarce, and she lacks affordable alternatives.

As stream flows and groundwater levels become more variable, over-tapped and contaminated (Salike & Fee, 2015; Saraswat, Mishra, & Kumar, 2017), urban residents like Uma worry about the future habitability of the Kathmandu Valley. Already, many households are not meeting their water needs: a recent study shows that the median total per capita water consumption in Kathmandu's households is below the United Nation's mandate of 50 litres per person per day for personal and domestic use (Raina, 2016). Moreover, a 2017 evaluation of water security in Kathmandu found that the public water company, Kathmandu Upatyaka Khanepani Limited (KUKL), provided much less than the 135 litres per person per day that the study recommends for economic growth (Thapa, Ishidaira, Pandey, & Bhandari, 2018). In the meantime, research continues to show that most water sources contain pathogens, heavy metals, ammonia, nitrates and other contaminants due to poor sewage and waste disposal (Udmale, Ishidaira, Thapa, & Shakya, 2016). As climatic changes impact rainfall dynamics (Salike & Fee, 2015) and current landcover changes decrease the Valley's recharge potential (Sangam Shrestha, Pradhananga, & Pandey, 2012), institutions face serious water management challenges to ensure residents meet their needs now and in the near future.

Peer-review literature, policy documents and institutional reports about the Valley's water situation tend to rely on data from surveys of households and water sources. While this quantitative perspective is critical to understanding overarching patterns of water supply, use and quality, there is a lack of understanding about the variety of ways in which people address water insecurity in their everyday lives. These diverse stories of resource access in everyday life are important for understanding both the drivers of resource insecurity and potentials for transformation at multiple scales (Carey et al., 2016; Furlong

& Kooy, 2017a; Hulme, 2011; Loftus, 2015b; Ranganathan & Balazs, 2015; Wutich & Brewis, 2014).

As such, this paper presents household perspectives of water security. It does so by drawing on the experiences of 47 household-level water managers over 2017's dry, pre-monsoon and monsoon seasons. These participants all live relatively close to each other in newer and older areas of Patan. The goal in recruiting participants was to understand everyday life in an urban area across demographics. Once recruited, the lead author created "story-maps" with participants over the year. Building story-maps requires constant participant feedback as photographs, maps and participant experiences are integrated into one story over time. The paper relates the adaptive strategies and framings of household-level water managers within the broader context of water management and policy in the Valley.

Analysis reveals several commonalities. First, although experiences of water security vary greatly between participants over time, household water options are increasingly limited; see Figure 19 for a schematic of the types of water systems that households access. These constraints appear through either cost and time investments in storage, additional water sources and treatment methods to ensure water is available for different tasks each week. Although wealth, household location, social networks and landownership alleviate these burdens to an extent, the burden – and stress – of managing water falls heavily on certain household members. Over time those burdens widen inequities and constrain the capabilities of families, neighbourhoods and communities to build and sustain water security.

The following section outlines the research methodologies and approaches that

inform this paper. To contextualize the study, the paper provides an overview of historic and contemporary water management issues in the Kathmandu Valley. From this background, empirical findings are presented in three sections. The first, illustrates the inequities of water access by detailing how households in the study secure water over the year, focusing on an example of piped water access. The second highlights the role of social connections and landownership in household water security. The third presents the burdens placed on households and particularly on certain people within households when coping with water access. Between these findings, the growing vulnerabilities and inequities between households, especially as water access becomes more variable and expensive, are emphasized. The paper concludes with policy responses to these insights.

Methods: Qualitative research insights

Prior to conducting this research, the lead author reviewed research publications on domestic water issues in the Kathmandu Valley. That review found that literature often describes patterns of water security based on the aggregated findings of large-scale surveys of households and assessments of water sources. However, there is a lack of information on the spatial and temporal variability of water security. Here, knowledge is produced within municipal and sometimes ward boundaries in-between either the dry or wet season. More fundamentally, there is a lack of in-depth research that investigates the drivers and experiences of water security in the Kathmandu Valley. Yet, examining complex environmental issues, such as water security, demands greater communication and integration between knowledge communities through multiple research approaches (Carey et al., 2013; Jepson et al., 2017; Klenk & Meehan, 2015; Loftus, 2015; Zwarteveen & Boelens, 2014). In the Kathmandu Valley, there is a need for more discussion based on

qualitative research insights, in addition to shared knowledge production between communities, institutions and researchers.

This paper primarily draws upon insights from the lead author's year of ethnographic research in 2017 in the Patan area of Lalitpur Metropolitan City. During this time, the lead author conducted over 150 semi-structured and informal interviews with 47 household-level water managers living in Patan during the dry, pre-monsoon and monsoon seasons. Interviews with these water managers took place over a series of interactions in 2017 in February–March, April–May and June–August. Over these interactions, the lead author built a spatial and visual database of how water sources and storage practices changed for each household between meetings to create individualized story-maps. These story-maps synthesize visual, textual and spatial information about how participants understand, feel and respond to changes in water quality, quantity and availability. The lead author designed these story-maps to encourage participation and reflection and, moreover, to facilitate comparison, transparency and reflexivity in the research process.

To contextualize these experiences in broader institutional changes, this paper is also informed by insights from interviews with 31 experts and water managers working for governmental, non-governmental, private, community organizations during the lead author's fieldwork in 2017. The second author's expert knowledge of the governance of water and the hydrogeology of the Valley informs the insights and policy directions for this paper.

Using convenience sampling, household managers were recruited from different neighbourhoods in Patan as a case study of water insecurity in the Valley; it is important to recognize that it is likely the dynamics of water insecurity vary greatly across urban areas

in the Kathmandu Valley due to the diversity of cultural histories and features in the physical landscape. The study area selected roughly encompasses a 1.5 km radius from the centre of Patan Durbar Square outwards to Kumaripati, Balkumari, Gwarko and Shankhamul. Some participants in the study are quite wealthy while others are poor; some own their homes (n=33) while others rent (n=19); and some live in temporary housing due to the 2015 earthquake (n= 4); most participants are women (n=40). (Five participants who rented provided information only for the dry season as they moved after the first or second round of interviews; consequently, only 47 participants of the 52 remained in the study throughout).

Background: Situating water insecurity

Historically, cities in the Kathmandu Valley were built around cascading water distribution networks of canals, ponds (*phuku* or *pokhari*), wells (*inar*) and stone spouts or stepwells (*hiti* or *dhunge dhara*) (Becker-Ritterspach, 1995; Colopy, 2012; Spodek, 2002; Tiwari, 2001). The dynamics of these water systems vary across the landscape but in general the system catches, stores and transfers various sources of water – from rainfed springs in the Valley's surrounding forests to aquifers in the Valley floor. In addition to their cultural heritage value, stone spouts and wells still function today as vital water sources for the urban population (NGO Forum for Urban Water & Sanitation, 2009).

The longevity of these water networks and their diverse engineering techniques constitute knowledge about the natural environment, particularly of the local geology, given the Valley's zones of high and low recharge (Tiwari, 2014). In other words, the ancient water system incorporated the physical landscape and ecosystem processes. For example, people tell stories of how the worship of frogs, snakes and fish icons at water sites

reflect the integration – and celebration – of life cycles in ecosystems. Here, the construction of these water systems both shaped, and were shaped by, the practices and beliefs of surrounding Newa societies (Shrestha & Shrestha, 2013; Tiwari, 2001). Newar peoples are the historic inhabitants of the Kathmandu Valley or Nepal Mandala civilization; Newa rule over cities such as Patan or Yala in the Kathmandu Valley ended with the Gorkha invasion in 1768.

The maintenance of the ancient system relied (and to some extent still relies) on natural and cultural systems such as the Newa festivals like *sithi nakha*, where people clean their water sources in worship of water deities (Tiwari, 2001, 2002). Many communities are organized around these ancient water sites and revitalizing wells, ponds and stone spouts for both their cultural significance and utility (Molden, Griffin, & Meehan, 2016; Regmi, 2005; UN-HABITAT, 2008). As these practices continue today, it is important to recognize that water and water infrastructure in the Valley are more than a resource or means of distributing a resource: they embody cultural histories and changing social relationships (Clark et al., 2017; Tamang, 2016).

The ancient cascading water system was radically transformed during the Rana period of government in the 1900s. Influenced and supported by the British Empire, Rana rulers imported metal pipes for elite households and stand posts for the public. In 1911, Prime Minister Chandra Shamsher Rana built the Pharping Reservoir which continues to feed pipelines supplying the Patan area. To lay down that infrastructure, which today's grid system extends from, the Rana regime set in motion a process of modernization that fragmented the infrastructure and governance of preexisting Newa water systems (UN-HABITAT, 2008), exerting some degree of authority through the water system: stand posts

appear directly adjacent to stone spouts, wells and ponds, and in other places these sites were demolished for new buildings. After the Shah dynasty regained power from the Ranas in 1951, the government expanded the piped water system for more public access (Colopy, 2012). From the 1900s to the present day, efforts to build new pipelines, roads, schools, government buildings and other infrastructure, both government and private actors have demolished or damaged many canals, ponds, wells and stone spouts. These developments not only diminish water availability in historic wells and stone spouts but also lead to displacement and the loss of cultural heritage (Molden et al., 2016).

The metal waterpipe system initially laid down by the Ranas quickly degraded due to poor maintenance and management. Moreover, extensions and replacements of that system have been unable to keep up with increasing demands from rapid urban growth and changing lifestyles. Demands for water have increased from 35 million litres a day in 1988 to 155 million litres a day in 2000, and then to 370 million litres a day in 2015 (Thapa et al., 2018). In the meantime, the extent of the built up area increased by 412 percent from 1989 to 2016 (Ishtiaque et al., 2017b). Growth in the Valley has largely been driven by rural to urban migration due to unrest during the civil war period (1996–2006) and a lack of development in rural areas. In 1990 and 2017, migrants accounted for 40 and 36 percent of population growth, respectively (Ishtiaque et al., 2017b).

Currently, the KUKL supplies 19 percent of demand in the dry season and 31 percent in the wet season, due to changes in water availability at KUKL's water pumping sites and reservoirs (B. R. Thapa et al., 2018). What this means is that few households can rely on piped water. A recent study (Raina, 2016) found that, on average, households in the study area of Kathmandu only receive 1.5 hours of water every 5 days from KUKL pipes;

the same study also demonstrated that poor households systematically obtain less piped water than wealthier households.

Plans to improve water supply came into motion in the early 1990s with an internationally funded scheme to privatize the water system and expand infrastructure with the Melamchi Water Supply Project, referred to commonly as “Melamchi”. Although the Melamchi project now involves many other projects, its key feature is a 27.5 km-long tunnel to transfer water from the Melamchi basin to the Kathmandu Valley. The project promises to bring in an added 170 million litres a day, year round, from the snow-fed Melamchi River until the completion of the second phase of the project which will add 340 million litres a day from the Yangri River. Even so, models predict a 124 million litre daily deficit with the first phase of the Melamchi project, based on growing demands (Udmale et al., 2016).

The Asian Development Bank approved a loan for the Melamchi project in 2001; however, it did not materialize and institutionalize until after the civil war ended (1996–2006). Moreover, due to protests at both ends of the pipeline (Domènech, March, & Saurí, 2013) tunnel construction in Melamchi did not begin until 2009, missing its first 2007 deadline. Decades later and around US$360 million spent, the project missed its second deadline extension. In April 2018 the contractor finished building the tunnel but kilometers of pipe laying remained incomplete in the city.

In addition to building the tunnel that will divert water from mountain streams into the city’s piped water system, the project required the restructuring of infrastructure and management systems within the Valley (Domènech et al., 2013). After changes to the scope of the project to expand and improve piped water distribution in the Valley,

institutional reform and foreign investment shifts took place in 2007 and 2008, involving the creation of three new water management entities based on a public–private model (Domènech et al., 2013b). These institutions are the operator of water and wastewater services (KUKL), the asset owner of those services (Kathmandu Valley Water Supply Management Board; KVWSMB) and the economic regulator (Water Supply Tariff Fixation Commission; WSTFC).

The KVWSMB is the sole authority responsible for water supply management within the valley area. It was formed from an ordinance in 2005 that was later accommodated within an act of parliament, the Water Supply Management Board Act, 2006 (the Act). The Act led to the formation of the KVWSMB as the authority responsible for regulation and monitoring of water supply business within the whole valley. The KVWSMB is the apex body for water supply management in the municipal areas of the valley and has issued a 30-year lease to KUKL, the main operating company responsible for piped water supply within the valley. Since its establishment, the KVWSMB has worked in the field of water supply management, groundwater regulation, identification of new water sources, artificial recharge, licensing and monitoring of small water vendors (such as tanker vendors), on social awareness campaigns and on the rapid water quality assessment of different water sources. One major goal of the KVWSMB is to ensure equitable drinking water access to all residents of the valley.

The temporal and spatial variability of insecurity

Within the span of many people's memories, water has become a highly contested and expensive resource to access. As public water sources run dry and become contaminated people must rely more on buying water. Costs include payments to KUKL, to

tanker and jar companies, to neighbours, or through the installation of new technology and infrastructure, such as pumps, tanks and filters. Together, these sources and systems form a complex meshwork where boundaries of formal and informal, legal and illegal, public and private, all become entangled (Schwartz et al., 2015). To help make sense of this meshwork, Figure 19 provides a schematic of these various sources based on household methods of access. As the schematic shows, households have a choice between tapping into water brought in through pipes, tanks, and jars or sources available in their compounds and neighbourhoods. For example, since Uma harvests rainwater from her roof in buckets and goes to a nearby community-run stone spout, she accesses sources that are comparatively less expensive and more localized.

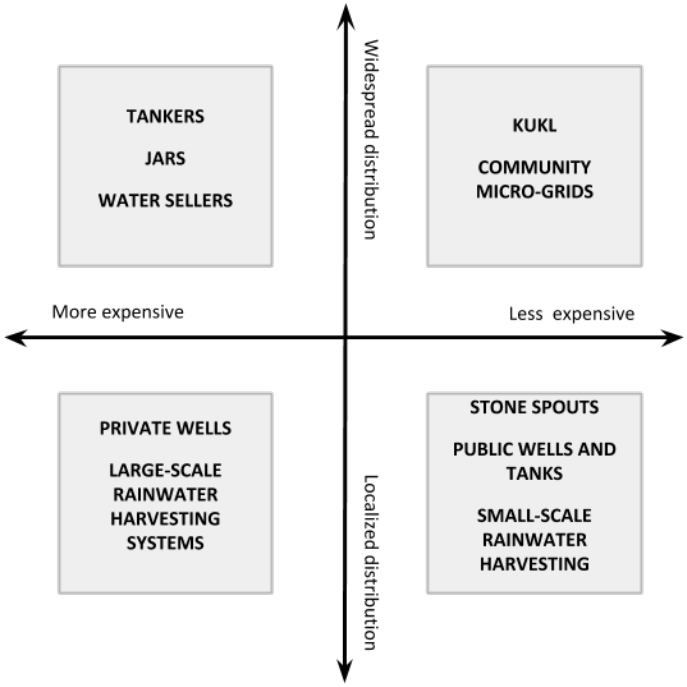


Figure 19. Schematic of different water sources and systems available to households.

Due to unreliable KUKL supplies, households and communities have invested in new water infrastructures for storage, treatment and supply. Small-scale rainwater

harvesting is common in households and the government now promotes rainwater harvesting and recharge on a large scale (V P Pandey, Shrestha, & Kazama, 2012). Some neighbours have worked together to create small-scale water supply and distribution systems. On a slightly larger scale, several communities have created water supply systems. Depending on availability and cost, community leaders collect water from deep-boring, shallow wells and tankers, and from ancient stone spouts or wells. Then, depending on membership status, people pay to collect water from public tanks and taps, from hose connection points to micro-grids, or from private tap connections to these micro-grids. Some communities also provide free water access to the broader public at certain times in the week.

Households, especially wealthier ones (Raina, 2016), increasingly rely on water brought in from the surrounding hills in tankers and jars; research in 2005 estimated that tanker and jar companies fulfil half of demands (A. Dixit & Upadhya, 2005). The costs of these non-grid sources are estimated to be around US$12 a month, or around 2–3% of household income (Gurung et al., 2017); however, there are many other hidden costs in time spent and the cost of pumping, storing and treating water that make this a much greater burden (Pattanayak, Yang, Whittington, & Bal Kumar, 2005). Cost is an important factor for research participants. Although some would like to pay more for a constant flow of clean water from taps, they do not want to keep paying high prices for water from sources like jars and tankers.

Groundwater from private wells (for homes, schools, hospitals, hotels, industries, tankers), KUKL wells, and historic community wells supply the needs of the Kathmandu Valley (Sangam Shrestha et al., 2012). Industries and private groups (including community

organizations) with land and capital are tapping deep aquifers through deep-boring technology. Overall, 21.56 million m^3 a year are being extracted, exceeding the recharge rate of 9.6 million m^3 (Pandey *et al*., 2010).

Research into Kathmandu's water use tends to portray households by dimensions of source access and less as a meshwork, or entanglement, of different sources that shift spatially and temporally (Schwartz et al., 2015). This study finds that access to water varies because of the subjective ways people distinguish quantities and qualities of water for certain tasks, for example using jar water only for drinking, and rainwater and well water for washing clothes. However, these use and storage dynamics transform; for example, in the rainy season when some people store their well water with tap water. Moreover, the amount of water households access varies greatly: some struggle daily to find enough water for drinking, washing dishes, and using the toilet. Other households worry about calling a tanker every month for their non-consumptive needs. During the dry season one participant had plenty of water in her well but the water in her neighbour's well became yellow and then ran dry.

Similar spatial discrepancies also apply to the case of piped water. Two neighbours, Sonika and Shanta who live next to the main KUKL water supply line in Patan experience water insecurity very differently. Sonika rents a room and has access to her neighbour's KUKL connection and to the public well. Once a week she waits in line with other renters in the area and collects 100–150 litres of water from her neighbour, paying her neighbour US$2 a month for that water. Sonika feels like she never has enough water. Across the street, Shanta has two KUKL connections because he expanded his family home into two lots and receives around 8000–9000 litres a week for US$7 a month. Shanta only buys

water from tankers after the 2015 earthquake and during the rice planting month when farmers divert water from the Pharping source to their fields. However, Shanta is concerned about the sustainability of the piped water connection as he does not trust the government or the Melamchi scheme. Shanta's experience shows that even with abundance insecurity persists due to a lack of trust and autonomy.

For households farther down the piped water line, the water that comes is not as clean or as voluminous. Here, households living upstream the pipeline and directly along the main line receive the most benefits, which coincides with more central areas such as along the road from Pulchowk to Mangal Bazar. In March, only five participants could rely solely on water from the pipes. Most participants who have KUKL access (n=12) received less than 400 litres a month. However, most lack easy access at all: 11 participants lack a working KUKL connection and 19 lack direct access to a KUKL line.

As Hari explains: "When it is Saugal's turn to get tap water [Saugal is a community downstream the pipe], if the force of water is high then we can also get water… But to send water depends on staff of KUKL. Sometimes they do not open the tap key but usually they open the tap keys on time. Then we would use tanker water. But once a week there will be water." There are also many areas which lack piped water connections because they are in newly developed areas or too far from the main line.

As the pipeline pressure is weak, many households invest in pumps and remove KUKL meters to collect more water. As such, people who can afford stronger pumps can effectively suck up more of the water that would extend further through the network. Although such practices are illegal, they are widespread and deregulated. However, for Nanichhori, a poor homeowner who lives adjacent to the main line, these forms of

"cheating" mean that she has to wait all day around the tap: "It [KUKL water] should come thrice a week but when there is electricity the people use machine and they get water. But we don't get [any]." She says even if she could access the tap water she doesn't have a place to store the water. Overall, even with growing inequities in access between families, as for Nanichhori and Hari, the current pipe network is a source of stress for all families, albeit in different ways.

Between these diverse experiences, feelings of security and insecurity do not necessarily change between seasons of overall water abundance and scarcity. Rather, feelings of insecurity depend upon the ease of access to water sources, which includes perceived financial costs of access and storage, time and physical burdens (e.g. carrying, hand washing, filtering), and social acceptability (e.g. changing gender relations, beliefs, community membership). These costs increase as groundwater levels drop, or as public spouts run dry and taps run black or dry. As a result, families must constantly negotiate with external forces – companies, stores, syndicates, community leaders, neighbours and government officials who control water flows – which in turn reinforces power disparities.

The Importance of social networks and homeownership

Homeownership is a powerful dynamic of water security. Registering a home provides residents with the ability to connect to the water mains and, if they have the means, to invest in underground or rooftop storage. Having this storage is particularly critical as it means they can pump well water, tap water or tanker water and store it for future use. Moreover, landownership often provides added income as homeowners rent out spare rooms and space or sell their land. However, not all homeowners have such benefits. Some homeowners cannot afford to move to a better area, repair earthquake damaged

homes, or renovate and expand. On the other hand, landless residents – such as renters, squatters and people living in informal settlements – have a more challenging time directly accessing, treating and storing water.

Whether homeowners and renters, participants were constantly adapting and changing their strategies: trying out different technologies, investing in new storage tanks, talking to neighbours about their strategies, or watching where other people collect their water. What this shows is that it is not just the ability to attach a hose to a tap or pump water from a pipeline that provides them with water security, but, more fundamentally, social connections. For example, renters like Rupa find friends that watch each other's buckets or children as they wait for water. Homeowners like Dev ask neighbours for the phone number of a more reliable tanker, while Prem invests with friends in revitalizing a community well to create new water possibilities. Or, take Shanti, for example, who talks about how her life has improved since "the brothers of the community" asked her to manage the newly installed community tank. Her daily life is different now: instead of buying water and carrying buckets home, she makes a small profit from selling water and spends her time getting to know the renters and homeowners in the area.

Migrants and homeowners who have shifted to a new area explained that they feel more insecure at first because it takes time to learn about water systems. Observing other residents and making social connections improves water security. Doing so, families learn new strategies, such as: using a tarp to collect rain; creating or joining a collective water collection and storage system; and acquiring more knowledge about local water sources and their management systems, such as when and where the "key man" comes to open pipes. However, as some migrants discover, access to certain public water sources are more

exclusive, favouring “locals” or historic homeowners in the area who have membership of community water systems.

Even for household managers who do not have to leave their home to fetch water because they can call a tanker, pump water from their well, or rely more on KUKL tap water, social connections are still vital. For example, Sangita had to talk to neighbours and relatives to find a tanker that would deliver to her home after the earthquake when KUKL stopped working for a month. Gautam’s street has a strong KUKL connection because one of his neighbours used to work for the government. Gautam can also drive his scooter to his ancestral home near the main KUKL line to collect water when his tap and well run dry.

Investments in certain sources, technologies and social networks provide many participants with a greater sense of autonomy and security. When asked if they would stop using non-grid sources after Melamchi, many participants said that they will continue to support their neighbourhood well and stone spout water systems or maintain their personal wells, but stop purchasing water from tankers, jars and other vendors.

Several participants rely on community leaders to make water management decisions. For these households in community cooperatives, the community system is an extension of their household as they are socially, economically, politically and culturally invested in their local system. For example, Samrat says it is the community’s decision to incorporate Melamchi into their neighbourhood water system. Systems like the one Samrat relies on provide inspiration for other participants who lack local connections. Prem and his neighbours are investing in a tank and filter system for his community’s well: “We have to use the source that we have. We have to think how can we use the well effectively. We have a strong well where about 30000 to 40000 litres of water is pumped daily. That water

is enough for us if we can collect properly. But we don't use it well. People hesitate if they have to spend money. We have to treat it with chemicals, medicines, filter plant and we have to clean it regularly. But in case of tap water we don't have to do all that. We just have to pay 150 [rupees]. But imagine if Melamchi comes and we have to pay 1000 to 1200 [rupees] per month then how difficult it will be. If someone gave us the medicines to keep in water I think this water will be okay to drink."

In some cases, strong cultural ties have enabled community groups or "clubs" to have a greater degree of autonomy (O. Molden & Meehan, 2018b). As a result, some household water managers have given up on the government attempts to fix the grid. Santa Maya, a resident in a historically low caste neighbourhood, feels betrayed by the government: "I don't care [what the government does]. We get water from the club. The government won't give you water." Samrat, similarly expressed, "the government had said that the Melamchi water was coming years ago. If we were just sitting and waiting for water then people would have died of thirst. But the community people has helped getting water. I don't know much about government. I don't trust in government."

Nevertheless, most participants complain that people in their area act too individually and selfishly. Participants wish for more local unity – to have meetings to discuss what the problems are, develop strategies, go in mass to the KUKL office to complain and make demands. Participants explained that these strong social ties grant them power but acting as an individual they are powerless, especially when making demands at the KUKL office or local government offices.

Yet, even for participants who are part of strong community systems, only a few groups have been able to successfully negotiate with the KUKL office, and still they

complain that the results are short lived. Take the neighbourhood of Chyasal where locals claim the government responded to their demands by building a deep-boring plant next to the Bagmati river and installed new pipelines to households in that neighbourhood. Despite this investment, residents do not think water will not flow through the system anytime soon. One resident complained that it would not come until after Melamchi.

These strategies indicate that insecurity persists due to rapid changes and the increasing fragmentation of social ties and physical water flows. All participants expressed worries that water is increasingly scarce and hard to find or more expensive to buy. Here the burden falls heavily on the people who secure water for their families and communities as most lack the ability to fully trust a larger system.

