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Changing Water Resources' Effect on Livelihoods and Socio-Ecological Relationships in Himalayan Communities of Nepal

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Table of Contents

Abstract

The looming threat of climate change will lead to significant alterations in livelihoods and daily practices for individuals across the world. This paper seeks to identify the effects of climate change on hydrological regimes in Himalayan communities in Nepal with particular focus towards livelihood and socio-ecological transformations. Using the socio-ecological systems framework to analyze specific communities and their resource use, along with vulnerability and adaptative capacity analysis, this paper includes a meta-analysis of existing

literature. Numerous findings indicated that rural, mountainous communities of Nepal face a variety of environmental impacts which may reduce viability of two significant modes of production: agriculture and pastoralism. Vulnerability to climate change among these communities is often related to socioeconomic status and history of social, economic, and political power. Additionally, the most significant method for reducing vulnerability is to diversify income generation. This research emphasizes the need for further exploration of the unique vulnerabilities of high altitude communities to transformations of hydrological regimes affected by climate change.

Introduction

As anthropogenic climate change threatens to upend livelihood patterns in every community around the globe, individuals and communities must search for adaptive solutions. We should expect to experience an increase in the frequency and intensity of extreme weather events, the diminishment of freshwater resources, and shifting ecological zones appropriate for crop cultivation. As once arable land becomes infertile, communities may be forced to migrate to newly fertile land. As communities work to adapt daily practices, established socio-ecological relationships will transform correspondingly.

I will explore the dynamic relationship between people and the ecosystem they exist within in the Himalayan communities of Nepal. Through the essential natural resource, water, I hope to discover how Nepali individuals engaging in different livelihood practices conceive of the changing climate. I hope to explore specific vulnerabilities experienced by Himalayan communities as a result of changing water resources and to understand how they are impacted by existing social and economic structures.

Through analysis of existing literature, I will investigate how individuals across a spectrum of social and economic means use, are constricted by, and engage symbiotically with water in their daily activities. Key to the larger question of climate adaptation through changing water use patterns will be to establish what exactly previous practices were, and how current ones differ in a socially layered manner. I am driven to understand how climate induced hydrological change has forced social and economic transformations in Himalayan communities.

I will strive to consider Himalayan communities in Nepal as socio-ecological systems where the social and ecological landscape are mutually constitutive and intricately bound. I aim to provide useful contributions to conversations around climate adaptation and vulnerability.

Observations and understandings of contemporary adaptations to anthropogenic climate change are inherently useful in that they provide examples of the social, economic, political, and epistemological reconfigurations that every community will encounter eventually. As livelihood and consumption patterns face reconstruction driven by the decreasing abundance of vital resources, the devastating work of climate change threatens to upend familiar structures and expectations. As these transformations take place, we may learn valuable lessons of human capacity for and heterogeneity in adapting to new socio-ecological conditions through contextualized accounts of communities engaged in change.

As recently ranked the 13th most vulnerable nation to climate change, Nepal is already dealing with the transformations and their multiple manifestations. Over the past 40 years, over a quarter of the glacial ice of the Himalaya has melted (Leahy 2019). This ice provides water for 1.3 billion people. Additionally, given Nepal's susceptibility, the symbolic and material

topographies of the nation provide fruitful grounds for exploring the mediation and transformation of culture as encouraged by the changing climate.

Both predicted and felt impacts of climate change-driven hydrological alterations will require adaptation and resilience in every livelihood, not only agriculture or pastoralism, as conditions become more extreme. As these impacts worsen, it remains imperative to remember the plight of the marginalized and vulnerable communities that will experience the most drastic effects. Employing Social-Ecological Systems framework (SES), this research will assess the adaptability and vulnerability of Nepali Himalayan communities to hydrological change driven by global climate change through analysis of existing literature.

Research Questions

I. How have differentiated effects of climate change on water resources in Himalayan Communities of Nepal disrupted livelihood patterns?

II. How have climate driven alterations in typical regimes of water use impacted the social landscape of these communities?

III. How are current vulnerabilities and adaptive capacities in these communities results of both ecological and structural dynamics?