The burdens of coping

Institutions often praise the resourcefulness of residents as they wait for the completion of Melamchi. Here, institutional narratives view the use of multiple sources and water saving techniques as coping mechanisms, or temporary alternatives, until the grid supplies demand (Molden et al., 2016). As Ching (2018) argues through her research on public narratives of piped water supply in Kathmandu, there is a paradox of resilience: the act of coping creates a false sense of resilience. Coping thus becomes part of a cycle of inaction where the public's perceived resilience feeds into bureaucratic incentive towards blame-aversion (Ching, 2018).

However, what does coping look like in everyday life? This study finds that the burden of coping falls heavily on households as families take management into their own hands. More specifically, that burden of managing water falls on certain household members who bear responsibility for gathering, paying, storing, treating and using water. In

most cases that burden falls on women, yet, with changing social relations, participants explain that men are more involved in water tasks, to varying degrees.

Take the following two experiences of household water management, from Rupa and Dev. Rupa, a grandmother, who migrated with her children to the Valley 10 years ago, says she spends her entire day "touching water." She must walk 10 minutes down the road to a stone spout and then wait in line, sometimes for an hour, to collect one bucket of water. When water comes and the homeowner lets the renters take water, Rupa and her neighbours take turns collecting buckets from the KUKL line. She stores the tap water in clear jars under her bed and uses it for drinking. Then, when the homeowner has unlocked the well and it is not smelling of sewage, she takes turns pulling buckets with her neighbours. Rupa's children and grandchildren will sometimes help her when they get back from school or work. Rupa says it is always hard work securing water but it is easier when there is more water available through the KUKL tap or well.

Dev, a grandfather who is long retired, has built a new home on the outskirts of Patan. He has two large storage tanks on his roof and on the ground floor, and has built a system to channel rainwater directly into the toilet cistern. Dev orders a tanker twice a month and collects one large bottle or jar of water every three days. He lets his renters use the household well.

While in completely different situations, both Dev and Rupa cannot rely on systems beyond their household to provide them with water. Dev is constantly arguing with tanker suppliers and Rupa is constantly figuring out which sources will be available. While these experiences of insecurity vary between Dev and Rupa and their households, both managers feel stress and frustration. Both wish that water management could be less stressful, just

like the old days when Dev's previous household in Patan Dokha received a constant supply of water, or in Rupa's village where clean water was always available from springs.

To build security, household water managers like Rupa and Dev have invested in storage: for Rupa this consists of dozens of 5–20 litre buckets and drums stacked in her small room, while Dev has several 500–1000 litre tanks and an underground reservoir. Looking out at the water tank-lined skyline of Kathmandu, investment in different water storage units is clearly a key mediator of water security.

Participants long for a working KUKL connection where they can just turn on the tap and not have to worry about filling all their tanks when they have a chance. Both Dev and Rupa are optimistic that they will soon stop buying other water and only use tap water as they see pipelines being laid. However, other participants feel like "Melamchi will never come" or when it does they are sceptical of how long it will last.

Already the unfolding of Melamchi is amplifying the insecurities of some households more than others and increasing the multiple costs of coping. This is because, for the many households with unused and broken KUKL connections, household managers and community managers made a choice to either continue paying the bills despite not getting water, to ignore the bills and accumulate a large fine, or to "cut the line."

However, several other participants, such as Santa Maya and Samrat, opted to cut the line because they transitioned to rely on other systems instead and did not want to keep paying for water that they do not receive. As Muna explains: "After we built this house we cut the pipelines. So now we don't have [a KUKL line]. We have cut the pipes here, but we haven't gone to the office to inform them. So, I think if they send Melamchi water then we will have to pay a lot of fees. It's been 12–13 years that we build the house… But water

hasn't come for 18–19 years."

After seeing Melamchi finally materializing in the city, these participants have realized that they need to reapply for a connection or pay up all their fines, some of which have accumulated over many years. Sarita owes around US$500 to unlock her connection to Melamchi water. However, Sarita also needs to rebuild her house which was damaged in the 2015 earthquake, so she said she will see what Melamchi looks like before paying. Currently, she collects buckets from the community well and pays the mothers' group that manages it 50 cents a month. While homeowners, like Sarita, grapple with the costs of becoming reconnected to the piped network, renters wonder how much they will have to pay to access the landlord's tap. This is because current policy governing the piped water system systematically marginalizes residents who lack certain kinds of property in the city, as seen in the disparities of access between Sonika and Shanta or Sarita and Dev.

Discussion

Urban residents are paying for the costs of ineffective and at times absent water management systems. As one participant expressed: "let people realize that it is the government duty to provide water. Even if people don't pay, the government needs to supply water. It is a basic human right!" This paper argues that meeting these rights demands research, development and policy responses to look beyond the main pipe network and engage with the variety of ways households secure water.

When asked, participants prefer water from KUKL or community water sources such as stone spouts and wells. The reasons for these preferences vary but participants often emphasize perceived cleanliness, convenience, reliability and social value, especially around community systems. However, without regulation and enforcement, water sources

are vulnerable to contamination and over extraction from upstream or surrounding users. Thus, not addressing the drivers of inequities and vulnerabilities surrounding water access risks perpetuating the disparities or creates new forms of insecurities, as the stories of Sarita, Samrat and Rupa demonstrate. At the very least, addressing water insecurity requires the upholding of existing laws and policies to ensure water resources are available and accessible to the public for domestic needs through better regulation, public outreach and coordination between national, municipal, community and household management systems. Addressing inequities demands a greater understanding of the social, political and economic factors that shape spatial and temporal disparities in water access between families living in a city.

Following local, national and international laws and policies, the State must ensure that water resources are available for public use. Indeed, following Nepal's 1992 Water Resources Act, the State owns all water resources for "for the rational utilization, conservation, management and development of water resources", and prioritizes domestic use above all others. While Article 35, Section 4, of Nepal's Constitution states that "every citizen shall have the right of access to clean drinking water", those rights can be addressed through sources beyond piped water from Melamchi and KUKL. Yet, so far, the main way in which the State and development efforts have attempted to address that right is through a piped water network. However, as current practices in Kathmandu and other developing cities demonstrate, privileging the grid over other sources risks perpetuating inequities and insecurity (Anand, 2015; Bakker, 2010a; Furlong & Kooy, 2017a; Katherine Meehan, 2012; Ranganathan, 2014b).

Policy responses

In its effort to better manager available water resources in the Valley, the KVSWMB is working on new policies and regulations. It has issued a 30-year lease (license) to KUKL with the terms of reference of operation and maintenance of the piped water supply network in the Valley.

Recently, KVWSMB also issued about 500 licenses (to date) to private tanker water vendors. Each water vendor must submit a water quality report from the desired water source. After studying the physical, chemical and microbiological characteristics of the submitted report, KVWSMB classify the water as drinking water, household use water and other water. After the categorization of the water, KVWSMB issues the license with colour codes, e.g. blue for drinking water meeting all national standard values of physical, chemical and biological parameters, green for household use water meeting the national standard for physical and chemical parameters, and yellow for other water meeting only one of the physical, chemical or biological parameters. All license holders must put a colour sticker on their tanker according to the quality of water being supplied and this colour-coded classification for tankers has helped users to identify the water quality of tanker water they have been using.

Similarly, the licensing of more than 400 deep tubewells (to date) has helped formulate conjunctive water management strategies for incorporating good groundwater sources as a viable alternate water source to piped water.

KVWSMB has issued regulating guidelines with the aim of regulating tanker water business and groundwater abstraction in the Kathmandu Valley. *Licensing Underground Water Extraction and Use Guideline (2014)* and *Tanker Water Business Guideline (2017)*

are two major policy documents that KVWSMB has been following for better management of the water nexus in the valley. KVWSMB issues groundwater abstraction license to all major groundwater users within the valley depending on their water demand on the groundwater potential of the area, water quality a and on water consumption per day. Licenses thus issued have to be renewed every year and, for renewal, submission of data regarding water quality, water abstraction/day and rainwater harvesting schemes in the premises of the license holder is mandatory.

KVWSMB has additionally been working on a comprehensive and interactive database with detailed attributes about all available stone spouts, ponds, tubewells, community schemes and spring sources within the Valley. Overlapping this information on one single map will help the public and even policy makers to formulate a plan for equitable water access to all user group within the Valley.

Conclusion

This paper examines the ways in which households address water insecurity in the Patan metropolitan area of the Kathmandu Valley, Nepal. It draws on insights from institutional expertise and participatory research with 47 household water managers over the dry, pre-monsoon and monsoon season in 2017. By presenting the experiences of urban residents like Uma, Rupa, Shanta and Dev over the year as they negotiate different water challenges, this paper questions common assumptions in water security research. As such, this paper calls for greater attention to the diverse experiences of different people living in the city over time.

First, this paper highlights spatial and temporal disparities of water access across household demographics and water sources, for example between the neighbours Shanta

and Sonika. These disparities demonstrate that commonly applied spatial and temporal boundaries in discussions of water security, such as the dry season or the municipal border, inadequately reflect lived experiences and conceal inequities. Here, in-depth qualitative research of household experiences helps to reveal systemic forms of marginalization that mediate experiences of water security (Buechler & Hanson, 2015; Loftus, 2006; Meehan, 2013; Sultana, 2011; Truelove, 2011), e.g. the difference in the ways that renters and homeowners, wealthy and poor, central and peripheral residences struggle to access piped water from KUKL.

Second, this paper highlights the role of landownership and social connections in mediating experiences of water security. Registering a home in the right areas enables access to a KUKL tap connection, and also grants the homeowner extra space for storage, potentials for well-building and a possible means of income from renters. On the other hand, migrants who cannot afford to build and register a home, such as Rupa and Sonika, remain vulnerable and insecure as they lack these options. Nevertheless, as stories like Sarita's and Uma's demonstrate, not all landlords and homeowners are more water secure or privileged. For homeowners like Sarita, Uma, Shanti, Samrat and Sanu Maya, social connections and local membership of community water systems are vital lifelines and support systems. More generally, it is through socializing more than by direct access to infrastructure that people come to build security. As this study and others show, prevailing narratives about water management often overlook these social and cultural drivers of security in favour of metrics of access and basic needs (Jepson et al., 2017; Molden et al., 2016; Tamang, 2016).

Third, this research emphasizes the burdens of coping with poor water supplies on

particular household members. In the Kathmandu Valley, ineffective governance means that households must manage their own water carefully. However, within a household there are often several families and, within these families, there are particular individuals who bear the responsibility of securing water. The costs of coping are high, not just financially but also in terms of time, labour and stress, as Uma and Rupa explain. Moreover, the prevailing standards of measurement of basic needs, through metrics such as litres per day per person, poorly align with household management strategies by missing critical dynamics of water storage, social networks and belief systems that affect the security or vulnerability of a family (Jepson et al., 2017; Molden & Meehan, 2018; Wutich, 2009).

With these three findings, we argue that policy and development efforts must look beyond the piped water grid to fulfil residents' rights to water and build water security. Although residents dream of a functional water grid, current efforts to fix and supplement the existing piped water network will not adequately address water insecurities or inequities in access.

Supplementary Material

Figure 20. Thapa Hiti: the ancient water spout from which Uma collects her water.

Figure 21. Samrat's access point to Aalko Hiti's micro grid system that pumps water from an ancient stone spout. Samrat's story-map: https://arcg.is/01LSGf

Figure 22. Rupa's drinking water storage system in her room. Rupa's story-map: https://arcg.is/08uz9S

Figure 23. Two of Dev's water storage tanks on his terrace. Dev's story-map: https://arcg.is/0rzryG

CHAPTER IV

BUILDING WATER SECURITY IN THE KATHMANDU VALLEY: A CAPABILITIES APPROACH

Introduction

In Nepal's Kathmandu Valley, Nanichhori, a middle-aged woman, lives in a room in one of the prime residential areas for piped water access, Na:Tole, Patan with her husband. Even during the dry season when supply is at its lowest, piped water comes all day for three days a week to Na:Tole. For Nanichhori, however, supply does not guarantee access, "They [the engineers] send water for three days at once and because we don't have a [pumping] machine we can't get it. And we also don't have space for storing [water]." Due to tensions between her husband's family who share the same dwelling, she can only store so much water and cannot install a pump to pull the water. As she explains, "We have to search for water. We cannot dig a well. We don't have a house of our own. I have my mother-in-law so I cannot make any changes here while she is alive." As a result, Nanichhori spends much of her time each day hand pumping, both downstairs at her dwelling's pipe connection and at her neighbor's tubewell to ensure she and her family have enough clean water for activities they value. Nanichhori's relations with pumps, vessels, and extended family show that more than access to services, household water security is a matter of the spatial, technological, and social relations of people who care for others.

Patan, the historic urban core where Nanichhori lives, is situated within the larger Lalitpur Metropolitan City, which is the third largest city in Nepal. Like the rest of the Kathmandu Valley, the city has a water problem. The Nepal Census (2012) estimates that

around 68% of Lalitpur's 109,505 households have access to piped water. Yet, even for households with piped access issues of poor water quality, intermittent supply, insufficient quantity, technical barriers, cost considerations, and social exclusions leave many residents, like Nanichhori, struggling (Aihara, Shrestha, Kazama, & Nishida, 2015; Guragai, Takizawa, Hashimoto, & Oguma, 2017; Molden, Khanal, & Pradhan, 2018; Raina, Gurung, & Suwal, 2018; Roth et al., 2018). The benefits of piped water access, moreover, are highly uneven and poorer households in Kathmandu often pay more for less water (Raina, 2016; Raina et al., 2018). Issues of scarcity and socio-economic inequity associated with water access are so entrenched that the situation changed little following the 2015 Gorkha Earthquake, which completely destroyed 75,000 homes and buildings in the Kathmandu Valley (Okamura, Bhandary, Mori, Marasini, & Hazarika, 2015; Sadhana Shrestha et al., 2017).

Patan and the larger Kathmandu Valley resemble many other rapidly growing urban areas where poor public water utilities rely on household coping strategies (e.g. Buechler & Hanson, 2015; Furlong & Kooy, 2017; Jepson, 2014; Meehan, 2013, 2014; Ranganathan, 2014a, 2014b, 2016; Ranganathan & Balazs, 2015; Sultana, 2011, 2013; Truelove, 2011). In these places, the strategies of individuals and collectives to cope with poor water services can feed into systems of state-industry exploitation, while also subverting and transforming those conditions (e.g. Furlong & Kooy, 2017; Meehan, 2014; Ranganathan, 2014; Sultana, 2011; Truelove, 2011). Improving access to water and sanitation services in places like Nepal is a core aspect of household water security as a development agenda (Bigas, Adeel, & Schuster, 2009; Obeng-Odoom, 2012).

The centrality of access in water security framings is not unique; access is a central

concept for thinking about "the ability to derive benefits from things," like property, resources, or services (Ribot & Peluso, 2009). While parameters of access are important indicators of inequality and vulnerability, they risk simplifying the layered politics and power relations of how households secure and manage water (Loftus, 2017). As such, this paper examines water security from a relational framework, as "securing the ability to engage with and benefit from the sustained hydro-social processes that support water flows, water quality, and water services in support of human capabilities and wellbeing" (Jepson et al., 2017, p. 47). Following Sen and Nussbaum's (1993) capabilities approach, a relational framework extends and reorients existing water security parameters around human flourishing (Jepson et al., 2017; Wutich et al., 2017). Capabilities are "the alternative combinations of things a person is able to do or be" (Nussbaum & Sen, 1993, p. 30). In other words, the freedoms or opportunities to achieve states and activities which are of value to a person or group, which Sen (1985) explained through the example of the difference between the *choice* to fast for religious reasons versus the *inability* to buy food due to poverty.

Following a relational framework and capabilities approach (Jepson et al., 2017), I analyze the abilities of household water managers, like Nanichhori, to do and be things with and through water (Krause & Strang, 2016) based on the development of a story-mapping research technique over 2017. Using geo-visual tools, I designed story-mapping as an ethnographic and participatory narrative-building research technique to gather both grounded and top-down perspectives of urban water relations. Specifically, I drafted narratives with participants, like Nanichhori, about their experiences over time, synthesizing transcripts, photographs, spatial data, and collected information to create

interconnections between textual, visual, and spatial information. Through this process, narratives develop in-depth spatial and material perspectives of household decision-making. Additionally, I situate those household experiences within broader political, economic, and cultural processes by drafting thematic narratives based on analysis of participant experiences, ethnographic observation, collected documents, and interviews with city-wide water managers. As a result, story-maps feature 47 narratives about the experiences of household water managers and thematic narratives which make sense of trends of household experiences collectively. As such, narratives combine two perspectives: one looking down on the city and one looking out from the household. With these steps, the story-mapping technique facilitates a relational understanding of water relations.

Drawing from story-maps narratives of household experiences in Patan, this paper has three interrelated goals. First, to explain how residents actively respond to unreliable public services and infrastructure provision as more than acts of coping. I show that households are not merely reacting to poor piped water access, but that households actively build water security by experimenting with the social and material fabric of the home and larger city. Second, given the role of friends, pumps, and tanks in daily water practices, I advance a framework for analyzing household water security beyond access through spatial, technological, and social freedoms. Third, I expand Hoffman and Metz's (2017) relational reconceptualization of capabilities from an Ubuntu ethic to situate understandings of both coping and capabilities within processes of exploitation. As I found, water security for a few residents tends to deprive the water security for many, particularly renters and historically marginalized residents. From this study of household water security, I discuss

the potentials of examining environmental insecurities beyond matters of access or the differential abilities to benefit from things to a relational analysis of freedoms and capabilities or the abilities to do and be things.

Household Water Insecurity in Kathmandu

Residents of the Kathmandu Valley have waited over three decades for better water services based on the promises of a significant development project, "Melamchi." Melamchi refers to a plan to improve and supplement piped water supply for the Kathmandu Valley. The project involves the construction of new pipelines in the city, treatment and storage plants, and a massive tunnel to transfer water from the Melamchi river to Kathmandu. With international support, the project also has required significant shifts in the governance of water. Yet, as studies of piped water access, quantity, and quality show water insecurity has worsened since the project's inception in the early 1990s (Guragai et al., 2017; Gurung et al., 2017; KUKL, 2016; Muzzini & Aparicio, 2013; Raina et al., 2018; Shrestha, Roth, & Joshi, 2018; Shrestha et al., 2018; Thapa, Ishidaira, Pandey, & Bhandari, 2018; Udmale et al., 2016; Whittington, Pattanayak, Yang, & Bal Kumar, 2002).

The public water company operating the Valley's piped water network (*Kathmandu Upatyaka Khanepani Limited* or KUKL) services 45% of the total Valley area, or around 71% of the population (Muzzini & Aparicio, 2013). With rapid population growth from approximately 1 million in the 1990s to 3 million since 2012, demand has sharply increased from 35 million liters daily (MLD) in 1988 to 370 MLD in 2015 (Udmale et al., 2016). Supply cannot meet increasing demands creating a deficit of 255 MLD in the wet season and 301 MLD in the dry season in 2015. Additionally, a significant percentage of water is

lost from broken pipelines (KUKL, 2016). With breakage of adjacent sewage and drinking pipes, the piped water that makes it through taps is also unsafe for direct consumption. Poor maintenance additionally means the city floods quickly. Models of future water demand predict that piped water deficits will continue and that unsustainable abstraction of groundwater will persist even with Melamchi (Saraswat, Mishra, & Kumar, 2017; Sangam Shrestha, Pradhananga, & Pandey, 2012; Thapa et al., 2018; Udmale et al., 2016). Overall, Kathmandu's water flows are characterized by spatial unevenness between households and neighborhoods to favor wealthier households (Raina, 2016).

So far, fixing the piped water network has been at the forefront of governmental and non-governmental attempts to fulfill Nepal's constitution and commitment to the Human Right to Water and Sanitation mandate to ensure access to clean drinking water and safe sanitation for all citizens (Molden, Khanal, & Pradhan, 2018). Beyond Kathmandu, research and development reports tend to frame coping and water insecurity directly in relation to the failures of a piped water network. As tunnel vision is a driver of insecurity in Nepal (Ching, 2018; Domènech, March, & Saurí, 2013; Molden et al., 2018; Rest, 2018), this study looks at coping and insecurity more broadly through the injustices of public services (Bakker, Kooy, Shofiani, & Martijn, 2008) as regulatory and bureaucratic functions governing water resources are often absent or inconsistent. Existing policy and governance structures are contradictory in ways which reinforce inaction (Molden, Griffin, & Meehan, 2016); they also reinforce social prejudices and corruption (Allouche, Middleton, & Gyawali, 2015; Asthana, 2008; Gyawali & Dixit, 2001; Lord, 2014; Rademacher, 2011; Shrestha, 2007). Urban development projects have a long history of taking place on historical spaces for water recharge, filtration, storage, and supply, which

are also spiritually and culturally significant (Molden et al., 2016).

These governance failures shorten lives and life potentials. Doctors have complained about increasing bronchitis and asthma cases associated with Melamchi water pipe installation (Poudel, 2016). Infrastructure development is also responsible for accidents. During my fieldwork, two children on their way to school disappeared into open pipelines during two separate flood incidents; one survived. Meanwhile, failure to maintain pipes and regulate tankers leads to the loss of life from disease outbreaks (Dixit, 2018; Joshi, 2017). Residents increasingly have to pay more to access water markets (Guragai et al., 2017; Gurung et al., 2017; Pattanayak et al., 2005): buying water from tankers and 20-liter bottles or "jars", building and deepening wells, investing in storage, pumps, and filtration, and spending precious time and energy carrying water (Shrestha, Shakya, Pandey, Birkinshaw, & Shrestha, 2017). Yet, given studies of contamination, both public and private sectors provide poor water services (Pandey, Chapagain, & Kazama, 2010; Warner et al., 2007). Poor public services deprive people of their potentials to thrive.

Households and communities seeking independence from water markets and municipal systems create their own locally run water associations. The government openly admits to relying on local water users associations or community clubs to provide households with water (Guragai et al., 2017; Gurung et al., 2017; Pattanayak et al., 2005). Ching (2018, p. 70) speculates that perceived household abilities to cope because of water markets not only perpetuate but likely incentivize government inaction, including "a relative lack of enforced regulations" and delays in development. Similarly, Rest argues (2018, p. 15) that the

> …unrealized story of the multipurpose Melamchi proposal shows how actually existing alternatives are rendered unrealistic through a coalition of government and

> donor agencies, political parties, consultancy, and engineering corporations that compete for projects, funding, and kickbacks.

Indeed, difficulties in completing the final stretch of Melamchi have further revealed issues of corruption supported through development funding. Meanwhile, at a water treatment and distribution plant which has long served Patan residents, investigative reporting found that local officials have been selling water to tankers. Shrestha (2007) has outlined the pervasive forms of corruption that permeate all levels of infrastructure development projects. Prevailing narratives about the city's water problems, nonetheless, focus on rapid population growth and poverty rather than exploitation and the historical structures which perpetuate injustices (Rademacher, 2011).

Beyond Kathmandu, political ecology research examining urban water flows has highlighted the layered forms of exploitation and spatial fragmentation of water harms and benefits within and between urban areas (Buechler, Hanson, Liverman, & Gay-Antaki, 2017; Furlong & Kooy, 2017; Kooy & Bakker, 2008; Perreault, 2008; Ranganathan & Balazs, 2015; Swyngedouw, Kaika, & Castro, 2002; Truelove, 2011). Anand (2017, p. 186), for example, finds that illegal and personal alliances between state, industry, and civilian that give water systems pressure: "it is these corruptions— these leakages— that make it possible to live." Ranganathan (2014) similarly argues that water "mafias" in Mumbai gain power through land claims and public services and in doing so engage in civic and coercive behaviors much like the political strategies of state. Thus, rather than understanding such informal and illegal provisions as filling a gap in public services, mafias are "formative of the postcolonial state" (Ranganathan, 2014, p. 90). Following this logic, coping functions as a "mode of development" (Roy, 2005).

A Capabilities Approach for Coping

Derived from the global Human Right to Water and Sanitation mandate, Sustainable Development Goal (SDG) 6 to "ensure availability and sustainable management of water and sanitation for all" (United Nations, 2018), places direct emphasis on equitable and affordable access to safe water services as a means of inclusive development (Schwartz, Gupta, & Tutusaus, 2018). Following the SDGs, parameters for household water and sanitation expand the usual water security metrics of quantity, quality, and access with affordability and equity (Bartram et al., 2014; Hutchings, Johns, Jornet, Scott, & Van den Bossche, 2018; Jepson et al., 2017; Schwartz et al., 2018). While the SDGs and Human Right to Water recognize that that clean drinking water and sanitation are essential to the realization of all human rights, there is an implicit focus on the material benefits of access in relation to basic needs and standards for health (Gimelli, Bos, & Rogers, 2018; Mehta, 2014; Schwartz et al., 2018; Wutich et al., 2017; Zwarteveen & Boelens, 2014). Gimelli, Bos, and Rogers (2018, p. 2) find that "the current interpretation of access [in SDG 6] focuses on the right to secure health benefits from water services, while ignoring whether people require water services to not only survive, but also to flourish."

Even in desperate situations, coping actions are more than reactions to insecurities, but attempts to transform conditions and create opportunities to live lives of value (Hoffmann & Metz, 2017). Moving away from a focus on survival, theories of justice and capabilities reorient water security around wellbeing and flourishing (Jepson et al., 2017; Mehta, 2014; Zwarteveen & Boelens, 2014). Mehta (2014, p. 67) maintains, "merely having access to water is not enough. Instead, a person needs a certain kind of access in

order to derive certain freedoms or functionings (i.e., capabilities) which in turn depend on a host of factors and capabilities." Mehta (2014, p. 68) argues for an analysis of entitlements and capabilities to understand "why many people in reality cannot access and/or realize their freedom vis-a-vis water." Following Nussbaum (2003, p. 23), to consider the right to water and sanitation, or any human right, demands an examination of capabilities because people can only secure those rights "when the relevant capabilities to function are present."

In response to these critiques, I employ a relational framework (Jepson et al., 2017), which applies Sen and Nussbaum's (1993) capabilities approach. According to this framework (Wutich et al., 2017, p. 50), water security is

> …not simply a state of adequate water – however defined – to be achieved, but rather a relationship that describes how individuals, households, and communities navigate and transform hydro-social relations to access the water that they need and in ways that support the sustained development of human capabilities and wellbeing in their full breadth and scope.

In other words, water security is more than the ability to access or secure water as an object, but about the range of freedoms and opportunities people can enjoy in relation to water. Sen (2003, p. 44) explains: "Capability reflects a person's freedom to choose between different ways of living." Essential to those abilities are entitlements or the "actual or potential resources available" (Adger, 2006, p. 270) to individuals or groups based on "bundles of ownership rights, endowments and or assets" (Dapaah & Harris, 2017, p. 27). Take this scenario from Hoffmann and Metz (2017): someone may have a legal right to access a water source but faces punishment for doing so due to current local social norms, which means they do not have the real capability to access water under existing conditions. On the other hand, the ability to give clean water to others, or care for others, through water

work holds biological and ethical significance for the capabilities of many; for example, "providing water to one's child is an expression of care for her biological needs, and is part of the process of enabling a child to grow into a caring individual herself" (Hoffmann & Metz, 2017, p. 160).

As Nussbaum (2003) points out, however, not all freedoms are inherently good or just. The abilities of some to benefit from water by depriving another of water. Kathmandu's Melamchi project exemplifies this point (Domènech et al., 2013). In Jakarta, Furlong and Kooy (2017) find that the ways in which wealthy residents and businesses opt-out of the centralized water supply to rely on aquifers deprive the capabilities of poorer households to benefit from both the centralized pipeline and groundwater. Alternatively, Sultana (2011) documents the emotional and physical struggles of wives and mothers in Bangladesh as they secure water for their families, where, as a result of gender imbalances in the household, the capabilities of men often come from limiting the freedoms of women. Thus, water security is not just a matter of relations between people and water or the hydrosocial, but the kinds relations that enable conditions for people and the planet to thrive (Gibson-Graham, 2014). This is why Hoffman and Metz (2017, p. 161) extend a capabilities approach beyond the individual through an Ubuntu ethic of caring social relationships. As they (2017, p. 162) explain: "if development is a process of expanding an individual's freedoms to accomplish functionings, this [*ubuntu* interpretation of] freedom is a form of interdependence with others, where this enables her to express and receive care and thereby exercise her dignity."

Following calls for relational analyses of capabilities (Hoffmann & Metz, 2017; Wutich et al., 2017) common indicators of water security, such as household pipe access,

limit the possibilities for human development (Mehta, 2014). As I show below in my methods and findings, understanding water security demands looking through the web of spatial, social, and technological freedoms of people to do and be things in relation to water.

Methodology

In this paper, I employ the idea of freedoms from a capabilities approach to analyze household water security. Rather than focus directly on functionings (activities and states) or entitlements (resources and assets), I see freedoms (agency and real opportunity) as a helpful analytic. While capabilities reflect "what people are able to do and be, or genuine (and positive) freedoms and opportunities to realize those functionings [beings and doings]" (Jepson et al., 2017, p. 47), I engage with the *freedoms* that constitute capabilities. Taking the idea of freedoms as an analytical concept, I consider the interconnections between a person's abilities, opportunities, choices, and values. Doing so, helps to map out the possibilities and limitations for water-secure living

My research methods are suited to understanding water security relationally. First, given that the wellbeing and flourishing of people through water is more than the access or use of water, I consider a range of participant-water relations. This includes both understanding relations with water as it is collected or secured, moved, stored, treated, used, and re(used), in addition to how participants make sense of those practices and the multiple-ways they think about and understand water. Second, as specific individuals take on greater responsibilities caring for their household's water needs, my research engages with individuals who do most of the water work for their household. Third, as water relations vary over time and space, I attend to the changes and continuities of water

relations through an iterative and reflective story-mapping technique. Fourth, I situate participant experiences within broader social, political, and material conditions by examining the histories of urban development and the contemporary practices and assumptions of institutions which manage and distribute water. Here the iterative process of analysis, data collection, representation, and reflection help understand capabilities.

Findings: Disparate Freedoms of Homeowners and Renters

Space

In the Kathmandu Valley, homeownership as a claim to urban land, property, and space is a powerful entitlement. With financial means and political pressure, homeowners can: 1) apply for a connection to the water network; 2) install a well; 3) make modifications to the entire household to enhance storage and water access potentials; 4) rent out rooms or sell land for added income. Historic homeowners belonging to Newa clans or "locals" have an advantage because of ancestral ties to the land and strong place-based family networks. With more agency over space, homeowners can expand their financial abilities from rent and the sale of water or other goods and services.

The city's growing population of mobile residents, who rent or live in informal settlements, build the city and its economy. Those who rent or "renters" can buy their way into an easier situation by renting an entire property, living in a neighborhood with better water supply, or being able to purchase and store significant quantities (over 7,000 liters) of water, for example. Punam paid around $180 a month to rent an entire floor of a home along the main water pipeline where she could directly access and manage piped water supply and household storage. She also invested in an electric water filter and pump. The only time she said she faced water issues over the time we met was when she was preparing

to move because it was during rice planting season when piped water comes twice a month and the other renters had used all the stored water to wash their clothes. After her homeowner asked their neighbor to give Punam water, she carefully managed the 500 liters they gave to her for free. In the new home where she rents, the landlord shares the property's well and tanker water with her. As she explained, strong interpersonal connections with her neighbors and homeowners have helped. Punam's socio-economic status as a high-caste and well-educated resident, moreover, grants her more agency to do and be things without the advantages of homeownership.

I found that more than being a "local," control over storage shape water security. This is because storage capacity is fundamental in a system where water collection is uncertain. To access particular sources, like tankers, or take full advantage of source access, a household needs specific storage requirements. However, building and tending to storage is demanding in space, time, and financial investment. Several participants who built new homes in the past 20 years found that the underground storage or reservoirs they had built were not large enough and had to make modifications. Older homes in Kathmandu do not have an underground reservoir or much room for storage because historically families secured fresh water every day from nearby sources for their activities and needs. Srimaya and her husband built a reservoir in their older home so they could store more tap water and not need to rely on the public well.

However, as Nanichhori's case shows, water storage is thus a matter of wealth alongside agency over space and property. Some homeowners, like Sarita, do not have the means to build storage. Sarita is an elderly resident who lives in the neighborhood she grew up in. However, she cannot afford to rebuild her earthquake-damaged home, so Sarita and

her grandchildren live in a shelter on their adjacent land (Figure 24). Sarita's preference is water from a well because she grew up drinking from that well; she does not like or trust tanker water because she does not know the source. She is happy because her community well has water year-round, and she likes how the mother's group manage and clean the well. Although she prefers the well water, she spends much of her day working with water and has little choice in what she can do.

Figure 24. Sarita's storage: she stores empty bottles in her earthquake-damaged house; collects rainwater from the roof of her temporary home; and reuses water in her room.

For most renters, water is a daily struggle because they do not own, control, or have privileged connections to spaces where they live. Few renters I spoke with had easy access to their homeowner's water systems. If a homeowner has a private water source (like a working tap connection) and decides to share it, they will usually grant renters access to their water source for a specific time-period or by an amount after they have filled their tanks. Because of limited access within their dwellings and low storage capacity, renters source water from outside the household – traveling to a neighboring house, a communal

water source, or a shop where they can buy jars of water or fill jars they bring. Jun is a recent migrant, and young mother, the household tap where she lives is broken, and the homeowner's tubewell is only available in the monsoon. This means Jun has to leave her baby with friends to collect from a water tank at a restaurant, buy a jar of water at a nearby shop, or use her relative's well across the street at a workshop. Jun worries about the water she washes her baby with from these sources because the water is quite yellow and cloudy, however, she feels like there is nothing she can do but move or wait for her homeowner to fix the tap.

Jun's case reveals how household water security is negotiated through connections to land and private spaces both within and outside a home. Having strong place-based ties through family and cultural identity expand the spaces of private property. For residents who identify as Newa, the built environment reflects historic family relations, even though many families have moved away from their ancestral neighborhoods. Newa neighborhoods appear distinctly around a plaza or a road intersection with at least one well, stone spout, or pond. Looking at the water infrastructure of homes and public spaces is one way to tell you have entered a different neighborhood. As one renter, Laxman, remarked: "In Kathmandu after every few steps there is a different area. You don't even have to go a kilometer. If you go 100 kilometers, then there is a completely different place. But what I know is, this place that I am living, doesn't have tap water. [Pointing] It's not in that house, neither in that house."

In many Patan neighborhoods, youth groups, mother's groups, and other local associations offer water services. Signs on large tanks in the public spaces of neighborhoods often advertise support from aid groups, and some of these water user

groups become registered associations with non-governmental and governmental support (Figure 25). “Local” residents, like Sarita, can become members of neighborhood water groups for a small fee. “Outsiders,” namely migrants, cannot become members or take part in the group decision-making and activities. Usually, renters pay more for services and have secondary rights to water at these sites as local members can cut the line and collect first. As these local services show, privileged connections to locally-run water services and infrastructures help extend the water storage and access potentials of households.

Figure 25. Local distribution tanks with a filtration system.

Technology

Moving water through space demands a vessel and energy. People moving water with their bodies, by vehicle, hand pump, or electric pump are all signs that Kathmandu’s piped water system is broken. Wealthy or poor, all participants discussed how they try to reduce the physical pains of moving water. To reduce these burdens, households invest in pumps and hoses.

As Nanichhori’s experience shows, a pump is necessary to access water from the

piped network. Here, removing the water meter and attaching an electric pump is widespread practice albeit technically illegal. The meter is a barrier because it restricts pumping, lessens water flow, and increases the cost of poor services. Thus, the dual abilities of households to apply for a non-metered connection, which requires a greater upfront cost, and invest more in a stronger pump helps to compete against the pull of other pumps to bring in more water. Additionally, many households will also illegally modify their connection to the main pipe to pull water from its base where the water flows unpressurized. Some households and businesses have even figured out how to open the piped water access points on the road to open the flows of water. How much a household pumps is ultimately limited by storage capacity. Additionally, in this exploitative system, tap modifications are only worthwhile for households near the main input pipeline; households farther away invest in pumping water from other water sources.

Households also install pumps to pull water from public and private wells to meet increased storage potential and lessen physical burdens. For example, Bijendra and his sister installed a pump at their neighborhood's historic well, which pulls water directly to their rooftop storage. Alternatively, Rupa's in-laws only have a pump connected to their private well, but because that source is dry for many months, she spends hours each day pulling water from the neighborhood's historic well. She then carries that water upstairs and strains to remove the particles. While much better than carrying water, pumps still require labor in the form of monitoring and only work when there is water and power. When power cuts were a way of life, people either had to buy a generator, use the hand pump, or wake in the night when the lights turned on to pump water. With more pumps and electricity, both public and private wells quickly dry when there is not enough rain. As a

result, households spend more to deepen wells, install filtration, dig a new well, or switch to ordering from tankers, which in turn deplete ground and surface flows from another part of town.

For renters, pumps and hoses are a problem due to cost barriers and because to install a pump and lay out a hose requires the spatial agency that usually comes with homeownership and local membership. As such, some renters talked about how they organized to collectively buy and share a pump so that they do not have to rely on the homeowner or manually pull water from a source. For example, when Bhawana moved to the city, she had never pulled water from a well before and struggled to collect water. She made friends with other users of the well and bought a pump so that they could pull the water from the well into their buckets and drums. Nevertheless, with limited storage and power over space, many renters spend much of their time and energy physically moving water.

Once a household water manager has moved water from a source to a vessel, they will either use that water or move it to another vessel. The use of multiple vessels for different qualities and types of water is common in households which rely on multiple sources and worry about quality. Participants showed me different vessels for drinking, cooking, shower, laundry, cleaning house, worship, watering plants, and flushing the toilet, among other uses. Depending on the use and the perceived quality of the water stored, household water managers will treat the water. Bina, for example, does not trust the water filter for the community-run water grid she buys from, so she has started buying jars of water for drinking. Although more expensive, buying jar water saves time and effort. When people have the financial means and do not want to, or cannot, filter water for drinking,

they buy jars. Some participants additionally boiled or filtered the jar water before use because they did not trust it. Additionally, a jar is an investment in a storage container and frees space for saving water from other sources for other uses. As these investments in objects and technologies show, families and communities with more cash *and* entitlements can do more things in an exploitative landscape.

Society

As Nanichhori's situation shows, the distribution of water benefits *within* a household is often uneven because of social hierarchies. Patriarchal social norms leave many female members of a household in a more precarious situation. Rajamati lives with her husband, mother-in-law, son, daughter-in-law, grandchild, and domestic workers in big newly built home. In her old house across the Bagmati River, she was often stressed about water. Rajamati does little water-related work since they moved, but when she was a new daughter-in-law, she had limited life choices and worked hard to care for her household's water needs:

> When I was young, all my four brothers lived together, and their wives used to do everything. After I got married, it was really difficult. My parents used to counsel me that I have to stay in my husband's house no matter what otherwise we will lose our reputation. Only because of that reason I stayed in that house… But now I have changed a lot. My husband is really helpful and that helped me a lot. It's not like my mother-in-law didn't like me but mothers-in-law are always the same.

When we came to visit, her husband was cleaning the water storage tanks and preparing chemicals to add to them for treatment. In addition to the household facilities of a washing machine, water heater, and electric filter, a family lives with them who tends to the house: cooking, cleaning, ordering tankers. As Rajamati explained, the social and material conditions of her household changed in ways that enhanced her freedoms and allowed for her to engage in more caring relationships.

Family divisions and hierarchies can lessen the capabilities of other family members. For example, Shanti's brother-in-law split their home, creating two households. Since then, Shanti has struggled because her brother-in-law's home has the piped water connection and storage space. Cohesion, on the other hand, enhances opportunities. Shanta and his brother registered their home as two households and gained access to two piped water connections, which they collect in one underground storage tank. Good relationships with extended family also expand household possibilities. Sangita, for example, travels to her parent's home to shower or do laundry when there is not enough water at her husband's house. At Rajamati's house after the earthquake, 65 extended family members stayed with them, benefiting from the ample water (10,000 liters) she always has stored.

Water sharing outside dwelling spaces is also common practice. Many neighborhoods and individuals give water to others for free or by donation (Figure 26). One historic neighborhood in an area with ample piped water flows, for example, distributes the water it receives for free to anyone who comes at the right time. Rajkumari, similarly, rents an entire workshop space and leaves her two wells open for friends and family who live in the area. Given the clustering of migrant groups, they explained that most of the people who come are members of the same clan who recently migrated from Nepal's lowlands. Alternatively, another recent migrant proudly owned a store selling jar water, which provided her with a free source of drinking water. These interventions show how groups are subverting an exploitative system of landowner privileges.

As these experiences show, knowledge of water systems expands the freedoms of household water managers. All participants explained the benefits of gossiping and watching the movements of other people. Despite an abundance of people and groups who

will give or sell water, finding a good place to collect water is not easy. Without strong social support groups, the ability to form social relationships, or even observe others from rooftops and entryways, helps. Many participants explained that they found a source or made a modification, for rainwater harvesting or filtration, for example, from observation or conversation. When I asked about why a participant engaged in a particular water practice, they would often say they were "following others" and calculating their risks by expanding their knowledge of what is going on around them in their neighbor's houses. Thus, it is through observation that people not only strategize but recognize important similarities and disparities which motivate engagement or disengagement from certain issues or tasks.

Figure 26. A neighborhood in a prime area for piped water allows anyone to come to collect excess tap water when available for free.

Social isolation and exclusions constrain the freedoms of household water managers. Uma, for example, does not receive support from her local community or her husband's family, and cannot access their tap connection or storage units. As a result, she is

isolated from her household, family compound, and the larger neighborhood. Padma is also isolated from her community. Padma misses her sense of community after she moved out of her old ancestral home down the road to a new home along the Bagmati river. Despite living in an area where only a few of her neighbors are family, the new households in the area have created a social support network; they share the same tanker and will share leftover water from tanker orders.

Rojita and her husband also live in an area of mixed residents away from their ancestral community. In this newly urbanizing area, Rojita also shares her water with her neighbors when they run out and knows they will help her as well. Although there is motivation for more formalized social action in the area, she feels like everyone relies on her husband. She says that without adequate social support, he has not had success after asking the government to install sewage pipes, reconnect water pipelines, or fix the lights in the area. Collective action is highly desirable because it reduces the burden on individual households and is a source of power for creating larger-scale change, however, as participants expressed collectives are hard to do in newly developed areas with diverse residents.

As local committee membership shows, positive social relations also help expand the abilities and powers of household water managers. For example, participants who go out and collect water often talked about their brothers and sisters, who can be friends and relatives. Friends collect water together, chat in line or at a pump together, and share responsibilities to make it easier and safer. Many participants talked about watching each other's buckets in line or filling their friends' buckets if they have work or family duties. Friends also share important information which can mean avoiding illness, finding a new

water source, or making a modification to their water system. Several women I met with chose to go out and collect water to support their friends, like Jun, while many who no longer rely on water from outside their home miss the socializing which took place at water sources, like Padma. Thus, the socialization of water and creation of collectives around water not only help to free the burdens on the individual but allow participants to engage in activities and states they value.

Discrimination limits social freedoms. While many participants, low and high caste explained that caste-based discrimination (at least outwardly) is much less prevalent now or only amongst older generations, several participants still feel its effects. Renters find that "locals" discriminate against "outsiders," especially in terms of what water sources they can use, how, and when. Srijana, for example, who despite having a very generous and kind homeowner says, "The local people should voice their issues more than us renters. If we say anything, the people might tell us 'Return to your homes and you will get facilities.' If the local people here unite and complain then it will be good." Rupa, a renter, tried to complain:

> Last time, when there was dirty water, I had told the house owner but he didn't care. I asked the person who comes to give the electricity bill why the water was so dirty and smelly. Then he said, "If you get dirty water then fill up a bottle with that water and gather some people from the community and go to complain in the office. Also ask why did this happen? Was it because the pipe is mixed with sewage pipe? Then the office will send people to check the pipeline." Then I told the house owner about it. Actually, they should have asked these things not us. We are just renters. I said, "We have to gather some people from the community and complain in the office" then he said, "Why should I go? Other people haven't said anything about it." He was very angry. The people [in this area] do not get along very well.

In addition to outward forms of discrimination, non-governmental or governmental action often favors select communities, usually because of familial or economic ties. For example, central areas with more commerce and high caste residents tend to have better

water supply than those farther away, which also coincide with lower caste areas. Gautam lived in a newly developed area where a politically powerful neighbor along his street helped to ensure that the government installed a new pipeline along their road. It is also one of the few cement roads in the area. In addition to subtle forms of discrimination, many participants were keenly aware that certain areas, industries, and residents received more services than others.

Discussion: Household Freedoms

Even within the islands of piped water supply (Bakker, 2010), few households and individuals within households in the Kathmandu Valley are able to secure relationships with water which "facilitate the freedom to achieve wellbeing, fulfilling social arrangements, and human flourishing" (Jepson et al., 2017, p. 50). And if they do, those capabilities often come at the expense of other people. To understand water security under conditions of exploitation, this paper highlights the analytical power of freedoms (Sen, 2003) from a relational perspective (Hoffmann & Metz, 2017; Jepson et al., 2017). Specifically, I examine the social, technological, and spatial freedoms of households and household water managers (Table 2). From this analysis, I find that regardless of source access, urban living arrangements can be characterized in four ways (Figure 27).

Table 2. Indicators of the freedoms of household water managers in the Kathmandu Valley

Activity	**More freedoms**			**Less freedoms**
Securing water	Community leadership	Household leadership	Neighborhood friendships	Direct relations/ self
Moving water	Strong pump	Weak pump	Vehicle	Body
Storing water	Underground reservoir	Community tank	Household tank	Buckets/ drums
Treating water	Having an electric filter at home	Buying pre-filtered water (e.g. jars)	Adding chemicals and/or filtering at home	Straining or boiling water

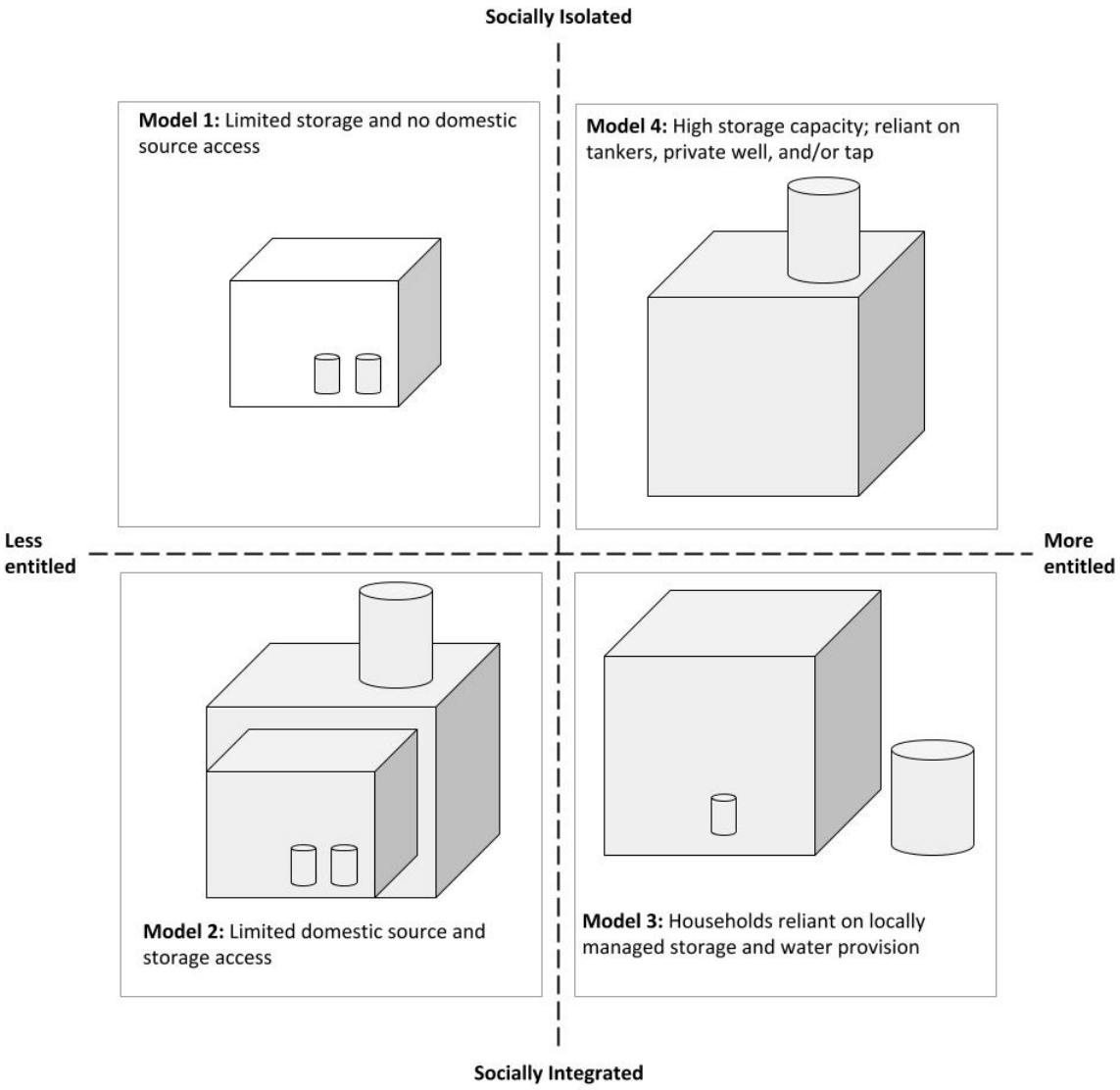


Figure 27. Models of different characterizations of households in the Kathmandu Valley by their entitlements and social cohesion

Model 1 characterizes poorer families living in older homes, rooms, or shelters who use buckets and small drums to store water. Securing water for these families was a daily routine and struggle. Model 2 represents residents who may rent or own their own but have limited source and storage access due to discrimination and socio-economic status. However, the difference between this group and the first is their integration in social support systems through friendships, family, or historic ties. Nanichhori, for example, falls between Models 1 and 2. She has few real opportunities or a limited set of functionings to

choose from despite infrastructural connection, water availability, and service accesses. This is because Nanichhori is deprived of spatial freedoms; she lives in an old and socially fragmented household which among other things, limits her abilities to store water and therefore means that she must carry water home every day. Nanichhori is also deprived of technological freedoms as evidenced by the absence of a pump due to household hierarchies. Without a pump, her household cannot compete with the pull of water from other households who have strong machines. She also cannot afford to buy packaged or "jar" water every time, so she says she has no choice but to trust the little tap water she collects. Despite constrained social freedoms in the household with her mother-in-law and brother-in-law, relationships with neighbors outside her dwelling make Nanichhori's life easier as she can collect water from their wells, but only for non-consumptive purposes. Nanichhori explained she feels exhausted by her water work that she does not take the time to clean her room.

Model 3 characterizes both wealthy and poor families, with smaller tanks and reservoirs who rely more on community managed water systems, sometimes in addition to household water sources. These families do not need to store as much because they can rely on their community to provide them with water. Model 4 represents wealthy homeowner families with a rooftop water tank and underground reservoir, who have greater potential to store water. Larger volumes of storage help to free the burden of worrying about water on a daily or even weekly basis. These families are often more socially independent because of entitlements and rely on pumps to bring in water from private wells, tankers, and the main water line. Figure 28 plots these freedoms (Table 2) in relation to typical examples of coping strategies for different steps in the household water cycle. As the above cases show,

specific strategies reflect the freedoms of a household manager and more broadly, the type of household they live in.

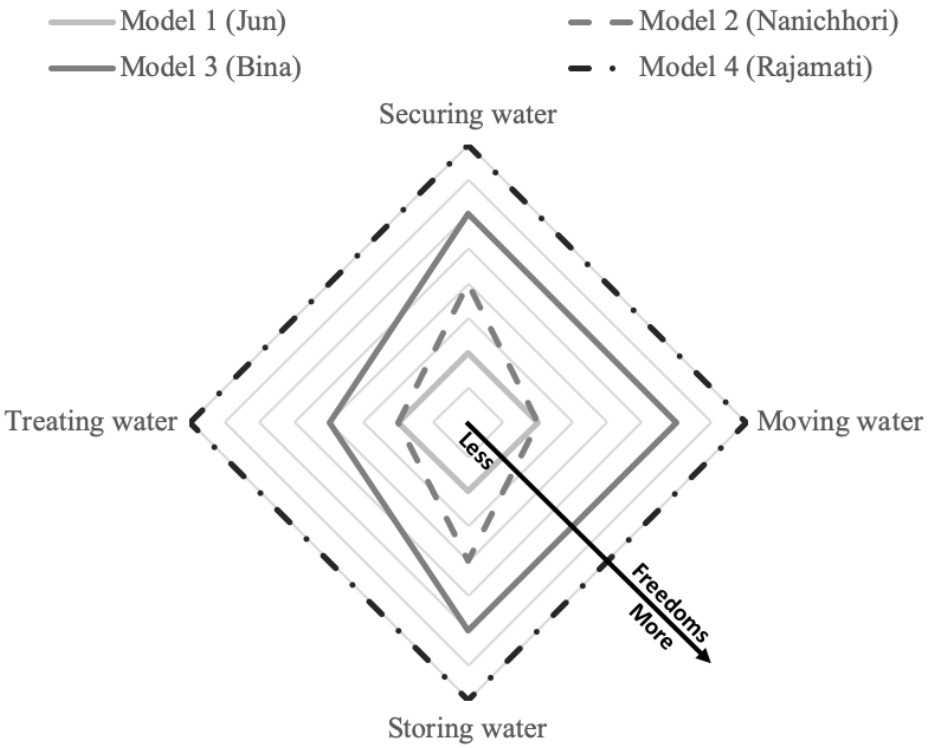


Figure 28. Model of freedoms based on household experiences

Like many places, claims to land often come with privileged rights to, or control over, water resources (Mehta, 2007; Mitchell, 2013; Ranganathan, 2014). In Nepal, the State owns all water resources and can acquire private land for the development of water resources; however, landowners do have privileges to water for personal and beneficial uses that cause no harm to others. Although these legal provisions have existed since 1992 under the Nepal Water Resources Act, people complain that they are only in writing due to the lack of enforcement and regulation. As the common expression *jasko shakti usko bhakti* or "might is right" suggests, strong connections to the built environment through economic, social, or collective power mediate abilities of families to address water insecurity and build water security. In privileged households, hired household help take on the labor of

household water systems – making sure reserves are full or filtering drinking water. Families with money to spare, say from renting rooms or owning tankers, can also deepen their well, build a new one, install a treatment system, or move to an area where there is more water. To the irritation of many participants, it is also often privileged people who make decisions in governmental and non-governmental offices. In other words, households with more entitlements, endowments, and assets have a greater range of freedoms to cope. Households are constantly experimenting with new coping strategies, which often come at high opportunity costs in time, money, labor, and social connections. Here, having excess wealth and powerful connections help.

While these models of household characteristics provide a helpful way for thinking about disparities in the abilities of households to build water security outlined in the findings, households with more freedoms do not necessarily flourish or secure living, especially considering conditions beyond the individual or household (Hoffmann & Metz, 2017). Hoffman and Metz (2017) argue that capability deprivation emerges from, 1) the constraint of an individual's ability to care for others; 2) a lack of care from social institutions, like the state; and 3) the attainment of capabilities from the deprivation of others. In a system of exploitation, coping to enhance individual, household, or even community-level water security often come at the expense of water security for someone else or other areas of life. For example, many of the poorer families I met with chose to tap into their savings to buy jar water because the jar saves them time, energy, and stress, especially if it means safe water for loved ones. Such sacrifices also appear in the decision to take out a loan to build additional storage to allow for the purchase of tankers or collection of more tap water. Sacrifices can also mean sending children to school with dirty

clothes so there would be enough water for other tasks. These sacrifices stand in contrast to the hoarding of water in large storage tanks from households and businesses who buy tankers, build deep wells, or pump piped water, which in turn reduces the flows available for others.

Despite the intention of coping investments to enhance water security, they can lead to a loss of freedoms both in the present and future. Take the example of when a neighborhood cut their connections to municipal pipelines to save costs but then could not afford reconnection because of accrued fines. Alternatively, when a community installed an expensive deep-boring well which supplied unsafe water and ruined the water quality of shallow wells in the area. These insecurities are embedded within larger forms of state-industry exploitation, which extends beyond water and sanitation services to other infrastructure development projects.

In my conversations, people would often compare Kathmandu's water situation with its electricity issues. For decades residents lived with load shedding or scheduled blackouts. Among other innovations and strategies, people invested in solar panels, batteries, and diesel generators to cope. While officials blamed a lack of power infrastructure, in truth, the electricity provider was creating an artificial shortage. Instead of providing electricity to households, officials and politicians made added money from deals with industries. They received kickbacks from solar energy and inverter companies, in addition to accepting bribes to supply energy-hungry industries. Investigative journalism, in addition to new leadership from Kulman Ghising in the Nepal Electricity Authority, exposed these dealings and led to arrests of key officials (Kumar, 2018). Ghising is now a national hero and urban residents since his appointment rarely faces electricity shortages.

One participant for example remarked

> We are paying tax to the government and they should be serving us. They are the ones to find solutions to such problems. If they don't find solutions to such problems then there is no use of such politicians. Every year they are increasing tax which means every year we are increasing their salary… Like, in case of load shedding, we thought that we would never get rid of load shedding. But after Kul Man Ghising came, he got rid of load shedding. No one thought it would be possible and that too in such a short time.

As the case of energy and water illustrate, connections between bureaucrats, politicians, and executives exploit household insecurities in both active and passive ways that benefit from coping mechanisms.

Conclusion

The 2015 earthquake, which was quickly followed by months of an India border blockade, limited water supply to households from the pipe network and tanker distributors. As a result, wealthier residents who relied on tanker and piped water explained that they experienced water stress when their reserves ran low and were unsure when they could refill their storage tanks. In contrast, participants who struggle with water daily reported that these events did not change their water situation that much. Nanichhori benefited as a donated tanker arrived and provided residents in the area with water for free. The sudden change of pace to urban life in Kathmandu thus laid bare the precarity of urban life. These temporal and spatial resolutions of water insecurities appear through the iterative and reflective technique of story-mapping.

Building on the insights of cultural geography and political ecology critique, this paper draws on the diverse stories of household water managers from story-mapping to examine urban water insecurity as a matter of building instead of coping (Gibbs, 2010; Hellberg, 2017; Hoffmann & Metz, 2017; Ioris, 2013; Jackson, 2006; Jasanoff, 2010;

Jepson et al., 2017; Linton, 2014; Linton & Budds, 2013; Loftus, 2015; Molden, Griffin, & Meehan, 2016; Mosse, 2008; Schwartz, Gupta, & Tutusaus, 2018; Watts & Bhole, 1993; Wutich et al., 2018). This research highlights how people take development into their own hands – building wells, storage tanks, creating water systems with friends – not just to survive or cope but to transform the conditions of insecurity and create possibilities. The pressure of pumps, the capacity of storage, and power of social connections mediate not just where water flows but who benefits or struggles and at what costs.

Household water managers navigate the spaces of the household, dwelling, neighborhood, and beyond to build water security. Power arrangements appear through the ability of household water managers to move through spaces and in doing so, interact with the built environment, technologies, and people. Even within the physical building of a household or social unit of a family, accesses to water can be highly differential as certain individuals take charge of pumps and tanks. Given the differing abilities to build water security this paper understands household water security through a framework of freedoms: the spatial, technological, and social abilities of individuals and collectives as they make water available for purposes, and people, they care for. The idea of freedoms here draws from the capabilities approach to reference the abilities of an individual or group to choose certain activities and states. From a relational perspective, real capabilities are attained through systems which enhance friendly and caring dependencies between people and the larger social and ecological landscape.

CHAPTER V

THE SOCIAL INFRASTRUCTURES OF WATER: HOUSEHOLD WATER WORK IN THE KATHMANDU VALLEY

Introduction

Kaika (2004b, p. 70) writes that in a network crisis, when pipes burst and lights do not turn on, the household becomes the domestic uncanny, a familiar space turned unfamiliar,

> One of the reasons why anxiety and discomfort is produced by a domestic network crisis is precisely because it forces us to reflect on the existence of things and social and economic relations to which the home is connected and which, when disrupted, render the normal function of our lives anomalous and reveal that the familiarity based on the supposed autonomy of the private space is itself a form of alienation.

However, what happens to the home and household when residents live in a state of infrastructure crisis? The modern infrastructure ideal, characterized by grid or network service provision, has proven challenging to materialize globally (Bakker, 2010; Furlong, 2014; Gandy, 2008; McFarlane & Rutherford, 2008); six in ten people do not have access to safely managed sanitation facilities (UN-Water, 2013). Moreover, studies of drinking water provision find that certain households are systematically excluded from public infrastructure services because of racialized, gendered, and classed histories of infrastructure development (Bakker, 2013; Deitz & Meehan, 2019; Gandy, 2004; Kooy & Bakker, 2008; Ranganathan & Balazs, 2015). Meanwhile, neoliberal trends in development exploit the abilities of households to fend for themselves, which given gendered histories of social reproduction, tends to exploit the unpaid "life's work" of women (Meehan & Strauss, 2015; Mitchell, Marston, & Katz, 2003; Ranganathan, 2014; Roberts, 2008). As a result, the domestic uncanny is an all too familiar state for most households.

In Nepal's Kathmandu Valley, only elite government households and a small percentage of urban residents can rely on piped water. In general, the experience of urban life in Nepal's sprawling metropolitan area is a test of patience; most residents are used to waiting for services – in the household, at an office, on the road, or around a public space. Like many other cities in South Asia, water services prove to be particularly troublesome for household and provider alike (Anand, 2017; Truelove, 2018). With a dysfunctional water management and infrastructure network system, residents become the city's infrastructure (Simone, 2004), taking on heavy burdens to ensure they and those they care for have water. A recent survey of women who care for their households, for example, found that 70% could not secure enough water for their household needs and that water was a source of great psychological distress (Aihara, Shrestha, Kazama, & Nishida, 2015). In my research, I engage with the experiences of people who care for their household's water needs in the Kathmandu. This paper critically examines the ways households respond to the insecurities of urban living. Specifically, I look to the work of *social infrastructures* (Meehan, Under review) of households, or the ways social activities (Simone, 2004) and social relations sustain urban life in ways that can be exploitative and exploited, but also generative of alternative possibilities. Doing so, I ask, how does the Nepali household challenge urban political ecology?

Insights for this paper come from mixed-methods research of household-water relations in Patan, a historic urban area within the larger Lalitpur Metropolitan City. Patan is also known as *Yala* (in Nepal Bhasa) and *Lalitpur* and is historically distinct city to Kathmandu. I focus on a central urban water service area to situate the lived experiences of the city in relation to the city's water suppliers and development histories. To make sense

of the spatial and temporal relations between individual, household, neighborhood, and city, I developed a technique called *story-mapping*.

Story-mapping uses geovisual tools to facilitate the construction, analysis, and representation of individual and collective experience. Story-mapping is a mode of research which incorporates various methods to build spatio-visual narratives with participant input. I drafted story-map narratives with household water managers living in Patan over 2017, through an iterative and reflective process. Reading for trends across those individual story-maps I also crafted thematic narratives which situate household experiences within larger development trajectories based on conversations with the city's water brokers: the non-governmental, governmental, academic, and private groups which influence Patan's water flows. This paper draws on analysis of the social and material connections (Furlong & Kooy, 2017) which negotiate the movement of water from source to use, including access, transfer, storage, treatment, and re-use.

From the story-maps of Patan's water worlds, this paper makes two interventions for urban political ecology. First, following the contributions of feminist geography I argue that attending to the domestication and devolution of public services demands engaging with household labor (Button, 2017; Katz, 2001; Strauss & Meehan, 2015). Following debates about scale (Marston & Smith, 2001), feminist research has shown the household is not a stable background but an active force of change (Buechler & Hanson, 2015; Buzar, Ogden, & Hall, 2005; Fam, Lahiri-Dutt, & Sofoulis, 2015; Gibson, Head, & Carr, 2015b; Hand, Shove, & Southerton, 2007; Hewage, Kumara, & Rigg, 2011; Jacobs & Smith, 2008; Nightingale & Rankin, 2014; Power, 2009; Yotebieng & Forcone, 2018). Moving forward, I find that the concept of *social infrastructures* (Meehan, Under review; Simone,

2004) offers a powerful site for analysis to examine how processes of development exploit life and the ways life's work creates new possibilities for urban living that are less exploitative. Second, following calls to provincialize urban political ecology (Lawhon, Ernstson, & Silver, 2014), I argue that the Nepali household offers insights beyond the social and material histories of European and American households towards the diverse ways domestic life provisions take place in cities like Kathmandu.

Households, Water, and Infrastructure

The concept of household sits between the physical structure of a dwelling, feeling of home, social relations of cohabitators and family, and domestication of nature. The United Nations Statistics Division classifies a household as an arrangement where one or more people make provisions for their living. Following this definition, a household is a fundamental social and *spatial* unit: a site of life provisions and social reproduction. The household is also a political and economic unit. As the household becomes privatized and individualized with connection to modern infrastructure systems, the household becomes legible to the state and circuits of capital (Buzar et al., 2005; Kaika, 2004a).

Of those infrastructure systems, water has proven particularly challenging to manage and contain (Bakker, 2012; Gandy, 2004; Krause & Strang, 2016). Glacier lake outburst floods, contamination crises, and dry reservoirs are examples resulting from the failed promises of water infrastructure projects to protect or enhance lives (Carey, French, O'Brien, & O'Brien, 2012; Millington, 2018; Ranganathan, 2014; Sultana, 2011). Moreover, the distribution of benefits and harms from infrastructure systems are spatially and temporally uneven (Arboleda, 2016; Coutard, 2008; Kooy & Bakker, 2008). Deitz and Meehan (2019, p. 16), for example, spatially analyze household plumbing connection

across the United States to find that "plumbing poverty is not a simple artifact of income, rurality, or housing type; infrastructure provision is clearly racialized and historically produced in the United States." As Deitz and Meehan (2019) emphasize, the lack of access to vital public services is a systemic form of violence that takes away from people's lives and futures (Laurie & Shaw, 2018). Moreover, it is the households in places characterized by infrastructure crises which help to create a modern home, either as hidden sites of extraction (Arboleda, 2016; Perreault, 2012) or otherized symbols of difference (Kaika, 2004a; Kooy & Bakker, 2008; McFarlane, 2010; Robinson, 2013).

In places characterized by pervasive infrastructure failures, like Kathmandu, residents live in a under conditions of insecurity. Boundaries between civilian and state become blurred as people hustle to make do in a leaky bureaucratic system (Anand, 2017; Ranganathan & Balazs, 2015; Truelove, 2018). As Roy (2005) argues, informality is a powerful mode of development. The functions of urban services fall heavily on households, especially as neoliberal policies unfold with informal systems of governance.

All too often, development projects target victims of infrastructure crisis instead of the driving forces behind those crises (Kaika, 2017). Non-governmental and for-profit groups supported by international and national governments, for example, provide rainwater harvesting retrofits for wealthier households and training or chemicals for poorer women's groups to cope with poor water infrastructure and become resilient or empowered (Button, 2017; O'Reilly, 2006). Thus, understanding urban precarity demands peering into the household, particularly the dwelling structure and work of social reproduction that sustain the household (Buzar et al., 2005; Strauss & Meehan, 2015). The intimate spaces of everyday life are not just embedded within broader political and economic processes, but

both are also productive and subversive of them (Caretta & Riaño, 2016).

Kaika (2004) argues that the idea of the household serves as a site to tease apart the boundaries between the private and public, nature and society, inside and outside. However, Kaika's study of the household in Athens and London is situated within a Western history and way of experiencing the world. And although part of the project of colonization and modernization has been to transform the household, or at least disperse a vision of the ideal household and urban citizen, through infrastructure development (Anand, 2017; Bakker, 2010; Banister & Widdifield, 2014; Bear, 2008; Kooy, 2014; Ranganathan, 2014), the European household Kaika describes is not universal. The household in Nepal, for example, has diverse cultural histories which have transformed through processes of internal colonization and international development (Nelson, 2017). The resulting modern Nepali home, much like the home Kaika writes about is idealized as "an autonomous protected utopia" (Kaika, 2004b; Nelson, 2017), yet the social and material fabric of the even the modern household reflects Nepali cultural politics. This paper details the diverse social and material fabrics of the household through the social infrastructures which are integral to the water work of the household.

Methodology: The Story Map

Following calls to provincialize urban theorizing (Lawhon et al., 2014; Robinson, 2013; Sheppard, Leitner, & Maringanti, 2013), Furlong and Kooy (2017) call for a "worlding of water supply" to decenter the analytical focus from the grid's failures to the myriad realities of water's urbanization. Looking at the case of Jakarta, Furlong and Kooy (2017) argue that "ecological connections— mediated by socio-technical practices and power—are important because making water flow in one area easily leads to the

degradation of flows in other parts of the city" (p. 900). Similarly, political ecologies of tool-power (Meehan, 2014), mediating technologies (Furlong, 2011), and pressures (Anand, 2011) highlight the analytical power of infrastructure (also, Amin, 2014; Carse, 2012; Larkin, 2013; McFarlane & Rutherford, 2008; Molden & Meehan, 2018). As these studies from Mexico to India show, the ideals of the Western household are powerful imaginaries that have been dispersed through colonization and modern development. Compared to these ideals, a grounded perspective of water shows that households have diverse cultural histories and contemporary realities that are situated within a web of interconnecting social and material infrastructures (Schwartz, Luque, & Rusca, 2015).

In this paper, I examine social infrastructure – or the "complex combinations of objects, spaces, persons, and practices" which "become an infrastructure—a platform providing for and reproducing life in the city" (Simone, 2004, p. 407). I look beyond direct social relations *with* pipes, tanks, and pumps to the social relations *through* water and water infrastructure (Krause & Strang, 2016) – sharing and watching buckets, gossip about pipe schedules, complaining in groups at the water office, or observing others from rooftops. I do so because these social relations constitute life's work (Mitchell et al., 2003), generative and transformative of the conditions of urban *living.* As Amin (2014, p. 145) writes, households and settlements are crafted through social infrastructure or the "objects, and the cares, skills and chains of possibility." Social infrastructures are thus revealing of both systems of exploitation and the possibilities of new worlds (Meehan, Under review). If the household is a spatial and temporal arrangement where one or more people make provisions for their living, then the social infrastructures of household water work show the myriad ways in which the household as a site of domestic provisioning spills out beyond its

walls (Power, 2009; Yotebieng & Forcone, 2018).

To investigate the social worlds of water work, I developed a story-mapping technique. Story-mapping is a mixed method technique that utilizes ethnographic techniques alongside geospatial data sources and collection techniques to build geovisual narratives of individual and collective experiences. The technique synthesizes textual, spatial, and visual information from different time periods and sites into socially meaningful narratives about experience over time and space. Story-map narratives draft textual storylines with associated photographs of objects, technologies, places, and maps or sketches of spatial relationships through an iterative and reflective process. Each draft gathers feedback from relevant research stakeholders as a means of verifying, expanding, analyzing, and reflecting on the narrative-in-process (Riessman, 2008). In this reflective and iterative process, story-mapping differs from household surveys and diaries, and interviews which tend to focus on events rather than their relations. Figure 29 lays out the process of story-mapping for this research.

Story-mapping took place with two populations: 1) household-level water managers living in Patan and 2) institutional water managers whose work mediates water flows in Patan. In other words, 1) the people doing the water work of the household and 2) the people responsible for managing and providing water for the larger urban population. The purpose of conducting story-maps between these two populations was to examine capabilities within a larger system, to understand the relations between household agency and larger structures. Such an approach draws inspiration from parallel calls from postcolonial, feminist, humanist, and science and technology studies (Buechler & Hanson, 2015; Elmhirst, 2011; Gibson et al., 2015; O'Reilly, 2006; Sultana, 2011; Truelove, 2011)

to examine the "contextual, localized, historical characteristics" in relation to broader flows (Ren & Luger, 2015, p. 154).

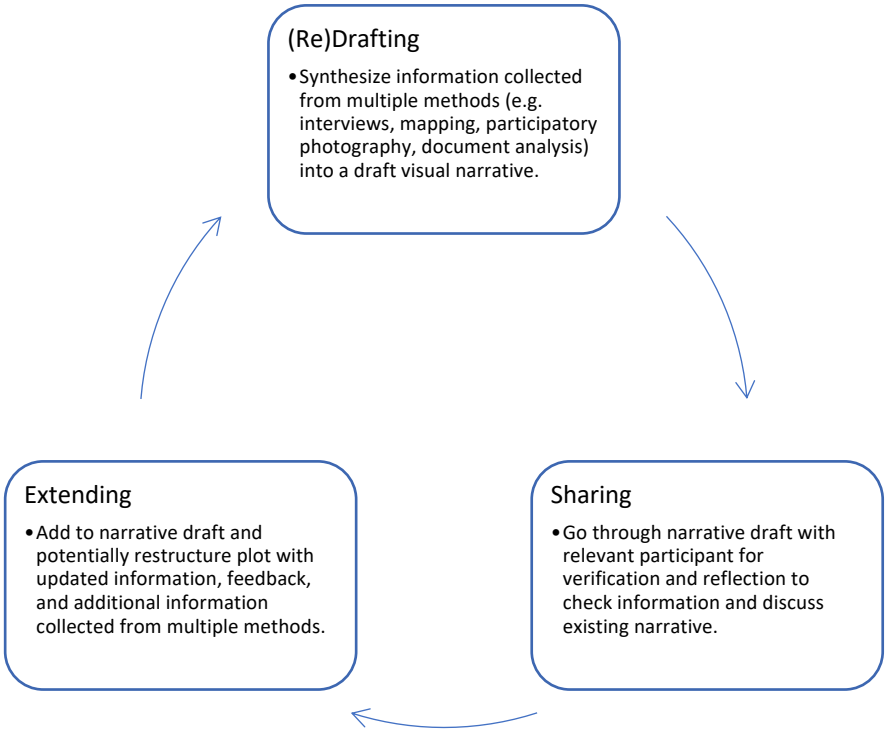


Figure 29. A schematic of the story-mapping process.

Centered around the historic core of Patan, I recruited families within an area of municipal water supply from the public-private company, *KUKL* or *Kathmandu Upatyaka Khanepani Limited* (Kathmandu Valley Drinking Water Limited). The 47 household water managers who participated and remained in the study over 2017 reflect the diversity of urban life in Patan, including some of the wealthiest and poorest residents of the city (Table 3). The experiences of a household water manager although productive are not reflective of the household. Given the social and immersive nature of the research, my meetings with household water managers also often included other household members. Moreover, story-map narratives are representations that emerge from negotiations between the researcher, research assistant, and participant.

Table 3. Number of participants according to identities of gender, local membership, wealth, and homeownership.

Gender		*Local identity*		*Household status* [a]	
Women (daughter-in-law, matriarch)	35	Local (Newa[b])	33	Homeowner	33
Men (head of household)	12	Outsider (migrant)	14	Renter	14

[a]Four of these participants were living in temporary and/or make-shift homes
[b] After Gorkha invasion of the Newa-ruled Kathmandu Valley, Gorkha rulers created a "Newa" ethnic identity (Gellner, 1986; B. G. Shrestha, 1999). Groups often describe Newars as speakers of Nepal Bhasa or Newari and as the original inhabitants of the Kathmandu Valley. Newa people are culturally diverse and live across the Himalaya.

As water relations are highly temporal, narrative-building with participants over the course of Nepal's winter (February-March), spring (May-April), summer/ monsoon (June-August), and autumn/festival (September-November) seasons. We also traversed between the spaces of the participant's household and city's water places to gather additional information. After each meeting with a participant, we transformed the narrative about their water world based on discussion about the existing storyline. To do so, I incorporated new elements of interview transcripts, photographs, observational notes, and spatial references into the narrative. Analysis occurred through the process of (re)drafting narratives, comparing narratives, and sharing narratives. After each session with a participant and day in the city, I analyzed collected information by transforming the numbers, text, and images into draft narrative structure sensitive to time and space for verification and further question with the next meeting. The narrative through photographs, text, and sketches, thus maps the movements of a household in flux (Yotebieng & Forcone, 2018). If story-telling is the primary way in which we make sense of the world (Cronon, 1992; Ingold, 2011; Moen, 2006), then a creative narrative analysis facilitates a systematic procedure for generating those stories, reflecting on their construction, and collaborating with participants (Roberts & Phillips, 2018).

Household narratives, in turn, become texts for further analysis and supply information for thematic narratives. To compare participant experiences, I created spatial databases and maps of point data on use, collection, and storage patterns. Secondly, with these spatial disparities in mind, I read across story-maps to identify commonalities and differences between narratives. Third, I conducted a discourse analysis of water infrastructure from interview transcripts from water providers (n=31), collected institutional documents (n=168), new stories about Kathmandu's water issues (n=382), photos collected from ethnographic observation (n=1,284). I shared thematic story-maps with water management experts and decision-makers (n=15) to gather feedback and perspectives on preliminary findings. Like other participatory and relational techniques, the drafting and re(drafting) of both thematic and individual narratives with research subjects not only helped check information but also gathered new insights and functioned as a mode of analysis (Cameron & Gibson, 2005; Dennis, Gaulocher, Carpiano, & Brown, 2009; Mistry et al., 2014; Wilson, 2014).

Findings: The Social Infrastructures of Water

Before engaging in the findings, it is important to contextualize how the responsibilities of water services have devolved to households, or more specifically the work of particular household members. In Nepal, the government technically owns all water resources in trust and can acquire private land for the development of water resources in the interest of the public. The government grants landowners privileges to water on their land for personal and beneficial uses that cause no harm to others. Although these legal provisions have existed since 1992 under the Nepal Water Resources Act, people complain that they are only in writing due to the lack of enforcement and regulation.

Over the past three decades of foreign investment in water infrastructure development, government actors have allowed more powerful entities (water companies, industries, hospitals, hotels, and wealthy homes) to over-extract from streams and groundwater reserves. Blaming poor government capacity, the public water company, along with other departments responsible for ensuring the rights of their constituents have come to rely on, and benefit from, the rise of private water services. Tankers and bottled water companies have enclosed land to manage and distribute water resources (Ranganathan, 2014). And as water becomes more difficult for residents to access from public infrastructures and private spaces, residents are forced to buy water services, like tankers and storage tanks. Such trends were set in motion by the Shah monarchy and Rana prime ministers who asserted political and economic power in the name of nation-building, for example, by asserting a new caste system, changing spatial relations with infrastructure projects, and grabbing and reallocating land (Mulmi, 2017; Rademacher, 2011; Riaz & Basu, 2007; Shrestha, 1999; Thapa, 2005; Whelpton, 2005).

Thus, under a seemingly haphazard and arbitrary system of governance (Truelove, 2018), access to land and water are revealing of how primitive accumulation continues and permutates. The civil war (1996-2006), driven by disparities in caste, class, and urban development, led to mass urban migration from rural residents seeking safety. This trend continues as residents from rural areas, seeking a better life for their children and family, find work in Kathmandu or other global cities (Rademacher, 2009; Thapa, Murayama, & Ale, 2008). With remittance money, these families can move to the Valley to access schools and other services that are not available in the village. As a result, more than half of Kathmandu Valley residents live in a rented space and are considered a “floating

population" (Central Bureau of Statistics, 2012; Muzzini & Aparicio, 2013). These floating people have become secondary citizens of the city, an exploited labor force building the city and supporting its economy. As studies from elsewhere show, because water is fundamentally a matter of historical claims to urban space, entitlements of land ownership, wealth, and social capital shape household coping abilities (Dapaah & Harris, 2017; Mehta, 2014; Orlove, Roncoli, & Dowd-Uribe, 2015).

A systematic literature review (Majuru, Suhrcke, & Hunter, 2016) of how households from different regions around the world cope with poor water services echoes experiences from Kathmandu. From this review, I outline here the strategies that households employ in response to six issues. First, to secure quantities of water: create new sources (e.g., wells), make connections to external infrastructure (e.g., illegally to the grid), purchase water, or increase storage. Second, to address unreliable water supply: secure water from alternative sources, reduce water use, recycle water, and reschedule activities. Third, to make water safe for use: boil, filter, and disinfect. Fourth, to enhance pressure: install electric pumps and overhead tanks. Fifth, to demand better services: complain, protest, and create associations. And finally, to lessen burdens: form collectives and create decentralized systems for moving, storing, and treating water. Water sharing between households is also common practice but varies in practice, given cultural norms (Wutich et al., 2018). I summarize these strategies in Table 4 by creating a typology of the households I met with during my research.

I found that household water managers, in taking on constraints and uncertainties on the one hand and creating securities and possibilities on the other, transform the social and material fabrics of their homes and urban spaces. Take the strategy of public protest

and complaint. I met several smaller middle-class families living in a modern house on the periphery of town who often faced moments of crisis when their tanks ran dry. Scarcity for these households can occur after a special social event, big laundry day, when the tankers were days late, or when the few hundred liters of weekly tap water did not come. As a result, a family (but mainly the daughter-in-law) would have to hustle (Thieme, 2018). They explained that they would talk to others to find out information, call the tanker company and water provider to make complaints, pull powerful strings or make complaints to the higher-ups, and leave the house to find water from different sources. In one instance, the aunty I was talking with said she commented on the social media page of a powerful politician that the local water official would not fix a broken pipe on their road. This complaint resulted in a quick repair of the pipe. As a result, that aunty has become a local hero and made room for social connection in what was once a fragmented community.

Table 4. Examples of different household strategies as differentiated by household types

Household type	*Built Environment*	*Technologies*	*Social Infrastructure*
Private	(Buy land and) Build a new home. Modify existing house.	Install a well, rooftop tank, and large underground tank. Install storage tanks, filter, rainwater drums.	Hire domestic help. Share with neighbors and family. Delegate domestic tasks.
Communal	Invest in public spaces.	Communal installation of storage, pumps, filtration, wells	Become a community member.
Landless	Gain permission modify dwelling/ public space. Move residence or find new ways of storing and treating water in room.	Buy new buckets, filter, bicycle for carrying water, pump. Make repairs. Repurpose vessels. Take time to find, carry, and manually filter water.	Create system of water sharing, collection, and storage with friends and/or homeowner. Observe/ talk to people about sources and strategies.

While the intervention of this one aunty was successful, many other participants I met with said they were tired of complaining and protesting because the government would only make empty promises (see also, Dennis, 2017). While many participants complained that change would only happen if a large group of people went to complain, several people who had experience protesting in mobs thought it made little long-term change, but did help to create social infrastructure (Molden & Meehan, 2018). In the following sections below, I go into more detail on the changing social and material form of Kathmandu households and the social infrastructures which constitute the flows of water through the spaces of the household and city.

The Public Household: Roofs and Intersections

In the Kathmandu Valley, the private work of water is public: water vessels sit on rooftop terraces, household doorsteps, and at the intersections of roads and communal spaces. The roof has become a particularly important space where the dwelling, household, and public fold together as an active social space. In contrast to the sloping tiled roofs of older homes in the city, the flat concrete roof area is a common feature of renovated or newly built modern homes in the Kathmandu Valley (Nelson, 2017). When pomelo comes into season, people prepare a special dish of pomelo, fenugreek, mustard oil, and yogurt to eat while sitting in the sun warming up and gossiping. In a city with limited open space, some of the best places to enjoy full sunlight are on the roof or in a large public square (Figure 30).

The roof has become an area for water. Metal and plastic tanks dot the skyline allowing gravity to flush water throughout the household plumbing. In wealthier households, these tanks often overflow over the side of the house as people forget to turn

off their pumps, which are helping move water from the underground reservoir to the roof. Roofs also are spaces for solar water heaters, gardens, and rainwater harvesting with tin, tarp, or by collection through the rooftop's drainage. People gather on their roofs to do laundry, dry food like *lapsi* for candy and greens for making *gundruk*, gossip with neighbors, fly kites, worship, make sweaters and a host of other activities. Many homeowners I met will allow renters access to the roof, but as Nelson (2017, p. 63) observes this is usually not the case as "the upper levels of rented houses have become domestic space reserved for the owning family to have access to the roof, kitchen and ritual space." The contrasting experiences of Bina and Srijana, who rents a room from Bina, are telling of how ties to space and place shape the abilities of a household to make provisions for living.

Figure 30. As this household water manager told me from the roof, neighbors watch each other. In this area, many households have used tarps to collect rainwater.

Bina is a resident of the historic Chyasal area. Bina is passionate about social work and spends most of her day chatting with people as she has a small shop at the base of her

home, where she sews clothing and makes alterations. On the upper floors, Bina lives with her husband and daughter, who is attending university. She shares her dwelling with several families who rent rooms. Renters can request water from Bina's reservoir or collect rainwater from one of the two blue 200-liter drums on the roof. Srijana is one of Bina's renters. Srijana moved from Eastern Nepal to Bina's home seven years ago with her husband and at the time, baby daughter. Srijana stays at home, taking care of the household. To cook and clean, she spends much of that time filling and emptying the vessels in her small room and stairway of the house (Figure 31).

Figure 31. A visual summary of Srijana's story-map showing her sites of water work.

Walking into Bina's home, two taps are visible by the door, but for the past three years they have not provided her with water. She installed the second tap hoping that water would come since it connected to a different pipeline. She is upset because she still pays for

those taps and sometimes receives fines if she forgets to pay on time. She is also frustrated because “community people collected signatures and submitted them to the KUKL office as an appeal for not paying the bill until the water comes or if the water doesn’t come to cut the line. But the government told us we have to pay double if we want to install the pipeline again, so we are paying the bill for nothing.” After complaining at the water office so many times the water office agreed to install a deep-boring plan and new pipes to supply the Chyasal area three years ago. Even though the deep-boring plant is now complete, residents are still waiting for supply, and Bina heard that they need to pay additional money for meters.

Outside her door is another tap which supplies water from the community-run micro-grid, which at different times of the year is fed by a well, tanker, and ancient stone spout. She remarks that after the community supplemented the spout water system with a well, it is has become much easier for her. When her two taps and the community stone spout started to supply less water around ten years ago, she would walk all over Patan searching for water. She met an old woman living in a house near the Kumbeshwor temple who was kind and gave her water. Although an incorrect observation, she remarked that “in that place [Kumbeshwor] everyone has access to that water. The water there is clean.” Bina stopped going because the woman’s daughters-in-law started telling her in an unfriendly way that they did not have electricity to pump the water. These days, Bina can request water from the community committee and pump it directly into her reservoir. In the dry season when the stone spout is dry, Srijana purchases around 200 liters of that community water from Bina at cost every two weeks for around 50 cents. Both Bina and Srijana are not happy with the water quality and do not use it for consumption. Instead, they purchase 20-

liter bottles or "jars" of water from the nearby shop for drinking, which they are also not entirely trusting of, especially after Bina saw the jar delivery people step on the jars.

While the community system has made Bina's life easier, Srijana still goes out almost every day to collect water 20 liters in the dry season from the other community well and 40 liters in the wet season from the stone spout (Figure 31). During the dry season, she waits in long lines from the Chyasal committee's other community well system. As she remarked, "We have to pay rent too. So, it is not good if we have to go out and buy water. It is good if we pay in our community and we get water at our doorsteps, even though it might be 10-20 rupees [10 cents] more." Srijana's transactions, although friendly, with Bina and community water sellers, mark her status as an outsider. Alternatively, Bina's investments in the built environment mark her as an insider – she invests in new possibilities for her household that are reciprocal and supportive of the larger community.

Household Volumes: Wells and Tanks

As Bina and Srijana's experiences show, the pump and tank are necessary mediators of water over space in the Kathmandu landscape and a matter of entitlements. Storage is critical because a primary goal for household water managers is to ensure water is available for the day and upcoming days –to reduce both their daily labor and stress of worrying about their care work. Here, matters of place and space are critical because water takes up room and is hard to move. In a turn away from an individualistic model of making the household autonomous, many groups are mimicking pre-modern systems. Historically, cities and urban neighborhoods of the Valley were built around a cascading system of recharge and filtration, transfers (canals, pipes), storage (reservoirs, aquifers), and collection sites (wells, stone spouts) where women would carry home drinking water or

stay to do water work collectively. Thus, water work was very much a public act. In new community systems, pipes and hoses extend from collection sites to households to minimize the work, especially in public space.

For Kayo, new technologies have radically transformed how she interacts with space and people. Once a farmer who spent her days in the fields, Kayo now tends to her households and cares for her grandchildren. She divided her fields into two properties for large apartment-style households. In one of the dwellings, she lives with her sons and daughters their families and several families who rent lower floors. Adjacent to this building, she maintains one small plot for farming but hires outsiders to do the work. Kayo is among many historic residents who have either sold their farmlands or developed them.

Kayo has not applied for a piped water connection to these households. From my other interviews with nearby households, it is unclear if households can even access or apply for piped water. Engineers from the water provider said that they have trouble providing water to the area given the lower elevation and slope. Instead, Kayo buys a truckload of 20 jars a week for all her family and renters for drinking. For all other purposes, she stores filtered well water from her property and water from a tanker in her underground reservoir of 18,000 liters. She also collects rainwater on her rooftop but never mixes this with her well water because she heard it could make her well dry. Kayo's daughters and daughters-in-law do much of the household work, but she has a washing machine which has made domestic work much easier. She estimates that every day she spends three hours on water-related household work.

Kayo has relied on tankers for a long time. At her ancestral home, which is up the road in Sankhamul, she would carry water home that the government distributed by tanker.

Once she moved to her newly built home, she ordered tankers from a contact in her community who started a tanker business. Like many participants, she expressed that she has no choice but to trust the water, however, she is still wary of the water because she does not know where it comes from. To reduce her dependence on tankers Kayo installed a well with the house. As the well water keeps dropping and changing in quality, she has spent a lot of money and effort to keep it alive. She has added two more layers of depth to the well and in 2016 installed a filtration system, which her husband runs. At the start of the monsoon when we met her, she said that if it does not rain for two or three days, the well dries, so she has had to order more tankers (Figures 32 and 33). However, she remarked that "In other houses there is no water in their tubewells. We have well that is why we [at least] have a little water." As her statement implies the kind of technology households invest in, directly or indirectly, matter and, moreover, are a source of gossip as people make decisions about what modifications to make next.

Figure 32. The household water cycle: Well water passes through the new filtration system before being pumped into her underground reserve and then to the rooftop tanks for use.

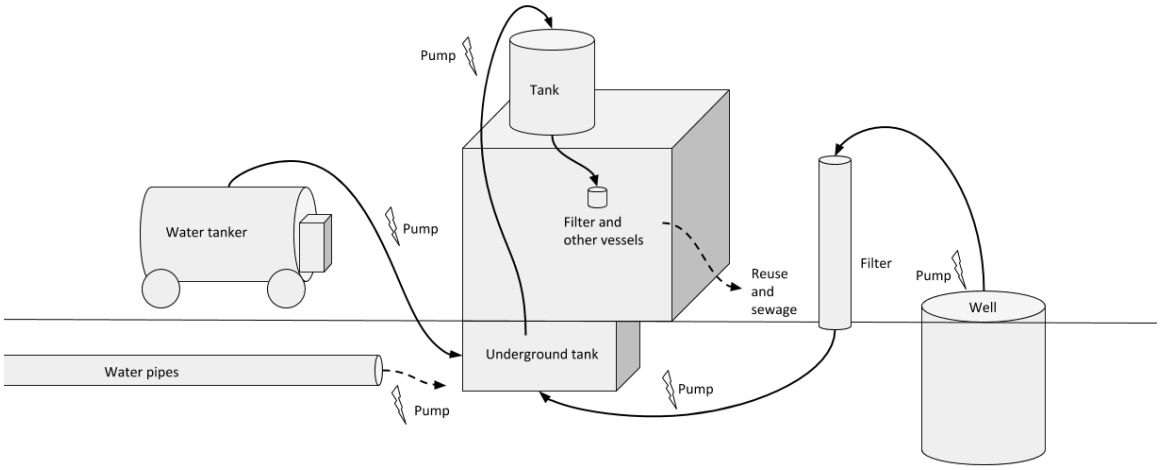


Figure 33. A model of a household water systems based on Kayo's home

The proliferation of wells on private property is a source of high anxiety for residents and the government. In addition to factors of well depth and location, is pump power – a small but expensive mediating technology that pulls water against gravity. Many people I spoke with, government and residential, emphasized the need to regulate well construction and remove pumps from the landscape. Without a government to do this work, one community gathered a mob to destroy nearby wells and pumps in the hopes that doing so would increase groundwater levels enough to make their ancient stone spout or *hiti* flow again.

In my conversation with one participant and her family who are members of a lower caste community historically known for being street sweepers and broom makers, I asked what can be done locally about the water problems. She responded, "We all have to gather and go to people who are making tubewells and should ask them to stop using that. If we do that there will be a lot of water" to which a relative retorted,

> We have already done that. When the water came through the pipeline the people started pumping water through machines and the water in Hiti stopped coming. So, we all went to protest. We threw slippers in the well and buried the tubewell. We destroyed most of the tubewells but still it didn't work out. They made it again… we joined the pipe in the stone spout and bring water because we couldn't carry it.

As a low-caste community, throwing shoes in the well made the water impure, meaning the group used their "untouchable" status as a form of power. I met with two households affected by this act who were horrified by the act – for them the intrusion was the domestic uncanny. The low caste community employs other strategies, repairing social connections with neighbor groups and creating a strong local water system, built around ancient stone spouts. Even with a newer piped water system, residents I met with in this area said they will still use the local system and go to the spout for drinking. As this participant explained, "Even if Melamchi water comes, I will get that Hiti water for drinking. People come from faraway places to get water from there because they believe it has healing power. I will take at least one bucket a day." As such, the revitalization of the ancient water site with new technologies and technologies has also transformed social relations with the water and its infrastructure. The spatial and technological transformation of public areas and infrastructure by local groups is common in Patan neighborhoods and allows for a higher degree of independence from both the government and water sellers.

Kayo moved to a new area without a sense of community. She may share water with neighbors and share knowledge but compared to participants in historic neighborhoods, she has a more defined sense of her household property boundaries – its inputs and outputs. Kayo's house is new; she built it to accommodate the city's water problems with a large underground tank and well. Although she still must make modifications to address changes, Kayo has made more permanent investments than the kinds of incremental tinkering Bina and her family have done with mobile drums, tanks, hoses, and pumps. Unlike Kayo, Bina built her underground tank when conditions were quite different and as a result, she cannot order an entire tanker. Meanwhile, Kayo has left

her historic neighborhood, which still functions much like Bina's with a community water system, to rely more on her nuclear family and private space. Although tanker water helps sustain Kayo's home, Bina's community-run water system is more than an input – it is an extension of her household.

Domestic Labor: Brothers and Sisters

While the built environment provides the material grounds for making investments in new systems, and technologies and technologies allow for various kinds of interactions with water and water infrastructure in its movement or storage, social relations are the ultimate mediators of water flows. Social connections through networks of contacts, neighbors, friends, family, and extended family are a form of water relation as well as a force which can enhance or stymie flows. Sharing water, drinking tea together, or even talking about water are all important social acts that often lead to new investments and changes in the ways people think about water and interact with water. Samita's experiences illustrate the power of social relations.

When Samita's is not working in finance, she takes pride in her social activism. As a volunteer for local water sanitation and hygiene (WASH) non-governmental organizations she tests water sources and talks to people about sanitation and water treatment. At home, Samita checks her water sources and treats the buckets and jars she brings home with chlorine. She does not trust the water and feels like she never has enough.

Samita and her family live in a community tied together by narrow *galli* passageways situated next to Kathmandu Valley's Patan Durbar Square, a UNESCO world heritage site that famous for its temples, water spouts, and palace. When I first met Samita

she was living in her Newar community's meeting house, or *guthi ghar,* because she was rebuilding her home which the 2015 earthquake destroyed. At the *guthi ghar*, which had no electricity or plumbing, she struggled to take care of her family with a few buckets a day. While living there, she bought jars for drinking and spent hours each week collecting water from her friend's municipal tap and the nearby community well, run by the "brothers of the community." However, she is frustrated with them because they are not proactive; she makes many requests and puts forward ideas but they rarely go anywhere. (Calling someone brother or sister, even without direct relation is common in Nepal and indicates a level of familiarity.)

Samita says she is lucky because, despite social norms, her husband helps her as much as he can with household tasks, including carrying home water. As she explains,

> Even the community people say things to my husband like, "You are your wife's servant. You are doing your wife's work" when he goes to take water. And he tells me, "I don't want to get the water. You carry it halfway and I will carry it back home." In the past they used to tease us a lot but now I answer back saying, "Will the men be servants just by working? He does that to help me. When one of us falls sick the other one works. That is why we are married. Otherwise, why would we get married." And they would say, "Okay you won." I used to answer back to all their comments.

As Samita's story of dealing with the men in her community, including her husband, shows, water demands constant social negotiation. It would be more difficult for Samita to tend to all the household work, so the help from her husband makes certain kinds of innovation and work possible.

When I met Samita in June she had moved into her new home although it was still under construction. At her new household she now rarely goes to the community well or her friend's house to collect water because she wants to save money. Instead, she and her neighbors use a nearby well at a home that collapsed during the 2015 earthquake for free.

She also has a well on her property that she used for construction. Compared to the *guthi ghar*, Samita has invested in plenty of storage because she has few guarantees about the state of water access in the near future. As she figures,

> After they [the neighbors] build the guest house here they won't give us well water. That well would be theirs. So, for that purpose we built two underground tanks. When we buy tanker water it won't come in small quantity. We have to buy 7000/8000 liters. So, it would not be enough for us. That is why we built the tanks. I told my husband that it is not necessary, but he said if we have to buy tanker water later then it will be difficult for us.

Although relieved to have her own home with plenty of water storage, plumbing, electricity, and a well, she said she was still stressed because she must pay back her loan for construction. Their incomes and government earthquake reconstruction funds were not enough to cover the costs of building a new home. Those costs accrue on top of other expenses of city life. Another participant, Prem, reflected on the increasing costs of urban life,

> People started to have a busy life and they have to earn by themselves. They can't just earn and spend it carelessly. They have to think of many things like educating the child, and also things are very expensive. These days it is also very difficult to celebrate festivals because we used to have rice, beaten rice at home, and everything is readily available at home but now we have to buy everything.

Prem's reflections are nostalgic for the past when social relations were stronger within a home and community. Because of dispossession and recent selling of land, Newar families can no longer rely on rice produced within the community – they have to take part in the city's political economy. Like other communities, Prem is actively working with his other community brothers to revitalize the community well so they can distribute water to neighboring residents instead of relying on the piped water system. For Prem, the well is not just a water source, it is symbolic of his community and its social ties – the opposite of what he sees happening with Kathmandu's modernization.

Discussion: Water Work

Kaika (2004b, p. 274) writes of the Western city: "crises reveal that the familiarity based on the supposed autonomy of the private space is itself a form of alienation." Yet, in Kathmandu, the "guts" are part of everyday life. In the Kathmandu Valley, water is available, however, for a person, family, or collective to access and then use this water they must be able to secure, move, contain, and transform the water, or rely on other service providers, for example, a water seller or domestic helper. For decades, the Nepal government has relied on the social reproduction of households and communities to ensure household water needs are met.

Over the past two decades, families in Kathmandu have been making modifications to their households in anticipation of infrastructure breakdown. A goal for many households and communities is self-sufficiency, especially in terms of water (Molden & Meehan, 2018). Here, the anxiety and stress of insecurity is embodied in the perpetual quest to transform the household, which also can be a form of alienation – a distraction from the injustices of development.

This domestication of water services feeds on the constant work of household members to create a water-secure home (Button, 2017; Kaika, 2004a; Meehan, 2014). Work that has been passed down through generations by story and practice. Participants often reminded me that in Nepal women are the bearers of water, a responsibility passed down from mothers to daughters and policed by in-laws. Many of the older women I met with remember not having a tap or storage in their home because they would instead go out and collect fresh water every day as their mothers and grandmothers did. This is why the water vessel is a dowry item in marriage.

While the gendered divisions of water work are shifting, and many women share these tasks with their husbands and brothers, the burdens of domestic water work are still being passed down through the generations. Attempts to democratize and, now, revitalize Nepal's piped water system speak to a contradiction between the promise of development for households to be free of water work and systematic reliance of powerful men and public works on the labor of housewives, daughters-in-law, and domestic work of the urban underclass. In these ways, government practice (including its absence) continues to perpetuate systems of Khas Arya Hindu patriarchy and caste division (Bista, 1991; Mulmi, 2017).

Given these histories, the fetishization of infrastructure networks, particularly the promise of water pipes, is different for the Nepali household but also all-too-familiar, resembling what Kaika writes of the European household. Here, the pipe network conceals the "multiple socioecological processes of domination/ subordination and exploitation/repression," (Kaika & Swyngedouw, 2000, p. 136) namely of a government that is still run by high caste Hindu men, in not just sites of extraction and production, but also social reproduction. Without a functional waterworks, people like Kayo, Samita, Bina, and Prem do the city's water work as they care for their loved ones. As such, it is vital to look to the social infrastructures – rooftop socializing and destructive mobs – which sustain urban life and create alternative futures (Gibson-Graham, 2008). These social infrastructures are as diverse as the Kathmandu population.

As I show with story-mapping, Patan residents subvert processes of exploitation and create new possibilities. Bina, for example, helps to maintain the social infrastructure of her community because she believes collective action and protest is a powerful means of

pressuring the government to act. Prem, is a leader of his local club, and is looking outside the knowledge and social relations of his community to the migrants who share his home and the homes of his neighbors, as he explained "fixed [local] community people have limited knowledge. So, to expand that knowledge we should get in touch with people from other communities and castes." Prem has already set in motion plans to make life easier for everyone in the community by filtering and distributing local well water as the other committees have done. When we met Prem, one of his renters, an elderly woman, put down her jar and took a rest with us to chime in,

> I have to carry from Mangal Bazaar [Patan Durbar]. I am resting now because I am too tired. He gives water when we want to bath. But it is still not enough. We have to wash clothes, children's uniforms, clean dishes etc. Women need more water than men. I just carried water and I am very tired so I am resting here.

Her sentiments here are revealing, while Prem does most of his household water work, he relies on pipes, pumps, and tanks, which are supported by her money from rent.

Samita has worked hard over the years to challenge patriarchal social norms to allow for new social practices: she laughed happily when she explained that local men come more frequently to the well to gather water. Samita also helped to create social infrastructure by sharing water and water infrastructure with friends – generating caring systems for collective access and storage alongside the sharing of household functions of watching children, cooking, making tea, and calling to check-in. In contrast, Kayo has attempted to create an autonomous private space – the ideal Nepali *ghar* or household (Nelson, 2017). In addition to managing the renters, Kayo takes care of her grandchildren while her children work to earn money which helps pay for tankers and well modifications. In maintaining ties with her extended family and clan, Kayo still sustains the social infrastructures of her ancestral community – after all the owner of the tanker she orders

from is a member of that community. The Nepali household, in these ways, is a site of domestic life provisions. However, the spaces, practice, and subjectivities of the household rarely follow neat social, property, or plumbing lines.

Conclusion

Tankers, sachets, pumps, buckets, and rooftop storage tanks are all visual clues of insecurity and inequity documented in cities, like Mumbai, Jakarta, Accra, and Cochabamba (Anand, 2012; Kooy, Walter, & Prabaharyaka, 2018; Majuru et al., 2016; Mustafa & Talozi, 2018; Peloso & Morinville, 2014; Sofoulis, 2015; Wutich, Beresford, & Carvajal, 2016). In these places, the movement of people in and out of the household carrying or transporting water, searching for water, fixing infrastructure, tinkering with technologies, or managing water are all constitutive of the city's infrastructure (Simone, 2004). This state of flux and improvisation in the social and material infrastructures of households is a mode of development taking place in urban areas, like Kathmandu or Accra, where the boundaries of state and civilian, informal and formal, private and public are blurred (Ranganathan & Balazs, 2015). By focusing on the practices and narratives of household water managers as they move water around different spaces over time, this paper highlights the social infrastructures of households which keep the city going. Through story-mapping, this research highlights the ways in which people take development into their own hands – building wells, storage tanks, creating water systems with friends – not just to survive or cope but to transform the conditions of insecurity and create possibilities.

CHAPTER VI

IMAGINING A WATER-SECURE LIFE IN A STATE OF INSECURITY

Introduction

He gives his life to cutting grass and earns little money,
he hopes to make a well for his people
so he will be remembered after death,
this high thinking grass cutter lives in poverty,
I have achieved nothing, though I have much wealth.
I have neither made rest houses nor a well,
all my riches are inside my house.
This grass cutter has opened my eyes today,
my life is worthless if the memory of my existence fades away.

"The Grass Cutter" Bhanubhakta Acharya (1814 – 1868)

In one of the many historic neighborhoods of Patan in Nepal's Kathmandu Valley, I met Mala, a middle-aged woman living with her husband and four other families who rent rooms from her. Mala, like many other urban residents, relies on water from a private well. When I asked about her well during my first visit in March, we followed a hose which sat in her bedroom window, connecting the well under her bed to a storage tank outside where people were filling their buckets for a small fee. When I visited again in May, she explained the significance of the well,

> We have to do good things. Our ancestors used to say... don't you know that poem where Bhanubhakta digs a well for people and the merits will come to you? [Before] I was not able to give water for people to drink. I used to buy water and use the community well, using the water wisely and reusing the water again. Today I have water, so 500 liters of water [a day] is also not enough for me. At that time, we didn't have water, so 5 to 6 gagris [brass vessels of 10 to 12 liters] of well water would be used by me and the renters. That is why I dug the well… who else will dig the well when there is no space? I used to get tense as there was no water. I couldn't even sleep.

Mala's reflection reveals the impact of the well on her life. The investment allows her to easily tap more than enough water year-round, which helps her be and do things she values;

for example, she can now keep her house clean and give water to people. Although Mala says she sleeps better these days, she worries that her well could "just dry." Mala knows from experience that she cannot trust the government to ensure she has water, as she explains through her observations of piped water access,

> In some places, there is water in the mornings and in the evenings and in other places there is no water at all. Here, there is water once a week but only half an hour to one hour and the water is dirty. So, that water cannot be used... They [the government] should not do that. They should give clean drinking water in the same amount at the same time to all. They should not discriminate.

As this statement indicates, Mala still worries because she understands her situation in relation to a larger *paani ko samasya,* "water problem," that is driven by exploitative public services.

Mala's story presents several challenges for water security research: Is Mala water secure? Why does Mala worry about her water situation despite having enough water? What does a water-secure life look like to Mala? This paper examines how residents make sense of their water situation and define a vision of water-secure living. Doing so, I engage with political ecology writing around the idea of security and related concepts like vulnerability, risk, and adaptation. Since Watts' (1983) analysis of scarcity and famine in Nigeria, "security talk" and the "securitization of the social" under conditions of postcolonial and neoliberal development have remained central to political ecology critique (Dalby, 2017; Loftus, 2015; Perreault, Bridge, & McCarthy, 2015). Moving forward, this paper responds to calls for political ecology analyses to engage with the ways people define their experiences of vulnerability (Buechler, Hanson, Liverman, & Gay-antaki, 2017; Hawkins et al., 2015; Jasanoff, 2010; Jepson et al., 2017; Liverman, 2015; Mehta, 2014; Perreault, 2014) and more broadly, with "questions of life and security in new ways to ask

what it might take to be secure, and not securitized" (Lowe, 2015, p. 501). Specifically, this paper has two interrelated goals.

First, I explain the ways Kathmandu residents define water security, or what water-secure living looks like from the perspective of people responsible for their household water tasks. I found a collective story within and between those household narratives about what urban water relations should look like that emerged directly in contrast with the status quo. In this paper, I identify overlapping components of that collective story: water quantity, quantity, affordability, equity, sustainability, and management. I identified these components by examining normative statements and how participants make sense of their water situation through relations with other people and places over time, including the research process. I argue that participants define their experience of water security through moral judgments which hold government and development practices accountable. From these accounts, I argue for a moral understanding of water security, and by extension, a humanistic approach for political ecologies of resource insecurity and environmental change.

Secondly, to advance a humanistic approach for political ecology, this paper presents *story-mapping*, a spatial narrative-building research technique. I developed story-mapping as a means of relating everyday experiences with top-down perspectives from survey findings, engineering plans, and development reports. Over 2017, I built narratives with 47 people who secure water for their families to make sense of the diversity and dynamism of experiences, both individually and collectively. I additionally built thematic narrative drafts from participant narratives alongside collected information from relevant documents and 31 institutional water managers. To create story-map narratives, I

synthesized textual, spatial, and visual information over time from different sites for each household participant and thematic narrative. Building narratives was an open and iterative process, each draft gathers feedback from relevant research stakeholders as a means of verifying, expanding, and reflecting on the narrative-in-process. As I argue in this paper, performing research as a narrative-building process opens the possibilities for greater convergence between the GeoHumanities and political ecology.

Humanizing Water Security

Security and insecurity are slippery terms. The word *security* refers to a state of being free from danger or being fixed. Insecurity is a lack of protection from risk and uncertainty. The root word *secura* means "without" (*se*) "care" (*cura*), making *insecure* "not without care." The idea of security in water security literature more often reflects securing kinds of relations with water – control, access, safety – than what it would take for people and communities to live secure lives (Jepson et al., 2017). For example, Grey and Sadoff's (2007) highly cited definition of water security as "The availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies" not only normalizes an environmentally deterministic vision of water security, but also assumes that meeting certain parameters will allow for people to survive. As political ecology texts have shown (Bakker, 2007; Clement, Suhardiman, & Bharati, 2017; Jackson, Spiess, & Sultana, 2016; Loftus, 2015), vulnerable people are often "viewed as passive bodies subjected to the whims of their environment and therefore in need of rescue by knowing, technologically capable subjects" (Loftus, 2015, p. 355). Thus, challenging prevailing water security narratives demands a grounded and humanistic approach. As

Jepson and colleagues explain (Jepson et al., 2017, p. 49) "Examining the ways that communities themselves define water security broadens our gaze from access and adequacy to include how cultural knowledge, values, and dynamic practices inform the hydro-social relations of water security at community and local levels."

Geographic research on the experiences of insecurity, and related ideas of precarity have drawn from sociology and psychology to understand both how people make sense of insecurity and the possibilities for positive transformation. Central to these studies is the idea of ontological security or a state of inner being which people desire (Bondi, 2014; Hopkins, Hörschelmann, Benwell, & Studemeyer, 2018; Philo, 2012, 2012; Vaughan-Williams & Pisani, 2018; Veland & Lynch, 2017); a state which allows individuals "to take for granted— to trust—that our ordinary, everyday worlds are reliable and dependable" (Bondi, 2014, p. 332). In contrast, ontological *in*security renders our ways of being in the world – meanings, identity, values – uncertain (Veland & Lynch, 2017).

Recognizing the affective dimensions of insecurity (Drew, 2013; Gergan, 2016; Jepson, 2014; Sultana, 2011; Truelove, 2018; Waitt & Nowroozipour, 2018; Wutich, 2009), I examine human-environment relations as an everyday negotiation of values (Drew & Gurung, 2014; Tamang, 2016), to see "the multiple, interconnected valuations of water" as "shared expressions of accumulated experiences, current circumstances and future expectations" (Ioris, 2013, p. 334). In this paper, I consider the interconnections between the emotional, normative, and imaginative to reckon with how participants make sense of insecurity.

Here, I consider imaginaries and beliefs as more than expressions of culture or politics. Maclean and The Bana Yarralji Bubu Inc. (2015) find that mainstream water

management approaches equate indigenous peoples with culture as an abstraction of customary traditions. Maclean and The Bana Yarralji Bubu Inc. state (2015, p. 151), "Although some Indigenous water knowledge, values and interests do relate to culture (spiritual and customary objectives), this category does not adequately capture the many and diverse interests that Indigenous people have for water..." These findings are relevant for Kathmandu, and the Himalayas more broadly, where international and national discourses of development similarly frame water practices and systems beyond the piped water grid as "just cultural" (Molden et al., 2016).

Thus, conducting research in heterogeneous landscapes, like the Himalaya, demands a relational and everyday approach, where cultural identities and practices are diverse and dynamic but also subjected to decades of cultural hegemony (Nightingale, 2011; Rademacher, 2011). In Nepal, for example, the Hindu elite who emerged from Gorkhali rule after Prithvi Narayan Shah conquered the Kathmandu Valley built the nation in their own image (Mulmi, 2017), creating social inequalities that are expressed and reproduced through processes development (Bista, 1991). Because of these histories, Drew (2016) examines reactions to the pollution of sacred water bodies in India through an everyday approach to religion. Drew (2016, p. 78) finds that "even as people navigate uncertainty with the understanding that cultural, structural, political, and cosmic forces are at play, they also see opportunities to make decisions and to forge their own paths." Drawing on these insights and building on this approach, I look towards the ways people assert particular ideas and ideals for urban water security to hold certain social actors accountable and create possibilities for more caring and moral water relations (Hoffmann & Metz, 2017). As I explain in the next section, story-mapping is particularly well suited to

both relational and everyday approaches of environmental insecurity.

Narrating Experiences of Water Security

Representations of water insecurity and environmental change, more broadly, create a disjuncture between fact and meaning at the levels of "community, polity, time and space" to project an "impersonal, apolitical and universal imaginary of climate change" (Jasanoff, 2010, p. 233). To challenge these narratives of survival and add necessary depth, Jasanoff (2010) calls for interpretive research that focuses on human meaning and sense-making. In similar calls, story-telling has emerged as a way to intervene in both the ways we know and deed environmental struggles (Castree et al., 2014; Hawkins et al., 2015; Hulme, 2013). For the most part, however, the role story in research concerns the use of story as an anecdote or data, narrative analysis, and the dissemination of findings (Atkinson & Delamont, 2006; Cameron, 2012). This paper introduces story-mapping as a geovisual technique which performs research as narrative-building. Here, I see narratives as an expression of ideas about the world is and the way it ought to be (Jasanoff & Kim, 2015) because "the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it" (Jasanoff, 2000, p. 2).

My goal with story-mapping was to attend to the interconnections of place, knowledge, and power (e.g Eriksen, Nightingale, & Eakin, 2015; Robinson & Roy, 2015; Yeh, 2015), particularly in relation to problematic concepts of development, like water security (Lawhon, Ernstson, & Silver, 2014; Leitner & Sheppard, 2016; Sundberg, 2014). Inspired by participatory and reflexive methods, I designed story-mapping as a means of attending to the ways we research, narrate, and make claims about subjective experiences, especially those of vulnerable people (Braun, 2008; Cameron, 2012; Caretta & Riaño,

2016; Sultana, 2007). By *we,* I refer to researchers broadly and, specifically, to the interactions between myself and the people whom I worked closely in the research process, including Nita who assisted me in the research and research participants. Doing so, I take seriously Robbins' (2012) definition of political ecology as a kind of text, born and shared from research efforts expose the drivers of environmental struggle and plant seeds for just transformations. As Gibson-Graham (2008, 2014) argue, the stories we engage with and the stories we tell are powerful and productive of alternative realities.

Over 2017, I conducted story-mapping in the city of Patan with residents who secure water for their families, or household water managers. I focused research within one urban area to allow for in-depth ethnography into the myriad practices of urban living. The 47 individuals that remained in the study throughout the year are a diverse group and fall between some of the wealthiest and poorest residents of Patan. Participants included 35 women and 12 men; 33 Newar homeowners ("locals") and 14 migrants who rent ("renters"). To contextualize those experiences and understand where their water was coming from, I also traveled to water distribution sites and management offices where I met with 31 decision makers, experts, and water providers from non-governmental, governmental, and corporate groups.

I divided research into four phases: three phases of story-map drafting in the winter, summer, and wet season, and then story-map finalization in the fall. A seasonal focus aims to capture changing conditions with climate, festivals, politics, and work. The initial phase created the base narrative structure from collected photographs with spatial reference points, observational notes, and interview transcripts. Before each step, I processed observational notes, spatial data points, transcripts, and photos into folders, databases,

maps, documents for each participant. I then selectively embedded text, sketches, photographs, and maps into Esri's Story Map App as a draft narrative that we then edited and expanded. Following the same research procedures and narrative style facilitated comparison between narratives to identify patterns of similarity and differences. The purpose of iteratively and reflectively synthesizing visual, spatial, and textual information together reflected an attempt to see the "diversity economic, social, cultural and political subjectivities that comprise any one subject" (Cameron & Gibson, 2005, p. 325), which is central to an everyday approach. Additionally, I utilized this process as a mode of analysis through which I created thematic story-maps, which I used in interviews with experts and decision-makers.

This paper draws on an analysis of participant story-maps as texts. Specifically, I employed 1) a narrative analysis as the synthesis of textual, visual, numeric, and spatial information collected to create socially meaningful narratives; 2) discourse analysis of each story-map draft to understand the relationship between experiences and normative statements; 3) thematic coding and database analysis to compare story-map narratives. As this paper weaves together participant story-maps, it is also part of the process of story-mapping.

Household Definitions of Water Security

Below, I present findings through five vignettes of participant experiences. These vignettes highlight six central components of water-secure living, which I identified from analysis of participant story-maps, summarized in Table 5. All these elements necessarily overlap. As management is a central aspect to all imaginaries of water security, I have highlighted this element within the other five – quantity, quality, convenience, equity, and

sustainability – in the findings below.

Table 5. Dimensions of water-secure living based on participant reflection

Quantity	*Quality*	*Convenience*	*Equity*	*Sustainability*	*Management*
Security					
More than enough water to share	Good water: "Blind trust" water is safe and purifying	Free water available all the time in taps, wells, spouts	Water for all – no disparities.	Good management, unity, greenery	Good people managing water (trust)
Insecurity					
Not having water to drink or share	Bad water: contaminated (smell, taste, appearance)	Paying any cost (in money and labor) for water	Inequities in supply and quality	Fluctuation (quantity/ quality) and uncertainty.	Bad people managing water (corrupt)

Quantity: Enough to Share

Muna, an older woman, lives in a historic Newar community around a courtyard or *bahal* of Patan with her husband, son, and daughter-in-law. Her community collectively decided to cut their connections to the water mains and install a well in 2007 for the *bahal* members to use. From Muna's roof (Figure 34) you can see the layout of the temple which faces the community well, free water distribution point, and community meeting hall, all built since the early 2000s. Since the 1990s, community groups like Muna's have installed wells, deep-boring pumps, or created local water grid systems from wells and ancient stone spouts. These groups have sought to not only amplify the water available for community use but also to transform social relations and generate possibilities for local organizing around shared infrastructure and space (Molden & Meehan, 2018).

Since her community built the well, Muna's water experiences have radically changed. The well has improved the amount of water she and her neighbors can access weekly. She easily connects her hose pipe to an input site multiple times a week or fills a jar with water from the public tank daily. The well also allows her community to share

water freely; local managers open taps for public collection at certain times of the day. Being able to give water is something Muna values for personal and spiritual reasons.

Figure 34. The community well, public tank, community office, and place of worship.

Before the community well, Muna explained how she and other women in the neighborhood collected water from an ancient stone spout down the road in a lower caste butcher community. During this time, piped water services to their neighborhood had diminished, forcing them to find alternatives. Out of frustration for paying for services that did not provide, they decided to “cut” their line to the municipal network in the early 2000s. Eventually, neighborhood leaders came together and took steps to build a well. Muna describes this process,

> I used to always wish for a well in our community. All the women in the community talked to each other about convincing our husbands to arrange a meeting in the community and do something about the water problems. We even told our husbands that they don't have the courage to do anything. I also used to tell my husband about it because we have to do all the work and we didn't have time. So, my husband took a step and discussed this topic with other people in the community. It was many years ago, even before the well was built. We had to see if there was water to do deep-boring. And when they asked who is going to spend the money for that, my husband said, "Okay I will spend Rs. 500 for that. If it is

> successful then it is okay but if not, I don't care if it is wasted." Rs. 500 was a very big amount then. We had to work for a whole month for that. So, we tested if there was water. And they found that there was water. The well was built much later after that…. The first time when they found there was water, we were so happy. Everyone rejoiced. But we didn't do anything after that. Later again we spent about Rs. 700 and rechecked the water availability. After they confirmed that there is water, we organized meetings and collected money from community people. Because all the community built this together it is good for all the people here. Now we go to take water in turns.

As Muna's story shows, the process to build the well was emotionally charged, especially given the struggles of Muna and her friends to collect water from the downstream stone spout. It was not only difficult for them to wait in line, collect water, and carry water home, but the added social tensions and prejudices at the time made it even more stressful. Building the well for Muna is a sign of community strength as the investment has improved relations and living in the neighborhood.

Although she is happy with the well, Muna still worries about water because she knows that not everyone has enough water. She also knows that the water level in her well, like other sources, may keep dropping. In recent years lowering groundwater levels have been decreasing, and sometimes there is not enough water. She says that recently her neighbors with more family members buy additional water from outside the community during the dry season. Muna works hard to manage her water carefully. Even at the start of the monsoon, during our third and last interview with Muna, expressed worry because there was not much rain and the well had not risen much. However, her worries are not just about her water situation,

> Everyone is struggling for water. So, we are trying to meet the water needs of the people. For the outsiders too, those who come before 7 am, we haven't let them go without water. We have to work [struggle] hard for water. If we don't work hard it is not possible for anyone to meet their water needs.

Muna understands her struggles through a collective struggle and moral duty; for example,

she supports her community's decision to provide water to outsiders, even in times of scarcity. The ways in which Muna situates her water struggles within a broader landscape were common across interviews. Respondents would often move between talking about their water situation and their observations about the water struggles of others or the more general water situation.

Muna hopes that with the new piped water system, pressures on local groundwater resources will lessen. If it does not improve, she fears making the well deeper because she has heard there will be "bad water" which will spoil the well. Worries about lowering groundwater levels, changing rainfall patterns, and promises of the new grid were repeated across story-maps. Despite her fears, Muna is not sure if she will use piped water again. She thinks that she will have to pay a lot of fines and fees to regain connection to the main water network. While many participants expressed a desire to use the new pipeline system, Muna says that regardless of whether she gains a piped connection, she wants to continue relying on her well. For Muna, using the well water is not a matter of meeting needs but a practice which affirms her sense of place and community. Such feelings were evident when we asked Muna about her outlook for the future,

> You can say I am optimistic. We have water till now. I hope I don't turn pessimistic. I just pray to *Nagraja* that everyone gets water. *Nagraja* is the God who gives water. Every day when I go to temple, I pray to *Nagraja* for enough water and not to lessen water in the well. I pray for that every day. I have not skipped a day. The more we give water the more we get… I just pray that everyone gets to drink water, and nobody has to suffer from water problems. I hope we don't have to listen to some news that says that people died because there was no water to drink. There is no world without water. No one can live without water.

As Muna emphasized, her worries are not her own. She sees water scarcity as a more significant problem, something which no one should suffer from because water is life. Between her prayers and the community's open taps for public use, Muna has faith things

will get better. A firm moral grounding that is tied her sense of community and spiritual beliefs is fundamental to how Muna addresses and makes sense of growing issues of scarcity, and more fundamentally, rapid change in the city.

Those understandings contrast with the actions of government and development. Muna and many other respondents talked about the absurdity of water scarcity in the Valley, given their memories of water in abundance and nationalist school-book lessons about Nepal's wealth in water resources. While several participants expressed beliefs that water scarcity is divine will, at another level they see their everyday water struggles as an issue of mismanagement and unethical politics. When we asked Muna about changes that could happen she expressed,

> It is not that we don't have water in the country. They should appoint some good people who know how to deal with water problems like storing and distributing. It would be good… We should first take those corrupted people out. There should not be corruption in case things as important as water.

Muna sees water shortages as brought about through corruption and inherently immoral given water's significance. Worries over corruption in water management were shared in my conversations and many people made references to how the arrest of corrupt officials in the energy sector and replacement with a good person has reduced rolling blackouts. Our discussions with Muna were revealing of the ways multiple values come to interplay in the ideas of good and bad alongside secure and insecure.

Quality: Blind Trust

Laxman rents a room with his wife and small children in a household on the sprawling periphery of Patan near Balkumari. Like many other migrant workers in the area, he spends his day refining brass sculptures of Hindu and Buddhist deities (Figure 35). Since he migrated to the city over ten years ago from a village in Ramechhap he has

already moved twice. The household where he rents a room does not have municipal sewage or a drinkable piped water connection. For homes in the area, the government pipes deep-boring water from a nearby source which they tell people not to drink even after filtration. The homeowner grants Laxman access to stored water from the deep-boring line and the household well. Overall, Laxman is angry that he pays so much for water he cannot trust.

Household water managers, like Laxman, evaluate water when they first access it and before using it (especially if the water has been sitting for several days) to check if it smells, tastes, or looks off from what they expect. After that, they may attempt to filter and strain the water, let it sit, or treat the water with "medicines." Government and non-governmental groups sometimes distribute "medicines," like free bleach or chlorine for people to add to their water, for example. However, some participants refused to drink chemically treated water because they did not like the taste and worried about its effects. Other participants reported that they would only drink treated water.

Across story-maps, participants made major investments in time and money to have good water. Those investments include visiting tanker and jar processing centers, testing the water, installing expensive filters, or moving water through multiple forms of treatment. Participants with more political and economic powers could go through additional steps to not just access "good," "pure," or "trusted water" sources, but also to transform water to make it so – both in terms of filtration methods for drinking water and rituals for making water pure for religious acts. The notion of transform, here, represents the various rituals and procedures people go through to change the state of water, so it is acceptable for different purposes like worship, laundry, or drinking.

Different storage tanks often correspond to varying qualities of water. Household water managers may save grey water in buckets for flushing the toilet, rainwater in barrels for laundry, stone spout water in brass jars for cooking, and jar water for drinking. The corresponding vessel is essential. One participant felt sick when she saw a shopkeeper step on a water jar for sale. Another participant explained her dismay at seeing renters bring dirty vessels to fill water at her water station, so she would give them extra water to clean the vessel first. Worries over cleanliness connect with feelings of being and feeling clean and healthy.

I heard about the desire to "drink blindly" repeatedly. Here, the desire to directly drink from the source without worry is a priority because it also means that the water is by extension, safe and acceptable to use for other activities. These desires reflect a lack of trust in water providers; they also speak to the role of relational understandings over time and space. Participants often talked about how community, government, and non-governmental groups tested their water to see if it is safe. While they trust those measurements, participants also rely on place-based knowledge about what sources are good and what good water should taste, look, and smell like. Mala, for example, felt disgusted when she saw the well in her friend's bathroom because she thinks of that space as dirty and impure. In Nepal, like many places, certain qualities of water are associated with specific places and rituals.

Laxman draws on his experiences growing up in Ramechhap to evaluate the water. As he explains,

> More than finding out if the water is clean, we used to drink water from the source, so we know the taste of water. That's the first thing. In my village, we used to get water directly from the source, beside the jungle through a tap. The water is very clean. We are used to drinking such water, and now when we have to drink this

> water we don't feel like drinking. The taste differs. Better than this water we prefer boiled water. Boiled water also doesn't have any taste. But at least boiled water tastes the same, either it is this water or village water. That is the reason.

As Laxman explains, he judges the city water based on his memories of the forest spring water from his village where he grew up as a "child of water." He uses water that does not meet his standards for non-consumptive tasks, like his work (Figure 35). For many Newar participants, memories about the sweet taste of water from an ancestral well or the salty taste of a stone spout with medicinal properties functioned as benchmarks for water quality. Some participants did not want to drink any other water sources they have always used – sources from home, be that in the house, neighborhood, or vicinity. Judgments about the "goodness" of water, thus, emerge from a negotiation of values and knowledge, which can be religious (e.g. by decree of religious leader), spiritual (e.g. by blessing, ritual, or source history), cultural (e.g. shared beliefs about a source), scientific (e.g. lab results, official reporting), and experiential (e.g. interactions with a source over time).

Figure 35. Laxman uses "bad water" for making statues in the shed opposite his room

When good water is hard to come by, household water managers carefully manage different qualities of water. Due to the difficulty accessing fresh water from a flowing tap or open well, some participants explained that for daily worship, they leave out drinking water on their roof overnight. For drinking, the desire for fresh water is powerful; some participants found stored, boiled, treated, or packaged water so disgusting it makes them feel sick. Laxman feels like he has no choice but to trust the water he has access. He would prefer tap water but there are no pipelines in his area, and while he trusts packaged water, he finds that jars are too expensive. As a standard, he thinks that water,

> … should be clean, healthy and it should be good for our health. It should be such that we can blindly trust and drink that water. Even if it costs much...but we also think that it should be cheaper… even if it is expensive, it should be clean for us to drink.

Like other household water managers, Laxman frets over the qualities of water he exposes to his loved ones in terms of both short- and long-term harms. For example, Laxman complains that the water coats their clothes and bodies in a white powder, which gives his children rashes. Other, participants complained about the ways water would burn their throats and skin or turn their clothes orange from too much iron. He says that in Kathmandu if you have money, you can have water.

Participants discussed issues of water quality in relation to the degradation of the urban environment. Here participants cited urban development, deforestation, and loss of recharge area as reasons for the city's water problems. When we talked about what to do, participants emphasized awareness and making the city green. Compared to other participants, Laxman had a specific idea of greenery based on his experiences in the village,

We aren't educated enough to know about this [what to do about Kathmandu's

> water issues]. But if we think from a villager's perspective, we find out which place has a water source under it. I don't know if you know it or not, but we have "Fanil or Chilaune trees" and in such trees, there is a well beside those trees. We can plant such trees in a larger area. When you plant trees, it will be cooler and roots will be wet. From those droplets of water, we can collect it and for a small area, we can distribute clean water drinking. In a villager's mind, I think like that. In the villages also where there are many trees there is usually a well. Even if people don't care, there is water flowing there. For that reason, we need to plant trees for water.

Laxman explained that he witnessed widespread deforestation and road building in his village area, which he thinks caused the drying of springs and water scarcity in Ramechhap. Such experiences are critical to why he believes reforestation is necessary for Kathmandu. Laxman's argument about the connection between certain kinds of trees and water availability, moreover, highlights a deep belief in the necessity of having clean water readily available so that "even if people don't care, there is water flowing there."

Convenience: Cost

Nandana lives in one of the most desirable parts of Patan to own a home and access water. Her home is across the road from one the Kathmandu Valley's guidebook tourist attractions: Patan Durbar Square. In addition to shops, restaurants, and hotels for tourists, her home sits adjacent to numerous shops and services for residents. In this central commercial area, piped water flows strongly. She loves her neighborhood and is happy with her situation because she can conveniently store and pump water.

In the past, she had to carry water to her home from nearby stone spouts. Although it was difficult, she said she was healthier with the exercise and "gained good experience." After they installed piped water, she still struggled because she had to use a hand-pump to pull water from the pipes. Even after they installed an electric pump, scheduled power cuts forced her to use the hand-pump or disturb her sleep to pump when there was electricity. She said the last time she seriously struggled for water was during the earthquake because

the piped water mixed with sewage. During this time, she ordered tankers for two months. These days she only needs to order a tanker during the start of the monsoon when piped water flows diminish because farmers divert the water for their fields.

Participants, like Nandana, felt conflicted about paying for water services because of beliefs that water is a public good. Nandana's neighbor who struggles to live with a few jars of water a day stated: "buying water means bad things." As Bhanubhakta's poem conveys, there is a strong moral belief that if anyone asks for water to drink, one should give that person water freely (Figure 36). Ramesh, for example, was surprised by water sharing in Thailand,

> Last time when I was in Thailand, I was really thirsty. I saw a person with two bottles of water and I asked him for water. He didn't give it to me but he left me in a shop and told me to buy water and drink. In other countries, we have to buy water to drink. And when we went to the hotel, they would only give you water from 7-10 and later they don't fill it up. Maybe because it was too expensive? So, in Kathmandu, even if there is a drought, we can manage water from anywhere though it might be expensive.

While Ramesh resigns that buying water is now a reality of urban living, he still finds injustice in the management and distribution of water, knowing some people, namely, wealthy politicians, receive more water. Between these discussions, it was clear that many participants did not know about or understand their rights, particularly in relation to the role of government services, like KUKL, the water provider.

Nandana is one of the few participants who felt happy with her water situation. Indeed, her situation is desirable with affordable water bills and the ability to have running tap water because of enough delivery and storage. Most participants wish for easy and affordable water connections like Nandana's. For example, when we asked Rojita about what an ideal water situation would look like, she said: "I wish if I didn't have to buy

water. But we have to buy, we need water. I like tap water also. If there was tap water, it would be like heaven." Rupa similarly wished for just one added day of piped water supply, so she does not have to wait in line for water at a distant spout. Overall, participants said that domestic piped water access is the most convenient, regardless if managed by community or government because it is easy to connect a pipe or hose from the nearby input to the household plumbing and storage system. Additionally, being able to rely on the services which manage piped water lessens the burdens of household water management.

Figure 36. Groups organize to give out clean water for free at celebrations and festivals. Some shop keepers and religious sites keep a jar of water outside for people walking by.

Nandana, however, still worries. Nandana repeatedly predicted a bleak future and feels pessimistic: "The stone spouts are all dried up. There's no place to fetch water. We

have to rely on KUKL [the municipal pipe network]. The population is expanding so they are not able to supply as per demand." She said half-joking: "We can have life without money, but we can't have life without water. We can't even buy water now if we had money." However, when we talked to her more about her concerns about water scarcity, she explained,

> The whole community and people can go to protest, but we should try to buy water first. If it is not available, then we have to do what is needed. For example, how we spent our days when we didn't have gas in the blockade. We should try to get it from all the alternatives and use as less as possible.

During our conversations, Nandana emphasized careful water management and lifestyle changes as a first resort, and protest as a last resort. Nandana's ideas about carefully managing water align with other older participants who grew up in Kathmandu and remember days when there were no taps and families used less water.

> Water is like money. It comes and goes. For that, there is no strict rule that we have to do this or that. We only have to use it less. I can't suggest anything. Even though we know that we should use less water, we keep on using more. It is easier said than done. In the past, people filled water in small mugs for any purposes. Nowadays there are taps everywhere. So, people just waste water. If only 1 liter is needed for anything, they end up using 4 liters.

This belief in careful use also aligns with technocratic water managers who worry about changing behavior patterns, especially as people use more water in their homes with new facilities and more Westernized lifestyles. Responses which blame behavior and population often came from participants who are in a position of power and control. For example, we often heard from homeowners that their renters mismanaged and wasted water. However, we observed some of the most careful water management practices among renters like Sujata and families who struggle every day to collect water. Renters, like Sujata, additionally feel like they cannot complain because locals will tell them to move back to

their village.

Nandana is one of the few participants who sees protest as a last resort. Most participants said they did not want to shy from collective action and wished that more people – both within and between neighborhoods – could come together to talk about their shared issues and ways to move forward together. There is a sense of injustice in all story-maps that people have no choice but to carefully use water and spend precious time and money to access poor services because of government failures. As Bina expressed: "We cannot do anything without water so we need to get water at any cost." Nandana, says she would like to move to a village where water is plentiful and free. Like Laxman, Nandana wants to feel a sense of autonomy, to feel like she has a choice, rather than having no choice but to pay.

Equity: Water for All

All participants noticed inequalities in water access, particularly piped water access. The ways in which participants noted those struggles and the disparities between them is revealing of their privilege and positionality. Participants who rent small rooms and struggle to collect water every day, like Rupa and Jun, explained that they felt better knowing that everyone else also struggles for water. Rupa and Jun both live in some of the most challenging areas for water access. Nandana, alternatively, interacts primarily with other wealthier homeowners in her neighborhood. Nevertheless, all participants expressed awareness that although water problems are widespread, some struggled more than others. As such, participants prioritized the need for equitable distribution, and by extension, institutional transformation.

In creating story-maps, I found that participant concerns over the equality of water

distribution, whether from the government pipe or household well, often aligned with beliefs about everyone being equal. We repeatedly heard the expression: “we all bleed red.” This phrase evokes the idea of common humanity that transcends caste, gender, and class – people are people. In practice, however, participants said they did notice discrimination, both in the ways the government provides some areas more and others less. For renters, they felt “locals” treated them as “outsiders.”

For Shanti, a local homeowner, the equal distribution of water is a priority in her work. In 2014, leaders from her neighborhood, who she fondly called “the brothers of the community,” recruited her to manage a community water tank (Figure 37). For this work, she orders tanker water, which either first goes to particular residents who have made requests to fill their household reservoirs and then to the black tank next to the neighborhood temple. At certain times of the day, she sells water from the tank to people who come with their vessels. She finds her best business is in the dry season because many of her customers go to stone spouts to fill water for free during the monsoon when they flow.

She says she has made friends with people who come to fill their vessels at her tank, many of whom she would not have met otherwise. She says the work has opened friendships with renters. She finds that she can relate to their issues because before becoming a water seller, she also struggled for water, waiting in long queues to fill buckets, or calling her neighbors for help. Shanti explains that she tries not to discriminate when selling water. For example, during a long water shortage, when everyone was asking her for water and waiting in long lines at her tank, some of the locals became angry with her,

> Some people from here they shouted at me saying that the water is for the community insiders and not for renters. But I am the one to give water and I give it

> to everyone, so the renters were not angry with me… There was no water in people's houses so everyone had to take water from me. That is why it was difficult.

After re-reading what she had said, she reflected,

> I emphasize people who stay in rent because they don't have enough like we do. Everyone is the same to me. The community people tell me, "Why do you need to sell water to the renters in cheap rate like us?" If possible, we should sell them in cheap rate than other people because they also have to pay their room rent. So, it will be difficult for them.

Figure 37. Buckets already in the queue at the tank where Shanti sells water.

Shanti's decisions here are difficult ones, especially since she lives in a split home due to tensions between her husband and brother-in-law. Shanti and her husband and son live on the side of the house without a connection to the municipal pipeline. However, Shanti recognizes that as a homeowner and a local, she has an easier time than renters who pay so much more for water and space. Renters are also often in a precarious situation because they are at the mercy of their homeowner, who may or may not give them easy or cheap access to water sources or storage units on their property. While many renters

complained about their homeowners, some renters we met with explained that they felt lucky because their homeowners were kind and treated them as friends.

Shanti says she is optimistic because water is essential for life, or as she stated, "we need water for everything." We heard this kind of statement – that water is life – from all participants, however, the logic tied to that statement varied. Shanti and other optimistic participants believe that because water is necessary for everything, and everyone, people will have to figure out a way to better manage water, otherwise "life will be finished." In some conversations, participants explicitly stated that this was the government's role. For example, Birendra feels optimistic because of this logic: "I hope that they [the government] can provide water to everyone. Water is the most important thing not only for human beings but also for animals and plants. That is why I am optimistic." Similarly, Rajamati expressed: "People should not have water problems. It is essential for all. It is needed from the time we wake up till the time we go to sleep. So, they [government] should do whatever possible to provide water. We have suffered a lot in this issue." Rajamati was another one of few participants we met with who had more than enough water for her needs year-round, yet knows what it is like to struggle. She and her husband moved to Patan because they wanted to build a home in a place where they knew they would have water. Rajamati's belief in the injustice of water struggles, highlights again how residents morally framed their water situation within a broader context of insecurity.

Sustainability: Future Opportunity

Samrat lives in a community which works hard to ensure the sustainability of its local water network and water source: Aalko hiti, an ancient stone spout. Like other communities, families in the Aalko hiti neighborhood cut their connections to the

municipal supply line to rely on water from Aalko hiti (Figure 38). The community installed pipelines to member homes for water supply, creating a micro-grid of locally supplied and managed piped water. Since investing in this local supply system, the community has gone to great lengths to revitalize the historic water source to make sure that it continues to flow. For example, they banned well construction and have promoted rainwater harvesting and recharge.

Figure 38. Aalko hiti's water collection system and recharge area.

Despite these efforts, the past few years the spout has stopped flowing during the dry season although the spout around the corner of the hill continues to run. Samrat reflects on these changes,

> When we were young, we didn't have any shortages of water. Now there is scarcity. Water scarcity is the biggest problem now. In the past, it was not a problem at all. In my mother's house, we had taps in every community. But now, they have built big houses and pump the water through electricity. Thus, the community taps are also dried up. In the past, people didn't use to pump water through machines. They used to get water in the community. But now, everyone has new houses. Especially after the earthquake, the sources of water have been cracked so there is no water. My friends were saying that after the election they have started to fix these things, but I don't know.

Samrat understands her current situation by reflecting on her memories of the past and conversations with her friends. As she explains, she sees the earthquake, pollution, wells, politics, and lifestyle changes as contributing to issues of water scarcity, both at her spout and in the broader landscape. Her thoughts about local politics moreover reveal a sense of insecurity and uncertainty about the political system. During my fieldwork, local elections took place for the first time in around 20 years. People I talked to at this time were hopeful that new local leadership could provide better representation and make changes, especially since they were voting for friends and relatives on the ballot. Returning to visit participants one year on from the elections, they said water problems persist, and that little had changed.

Elected officials aside, Samrat relies on local leaders who manage Aalko hiti. Although Samrat reflected that the leaders never thought the spout would run dry, she is happy that they have found alternatives. She explained that even when the spout dries, the community leaders provide tanks and tanker services to make sure paying members of the Aalko hiti collective have water (Figure 39). When we met her before the monsoon, she said that the community had incorporated water from the deep tubewell of a neighborhood household. The community allowed the home to install the well if they shared the water. Samrat says she can relax because she trusts the community to find solutions and take care of her needs: “If there is anything wrong then they will come to fix immediately after we go and complain. So, we don't have to think much.”

Samrat is in a unique position; only a few other participants expressed trust in water service, and those were also from local clubs. In comparison, she has little faith in the government. Around half the participants we met with said they have faith that someday

the government will make sure clean water is available for all. The other half did not, saying that conditions will worsen if government action continues along the current trajectory. Many made those judgements based on the progress of Melamchi. Melamchi is a major water diversion project that promised Kathmandu residents an end to their water woes in the 1990s but as of early 2019 is still not complete. Samrat explained her thoughts,

> The government had said that the Melamchi water was coming years ago. If we were just sitting and waiting for water then people would have died of thirst. But the community people have helped us get water. I don't know much about government. I don't have trust in government. When my child wasn't even born back then they said that Melamchi would come, but now he is already nine years old and the water is still not here. I doubt if we will get to drink it or not.

Samrat worries about water insecurity because of government ineffectiveness. She is able to feel more secure because she trusts her community leadership given their responsiveness to past crises. Additionally, she repeats the same logic we heard elsewhere: "If we were just sitting and waiting for water then people would have died of thirst." In this case, she shows the possibility for collective action to not only get-by but thrive. Through donations and volunteering, local clubs, like Samrat's, work hard so that people have water to drink in addition to supplying water for important festivals and cultural events.

Figure 39. Samrat's water access points: piped stone spout water in the wet season and tanker water in the dry season

Discussion

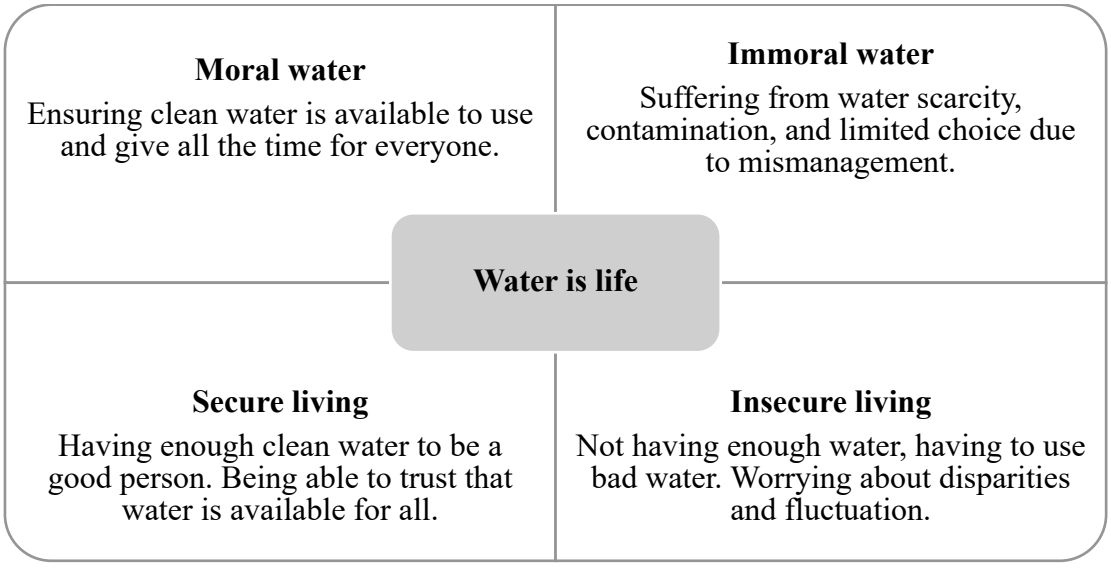
By building narratives with participants and comparing those narratives, I found that participants expressed insecurity through worry, doubt, frustration, and even apathy as they related their stories with trends in the urban landscape. While I found the experiences within and between story-maps sometimes hard to compare because of how much situations would change or differ, examining the normative ideals (the "should" and "ought" type statements) within and between story-maps helped reveal points of cohesion. Here, past experiences, social interactions, and ideas of rights and wrongs (Drew, 2016; Ioris, 2013) were critical to how participants made sense of what is happening in their lives to assert ideas and ideals. As story-map vignettes around issues of water quantity, quality, convenience, equity, and sustainability show: participants make sense of their water situation relationally. As Mala's story shows, Kathmandu residents care about more than their own situation; they see their water security as fundamentally interlinked with those of other people in the broader landscape. These relations resemble Hoffman and Metz' (2017) explanation of an Ubuntu ethic, in which flourishing and wellbeing emerge through caring relationships and social interdependencies.

I repeatedly heard expressions that water is fundamental to all life, evoking an idea of common humanity. Such views are not unique to Kathmandu; Strang (2005, p. 115) argues that across cultures water is understood as: "a matter of life and death; as a potent generative, and regenerative force; as the substance of social and spiritual identity; and as a symbol of power and agency." In a comparative study about cultural norms water justice, researchers found unity around "a vision of justice that includes a multifaceted human right to water, locally-engaged water governance, universal and equal water access, and

environmental stewardship. Implicit in many of these norms is the accepted role of government, especially in local and self-organized forms, in managing water" (Wutich, York, Brewis, Stotts, & Roberts, 2012, p. 375). Echoing these findings, I heard a common belief that it is the responsibility of social collectives, particularly the government, to ensure clean water is available anytime anywhere.

In Figure 40, I outline the components of this framework based on my analysis of normative statements in the story-mapping process. In this figure, I distinguish ideas of what moral water relations look like and what water-secure living means to participants around the core tenant that water is life. I found in the story-mapping process, a central logical thought process that because water is so fundamental, individuals, collectives, and the government, have to do something to ensure that life prevails. Following this logic are those who have faith that some being, entity, or system will do something, and on the other hand, participants who had no faith that the status quo would change. Between these beliefs, the struggles of the participant to secure water did not matter; rather, these ideas formed through the injustices of the collective struggle in Kathmandu.

Figure 40: Collective visions and ideals for water in Kathmandu



Despite cohesion in moral understandings of water, the ethics of water rights and wrongs were unclear and contradictory in story-maps. For example, although water is a human right, many said they wished for one more day of supply or a few more hours of supply, saying they felt ashamed to say that they would like to have 24-hour supply. Here, participants also explained that they did not know what the government or water provider should do in terms of their water needs. Regardless of the political savviness of a participant, we found widespread recognition in the role of interhousehold water services and management structures to ensure fairness. This interplay between moral and ethical resembles, anticorruption narratives in India which, "provide a cultural, semantic, and moral rubric to challenge the legally nebulous processes through which land is appropriated by elites and the poor are concomitantly dispossessed" (Doshi & Ranganathan, 2017, p. 184). Given the ways participants imagine water security and moral water as closely interlinked I have created a rubric in Figure 40, which contrasts an idealized landscape (moral and secure) with the status quo (immoral and insecure).

Stories of insecurity become interlinked and fundamentally tie into anxieties about the development and political trajectory of Kathmandu, and Nepal. For wealthier residents who enjoy more water-secure living like, Nandana, those worries mirror the views of technocrats: urban issues are a matter of behavior and engineering. Despite these beliefs, we found that most participants framed water issues as a politically and historically rooted problem. Several participants explained their struggles over water in relation to their struggles during the Maoist war and earthquake. This idea is reflected in, Pratt, Johnston, and Banta (2017, p. 91) research into the re-telling of trauma where "The knotting and linking of these stories builds to a larger global vision." While the specific parameters of

what the government should do (e.g. with the pricing and distribution of water) participants consistently talked about issues of mismanagement, unethical behavior (corruption), and immoral actions as they deprived people of clean water. Here participants recognize that their struggles were not natural or inevitable, but the product of failed development and government action.

The close interlinking of water security and moral responsibility in participant narratives hold authorities accountable, even when participants feel like they cannot make large-scale changes. Through moral beliefs about water and life, participants generate a sense of what things should be like in contrast to the status quo. In these ways, residents maintain a vision that creates the grounds for future possibilities. I see these normative framings as part of what Loftus (2015) identifies as a democratic struggle to secure water for all to make room for the possibilities of transformation. Everyday understandings and visions identified in the process of story-mapping, moreover, align with calls for reconceptualizing water security around justice, wellbeing, and capabilities but highlight the importance of looking broadly beyond ideas of culture as to what flourishing means and looks like (Gimelli et al., 2018; Jepson et al., 2017; Mehta, 2014; Neal et al., 2014; Schwartz et al., 2018; Zwarteveen & Boelens, 2014).

Conclusion

In this paper, I examine what water security means to household water managers through the feelings, normative statements, and visions through a story-mapping process. I focus on everyday experiences to understand how individuals navigate multiple, and sometimes conflicting, feelings, beliefs, values, interests, and practices over time to assert an imaginary about what water security should look like. Doing so, I bring together cultural

and humanistic geographies with political ecology to attend to how people define their experiences of security rather than be securitized.

As I found through the process of story-mapping, household water relations are in flux while government and development actions remain inert. Participants are aware of these contradictions as injustices and see themselves as living within a broader context of water insecurity that is more than a matter of individual concern. Through normative statements and imaginings, participants held government and development actions accountable through moral beliefs about water that directly stand in contrast to observations about existing development trajectories. Thus, even participants with more enough water for their needs, like Mala, do not take water for granted because of the risks to people, places, and social systems they care about in their household and broader landscape. These findings show that water security is not only an embodied and relational experience but also a negotiation of values, morals, and imaginaries, which create the conditions for change.

CHAPTER VII

CONCLUSION

After preparing a feast
satisfying the entire family,
like a highly skilled housewife
satisfying herself
she licks the empty cauldron and pan
or swallows the slightly burnt leavings.
And then hungry and weepy-eyed
this rainy night falls asleep.
Not without fulfilling you in your bed room.
She's been spending her days licking the salty grit
on the empty pan provided by legislation.
No justice has come to ask—"Have you eaten?"
It's not just this century-long night
she has slept without food.
There were many nights like that.
Today too there's a feast at her house
tell them: In her name
don't put out the rice the meal requires
she doesn't need feasts like these
for amid great feasts, she already has
the habit of fasting herself to sleep
fire rages on the riverbank.
With a flood of water
she has blanketed that terrible inferno of hunger.
She has doused the blaze sufficiently
with the unfathomable depths
of a single desperation.

"The Hunger for Justice and the Water of Desperation"
Manju Kanchuli, from Manoa *(2001, p. 55)*

Summary of Findings

In Patan, residents know that the most desirable piped water services are accessible adjacent to the main water pipeline, which flows down the main Pulchowk Mangal Bazar road starting from the Lalitpur Metropolitan Office towards Durbar Square (Figure 41).

Figure 41. Map of households by piped water access

STATUS OF PIPED WATER FROM THE MAINS FOR RESEARCH PARTICIPANTS IN MARCH, 2017

0 0.125 0.25 0.5 Miles

Liters per person per month in households with piped water from the mains:

- >2,501 (n=5)
- 401-2,500 (n=5)
- 101-400 (n=4)
- 12-100 (n=8)

Households without piped water from the mains:

- Connection not working (n=11)
- No main pipeline access (n=19)

THE KATHMANDU VALLEY

Households, hotels, and industries with large tanks and powerful pumps along this line quickly suck up most of the water. A combination of pipe leakage, breakage, and low-pressure flows leave households along ancillary lines with little to no piped water. Meanwhile, many people who live in these areas of piped water supply do not have direct access and pay their homeowners, neighbors, or family members for water access so they can fill their vessels (Figure 41). As I show in Chapters III and IV, to benefit from access to a source like the main pipe, a household requires a host of social and material abilities, particularly, dual access to powerful pumps and the space for large storage tanks.

I conclude here by way of spatial narratives surrounding Patan's piped water infrastructure. As I explain in Chapters I and II, I built with Patan residents over 2017 and part of 2018. I have argued that meaning-making and narrative are fundamentally spatial, occurring in place and about relations between places, as illustrated in Rupa's statement,

> Here it is difficult but in my village I am optimistic. There is always water in the village… the government has been saying that there will be water from Sundarijal and from here and there, but there isn't water yet. I don't think it will come even after my death. The government is always giving false promises that it will come this year. But its already been 10 years that we have shifted here and there is still no water.

Looking within and between story-maps in relation to more extensive processes of development, I detail domestic water security through multilayered forms of exploitation and show how they are perpetuated by processes of development, both historic and contemporary.

Through spatial narratives I detail participants frustrations with poor water services and the ways in which they take on heavy burdens to do the work of a waterworks. As one wealthier remarked, although he pays high taxes to the government and bills for piped water service, he still has to make investments in a well and storage when clean water

should be flowing through pipes. Meanwhile, further down the main piped water line in an area where flows are minimal, residents complained that the government allows a water bottle plant to take groundwater important for a communal water system. As the ancient water tap rarely flows, residents in this area pay more for water from other sources. Similarly, a Kathmandu Post article criticized the city for paying around $9,000 to install a water ATM instead of allocating money towards repairing and revitalizing the city's deteriorating ancient water infrastructure (Thapa, 2019). People feel like they have no choice but to buy water in the city. This form of dispossession (Chapter V) leads people to feel insecure even when they technically have enough water for their daily needs and more. As I explain in Chapter VI, people feel water insecurity because they make sense of water insecurity through their socio-spatial relations. Thus, the immorality of water supply is rooted in insecurities about the government and development.

Overall, there is a lack of trust in public services, particularly the piped water system and the management of water resources. Even households who receive more than enough water from the piped network feel like they cannot rely on water services. Weak trust in water services is tied to poor water quality and uncertain quantity. Every household water manager with I met with checks the water before they fill their vessel: sometimes the water that comes through people's taps is full of sewage and cannot be used say for maybe a few plants in the garden. More often, the water does not come as scheduled and fluctuates week to week. During the rice planting season, piped water comes twice a month. Many people I met with blamed farmers for stealing the water and cutting pipes. Upon visiting the main reservoir, which supplies Lalitpur's pipes, I found out that the government has a longstanding agreement to share water with farmers in the reservoir watershed when fields

need to be flooded for rice. This discrepancy between gossip and reality reflects a general, and most likely intentional, lack of public knowledge about the policies, regulations, and procedures of water provision and management. Such uncertainty moreover erodes trust in water services.

Stories of protest or participation in protest highlight the constraints urban residents feel in what they can do and be; as one participant articulated, “We should make people understand the reasons behind water shortages; we have to unite and move forward. If we just sit quietly then the government will dominate us more.” These modes of civil action also constitute the social infrastructures I detail in Chapter V. Desires for social unity is particularly difficult for people who feel socially isolated, especially recent migrants who are often excluded from local organizing by historic members of a community. As Rupa explained in response to a question of how she thinks local water problems can improve,

> I don't know. If it was only my problem then I would have said this or that should be done. But its everyone's problem and people here don't get along too well to come to any solutions. Last time, when there was dirty water, I had told the house owner but he doesn't care. I asked the person who comes to give electricity bill why the water was so dirty and smelly. Then he said, “If you get dirty water then fill up a bottle with that water and gather some people from the community and go to complain in the office. Also ask why did this happen? Was it because the pipe is mixed with sewage pipe? Then the office will send people to check the pipeline.” Then I told the house owner about it. Actually, they should have asked these things not us. We are just renters. I said, “We have to gather some people from the community and complain in the office” then he said, “Why should I go? Other people haven't said anything about it.” He was very angry. The people do not get along very well.

The dream of social unity is strong because it is a powerful force. For example, for Bina even making a routine complaint at the water office was painful without social backing,

> To pay a fine of about 900 rupees even if we don't get water is a very bad thing. They also know that we have not been getting water but we still have to pay the bills and if we don’t, they charge fines too. The officials themselves say that it is not only at our place that there is no water; this situation is everywhere. There was

> some mistake in their computers regarding the charge. So, I had to return home and take my electricity book and then they corrected the error. And then I had to pay the fine of 900 also. So, after I paid the fine, I said, "There is no water but we even need to pay the fines." Then they shouted saying, "I have already corrected your error. It is never enough what we do for you." But it was not my mistake that they had made a mistake in their computers. They sent me to many offices and I had a headache… They said, "This is not the place to complain about your water problems."

Yet, so far, no participant who has participated or supported a protest has seen change, although people point out how other groups who have complained have more power. Arjun, for example, blames local water problems on weakness in local leadership: "Those community leaders that can quarrel at the KUKL office get water." Samita, similarly, is frustrated that her neighboring community will not let the government install new pipelines. However, in talking to communities that do actively complain, including those living in Saugal, it is clear that their demands are not being met. When we asked Hari, a wealthy homeowner living directly along the main water line, if he has witnessed corruption or cheating, he said,

> It is happening right now. It especially happens in hotels. They bribe the staffs to do such things. I don't think the public has taken any action against these things. They do report these but there are no actions. We go for delegation in the KUKL office and complain that we are not getting water. They say that they will send water and they do it for a few days. But after some time, they stop again. Then the same situation repeats.

Hari's observations mirrored those of others; in most cases, the community saw no response at all, just promises. People make sense of their frustration with public services and development trajectories through their spatiotemporal relations, a point I expand upon in Chapter VI.

Given water stresses and government failures, participants were divided in their thoughts on the future, often in conflicting ways. Birendra, for example, said, "there will be

no water in the future. To start a new beginning the world has to come to an end; thus, people won't get water to drink," but in a follow-up conversation said, "I hope that they [the government] can provide water to everyone. Water is the most important thing not only for human beings but also for animals, birds and plants. That is why I am optimistic." Birendra's sentiments are not contradictory: he reflects on the cycles of life following a cosmological time-scale, but in daily life thinks that it is the government's duty to ensure water for life. Another participant, Bijendra similarly quipped, "I am optimistic about Nepal's development. Maybe in my grandchildren's time. Nepal has so much potential. Sometime in the future Nepal will be developed." I show in Chapter VI how normative statements and beliefs, like those expressed in these excerpts about the future, in all their contradictions, are revealing of how people in their everyday lives are making room for future possibilities and holding their government accountable.

This dissertation also details the ways in which households take on development. For example, several communities I engaged with talked about how they perform local water management by creating new local water systems that draw upon traditional spaces and practices. Other individuals talked about how groups take regulation into their own hands, for example, by punishing the person who opens and closes the pipes or by creating and enforcing local rules for water use. Among these strategies of addressing insecurity and building new systems, I saw and heard about more care than conflict. Giving and sharing water is not only common practice but desired for its spiritual and cultural meanings. Local water infrastructures also help create social infrastructures (Chapter V), for example, neighbors who would never meet become friends through community and household water providers. In these ways, people are creating their own systems and moreover maintain

conditions for democratic change through moral visions about what urban water relations should look like.

Contributions of the Dissertations

Through this relational study of water flows that sustain Patan households, I have answered questions regarding, *1) how water managers experience water insecurity in their daily lives, 2) how water managers build water security,* and *3) how water managers transform the conditions of urban living.* To answer these research questions, I developed and piloted a story-mapping technique to understand the lives of household water managers, whom I see as the individuals which make urban living possible for other residents of the city. Following a political ecology approach, I situate those experiences in relation to the broader practices and perceptions of water brokers: institutions, experts, managers, and providers who assert control over city-wide water flows. In summary, this dissertation makes three contributions outlined below.

Theoretical: Water insecurity is a relational state of being

Throughout my dissertation, I have found a relational approach good to think with. I used a relational approach in the field through a story-mapping approach. As I argue, story-mapping facilitates understanding participant experiences in relation to meanings of time, space, community, and polity. I have applied a relational framework of water security (Jepson et al., 2017) to examine the practices and perceptions of participants in relation to water as more than a set of material infrastructural connections for survival. I have also incorporated critically examined hydrosocial relations in their larger social contexts, to frame wellbeing and capabilities through an ethics of care and moral imaginaries (Hoffmann & Metz, 2017). A relational perspective of harms and benefits is particularly

important in a landscape where government inaction not only exploits the household, but allows for other social discriminations by caste, class, and gender to continue.

My goals throughout this dissertation surrounded expanding the potentials of political ecology beyond the power structures of exploitation towards creative understandings of human meanings and relations as people attempt to build better futures under violent conditions (Jasanoff & Kim, 2015; Jepson et al., 2017; Laurie & Shaw, 2018). By story-mapping experiences of water security, my research looks to the ways people define their experiences of vulnerability and insecurity. In Chapter IV, I argue that political ecology narratives have poorly engaged with moral imaginaries and meaning-making under conditions of insecurity. I show that participants feel insecure because of the injustices of water relations which persist in the landscape, regardless of their personal state of water security. Through moral frameworks and visions of secure living, people hold political actors accountable. This empirical finding is supported by a larger theoretical development towards the articulation of spatial relations in urban development.

Empirical: Governance failure is a form of dispossession and exploitation

In this work, I critically examine the concept of water security in its institutional narratives, academic use, and lived experience. Here I find the idea of water security helpful in three ways. First, as a way of looking through the ways people and institutions use and think about water as a critical resource for life. Second, as a means of engaging with broader questions of insecurity tied to environmental change, struggles over resources, urban development, and governance failure. Third, to engage with people impacted by and vulnerable to water insecurity. As political ecology critique has shown all too often normative framings of water security and related concepts like adaptation or resilience strip

people of their agency, vibrancy, and subjectivity to espouse environmentally determinist and technocratic narratives. I focus on the diverse social relations of Nepali households as they help to not only cope with water insecurities but generate possibilities for more water-secure living.

As I detail in Chapters III, IV, and V, my research argues that more than *access* to services and infrastructures, households *build* water security. In Chapter III, I employ a household perspective to challenge common narratives about water security in Kathmandu, which not only depoliticize the issue but abstract experiences of suffering and serious issues of injustice. This article highlights how a networked infrastructure ontology in science and policy can perpetuate water insecurity. I expand these points in Chapter IV, which employs a capabilities approach to think about household water security through spatial, technological, and social freedoms. I show that disparities in accesses to the built environment, tools, and social networks shape insecurities and inequities. In Chapter V, I focus on the social infrastructures of household coping strategies. In this chapter, I expand the idea of the household and domestic uncanny from the meanings and experiences of the Nepali household.

Method: Story-maps are tools to elicit relationality spatial narratives

Integrating readings of cultural and humanistic geography, this dissertation makes a methodological contribution to the field of political ecology. I present narrative-building as a mode of research through story-mapping. As I explain in my *Field Methods* manuscript, the story-mapping technique engages with questions of what it means for political ecology to be a kind of text. Drawing on feminist and postcolonial theory, story-mapping responds to the challenge of comparative research given the diversity and dynamism of urban

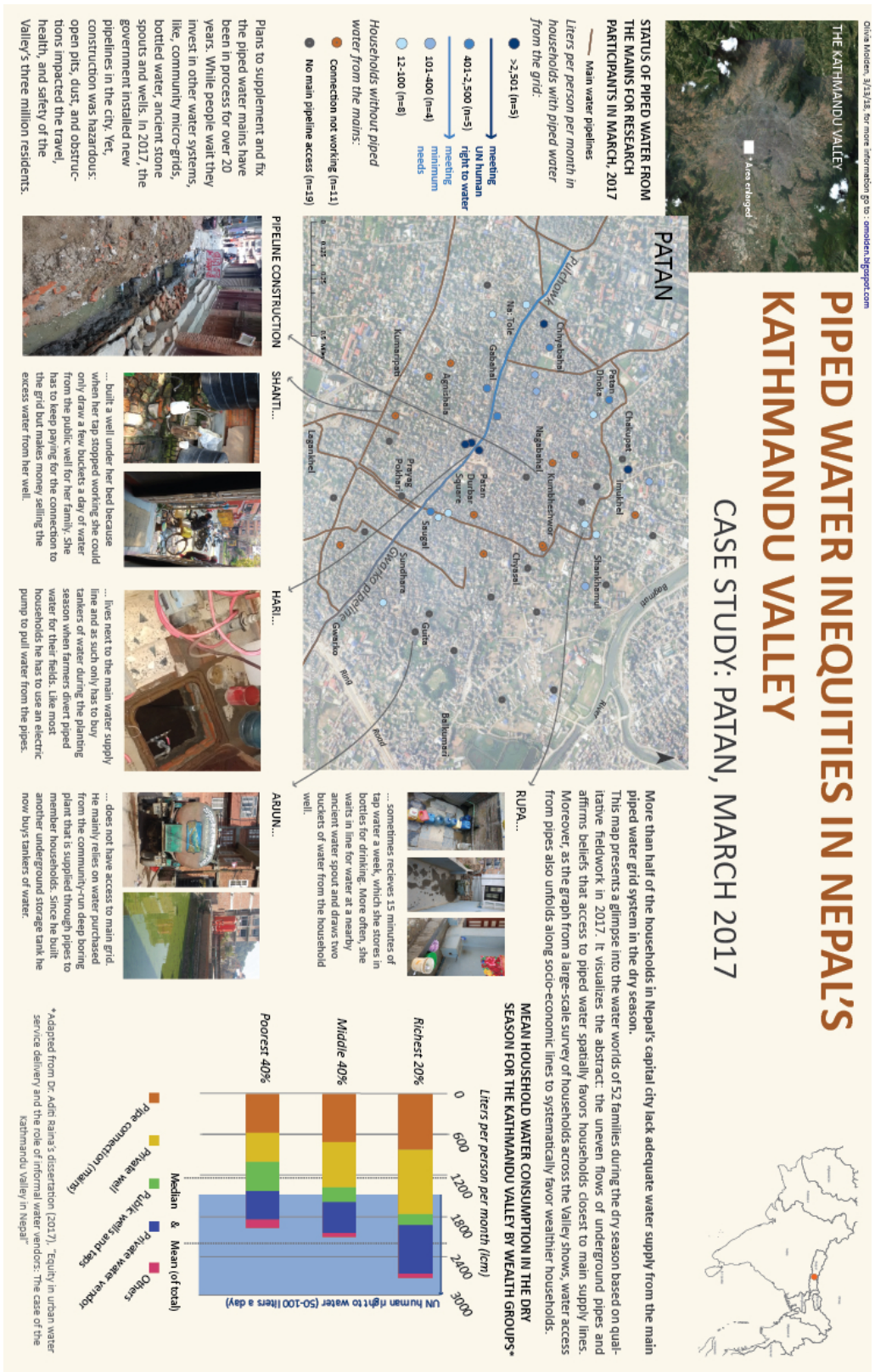
experiences between people over time and space.

Future work

Moving forward, this dissertation opens questions for the work of political ecology and water security to attend to the role of households, security, social infrastructures, and spatial narratives. First, future political inquiry should reconsider the household as a unit of analysis and site for theory-building by examining the spatiotemporal and cultural meanings of the household and drawing comparisons between household experiences. Second, there is room for greater conversation between water security and related concepts like, food security, energy security, adaptation, or urban sustainability. Third, engaging with the social infrastructures of water asks additional questions about the role of protest and civil action both within and outside the household as a democratic movement that can further the goal of securing the right to water and urban space (Sultana & Loftus, 2015). Finally, future applications of spatial narratives research in the geohumanities demands more critical engagement with questions of representation and the co-production of knowledge between diverse ways of knowing and being in the world.

APPENDICIES

A. MAP OF PIPED WATER ACCESS



B. HUMAN SUBJECTS APPROVAL

UNIVERSITY OF OREGON

DATE: September 09, 2018 IRB Protocol Number: 09162016.015

TO: Olivia Molden, Principal Investigator
Sustainable Environment, Institute for a

RE: Protocol entitled, "The Cultural Dimensions of Water Security in Kathmandu, Nepal"

Notice of IRB Review and Approval-Continuing Review
Expedited Review as per Title 45 CFR Part 46 # 6, 7

The continuation of the project identified above has been reviewed and approved by the Committee for Protection of Human Subjects (CPHS), the University of Oregon Institutional Review Board (IRB). This research has been determined to be no greater than minimal risk and qualifies for expedited review procedures.

The IRB has approved the research to be conducted as described in the attached materials. As a reminder, it is your responsibility to submit any proposed changes for IRB review and approval prior to implementation.

Approval period: September 09, 2018 - September 08, 2019

If you anticipate the research will continue beyond the IRB approval period, you must submit a request for continuing review approximately 60 days prior to the expiration date. Without continued approval, the protocol will expire on September 08, 2019 and human subject research activities must cease. A closure report must be submitted once human subject research activities are complete. Failure to maintain current approval or properly close the protocol constitutes non-compliance.

You are responsible for adhering to the *Investigator Agreement* submitted with the initial application for IRB review. The responsibilities of the agreement are reiterated at the end of this letter below. You are responsible for conduct of the research and must maintain oversight of all research personnel to ensure compliance with the IRB approved protocol.

The University of Oregon and Research Compliance Services appreciate your commitment to the ethical and responsible conduct of research with human subjects.

Sincerely,

Christina Spicer, J.D., C.I.P.

COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS ● RESEARCH COMPLIANCE SERVICES
677 E. 12th Ave., Suite 500, 5237 University of Oregon, Eugene OR 97401-5237
T 541-346-2510 F 541-346-5138 http://rcs.uoregon.edu

UNIVERSITY OF OREGON

DATE: October 02, 2017 IRB Protocol Number: 09162016.015

TO: Olivia Molden, Principal Investigator
Sustainable Environment, Institute for a

RE: Protocol entitled, "The Cultural Dimensions of Water Security in Kathmandu, Nepal"

Notice of IRB Review and Approval-Continuing Review
Expedited Review as per Title 45 CFR Part 46 # 6, 7

The continuation of the project identified above has been reviewed and approved by the Committee for Protection of Human Subjects (CPHS), the University of Oregon Institutional Review Board (IRB). This research has been determined to be no greater than minimal risk and qualifies for expedited review procedures.

Contingency:

- Since this research will be conducted in a language other than English, translated research materials need to be provided to RCS once obtained/developed.

The IRB has approved the research to be conducted as described in the attached materials. As a reminder, it is your responsibility to submit any proposed changes for IRB review and approval prior to implementation.

Approval period: October 02, 2017 - October 01, 2018

If you anticipate the research will continue beyond the IRB approval period, you must submit a request for continuing review approximately 60 days prior to the expiration date. Without continued approval, the protocol will expire on October 01, 2018 and human subject research activities must cease. A closure report must be submitted once human subject research activities are complete. Failure to maintain current approval or properly close the protocol constitutes non-compliance.

You are responsible for adhering to the *Investigator Agreement* submitted with the initial application for IRB review. The responsibilities of the agreement are reiterated at the end of this letter below. You are responsible for conduct of the research and must maintain oversight of all research personnel to ensure compliance with the IRB approved protocol.

The University of Oregon and Research Compliance Services appreciate your commitment to the ethical and responsible conduct of research with human subjects.

Sincerely,

Christina Spicer, J.D., C.I.P.

COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS ● RESEARCH COMPLIANCE SERVICES
677 E. 12th Ave., Suite 500, 5237 University of Oregon, Eugene OR 97401-5237
T 541-346-2510 F 541-346-5138 **http://rcs.uoregon.edu**

UNIVERSITY OF OREGON

DATE: October 26, 2016 **IRB Protocol Number: 09162016.015**

TO: Olivia Molden, Principal Investigator
Department of Sustainable Environment

RE: Protocol entitled, "The Cultural Dimensions of Water Security in Kathmandu, Nepal"

Notice of IRB Review and Approval
Expedited Review as per Title 45 CFR Part 46 # 6, 7

The project identified above has been reviewed by the University of Oregon Institutional Review Board (IRB) and Research Compliance Services using an expedited review procedure. This is a minimal risk study. This approval is based on the assumption that the materials, including changes/clarifications that you submitted to the IRB contain a complete and accurate description of all the ways in which human subjects are involved in your research.

Contingency Item:

- Once it is determined who the translator will be for this research, an amendment application must be submitted to RCS to add the translator to the protocol. The Personnel Form must be updated and the Research Plan in section I must be updated to explain who the translator is and what their qualifications are to translate. Additionally a copy of the translated consent document must be submitted.

This approval is given with the following standard conditions:

1. You are approved to conduct this research only during the period of approval cited below;
2. You will conduct the research according to the plans and protocol submitted (approved copy enclosed);
3. You will immediately inform Research Compliance Services of any injuries or adverse research events involving subjects;
4. You will immediately request approval from the IRB of any proposed changes in your research, and you will not initiate any changes until they have been reviewed and approved by the IRB;
5. You will only use the approved informed consent document(s) (enclosed);
6. You will give each research subject a copy of the informed consent document;
7. **If your research is anticipated to continue beyond the IRB approval dates, you must submit a Continuing Review Request to the IRB approximately 60 days prior to the IRB approval expiration date. Without continuing approval the Protocol will automatically expire on October 25, 2017.**

Additional Conditions: *Any research personnel that have not completed CITI certificates should be removed from the project until they have completed the training. When they have*

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UNIVERSITY OF OREGON

DATE: February 16, 2017 **IRB Protocol Number: 09162016.015**

TO: Olivia Molden, Principal Investigator
Institute for a Sustainable Environment,

RE: Protocol entitled, "The Cultural Dimensions of Water Security in Kathmandu, Nepal"

Notice of IRB Review and Approval-Amendment
Expedited Review as per Title 45 CFR Part 46 # 6, 7

The amendment submitted on February 10, 2017 for the project identified above has been reviewed and approved by the University of Oregon Institutional Review Board (IRB) and Research Compliance Services using an expedited review procedure. This is a minimal risk study. This approval is based on the assumption that the materials, including changes/ clarifications that you submitted to the IRB contain a complete and accurate description of all the ways in which human subjects are involved in your research.

The purpose of this Amendment is to:

- Add translator, Nita Pradhan, to the protocol. This satisfies the contingency issued in the approval letter dated October 26, 2016.

This approval is given with the following standard conditions:

1. You are approved to conduct this research only during the period of approval cited below;
2. You will conduct the research according to the plans and protocol submitted (approved copy enclosed);
3. You will immediately inform Research Compliance Services of any injuries or adverse research events involving subjects;
4. You will immediately request approval from the IRB of any proposed changes in your research, and you will not initiate any changes until they have been reviewed and approved by the IRB;
5. You will only use the approved informed consent document(s) (enclosed);
6. You will give each research subject a copy of the informed consent document;
7. **If your research is anticipated to continue beyond the IRB approval dates, you must submit a Continuing Review Request to the IRB approximately 60 days prior to the IRB approval expiration date. Without continuing approval the Protocol will automatically expire on October 25, 2017.**

Additional Conditions: *Any research personnel that have not completed CITI certificates should be removed from the project until they have completed the training. When they have completed the training, you must submit a Protocol Amendment Application Form to add their names to the protocol, along with a copy of their CITI certificates.*

Approval period: February 16, 2017 - October 25, 2017

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