Literature Review

Considering the interaction between individuals, communities, and their environmental circumstances, resources, and systems requires detailed and deeply contextualized analytical frameworks to outline and interpret culturally specific behavior. To address the dynamic agency that water is afforded and to track its material transformations on the landscape and in Nepali households given anthropogenic climate change, I will first situate Nepal's rural communities as socio-ecological systems—multilayered physical and symbolic landscapes wherein the social

and the ecological are intimately intertwined in a mutually constitutive relationship. Built upon substantially by McGinnis and Ostrom (2014) as a helpful linguistic index serving to unite various scholars working to support socio-ecological systems, the framework allows collaboration and facilitates understanding across disciplines in hopes of building mutually beneficial alliances. Ultimately, this framework shines light onto the multilayered, nested nature of the socio-ecological realities to be found in Nepal's rural mountain communities. Having situated this proposal and project in the world of socio-ecological systems literature, I will move to interdisciplinary analytical frameworks, emblematic of the project of SES work.

The basic philosophical underpinning of the SES framework comes from the economic and political theory of rational choice. Typically employed to understand the behavior of individuals and markets, rational choice theory assumes that humans are rational and so will always make choices that suit their personal rationality and preferences (Amadae 2017). Essentially, rational choice theory expects actors or agents to make consistent choices because these choices are grounded in personal preference determined by rationality. Rational choice theory became the philosophical basis for the Institutional Analysis and Development (IAD) framework, the precursor to SES framework. Developed by Elinor Ostrom, the IAD framework provides an analytical tool for conceptualizing and understanding particular institutional or development problems by incorporating and identifying major structural variables, actors, and the relationships between them (Ostrom 2011). The IAD framework allots equal power to structures and individuals and centers around the concept of the action situation where external variables, human, and structural factors interact and determine outcomes. This framework is based upon interaction and the structures that influence interaction; thus, using rational choice

theory, the IAD framework is able to analyze situations by assuming that humans are making consistent, rational choices.

As an outgrowth of the IAD framework, SES framework relies on the same philosophical basis and theory. Centered similarly on a type of action situation, the SES framework incorporates resource systems (RS), resource users (RU), users/actors (U/A), and governance systems (GS) into an analysis of interactions and outcomes within a particular SES (Ostrom 2007). The ultimate reason for using the SES framework is to understand and analyze interactions and outcomes in a system. To do so, researchers identify variables within the four categories above and continue to further complexify variables into second and third tiers. Breaking down the four main categories (RS, RU, U/A, GS) allows for greater complexity and adaptability of the framework (Ostrom 2007). Ultimately, the framework provides a tool for mapping major structural, historical, and ecological systems as well as stakeholders in specific social-ecological systems.

I am choosing to use the SES framework in the context of Nepali Himalayan communities because of the complex and dynamic nature of these systems. The SES framework offers invaluable assistance in mapping and understanding the complex relationships between various actors. In Himalayan communities in Nepal, many actors, from federal to local governments, community based organizations, INGOs, and individuals may all play a role in the adaptation to climate and hydrological change. The SES framework highlights interdependency between human and ecological systems. As these communities face the consequences of the changing climate, the delicate nature of the human-ecological relationship becomes apparent. Ecological systems change and human ones are forced to either adapt or collapse. Additionally, SES framework does not leave behind historical and structural aspects that constitute certain

systems and communities. These external variables will help guide the oncoming conversations towards who is most vulnerable, and, more importantly, why have they become the most vulnerable. Ultimately, all social systems are ecological systems. As these Himalayan communities experience changing hydrological regimes, their social systems and management of natural resources will necessarily shift. The SES framework will allow me to comprehensively map the variables that allow for positive and negative adaptive potential.

Nepali communities have begun to bear the weight of shifting hydrological regimes. Given Nepal's vast ecological and topographical diversity, expected and realized effects of hydrological change vary according to the locale. While the Himalayan region has experienced increased annual rainfall, Nepal as a whole has received less rainfall across more variable precipitation events (Pandey & Bardsley 2015). Rural Nepali communities experiencing these altered conditions are generally at risk of reductions in crop yields, greater scarcity of water, greater risk of natural hazards, and worsening provision of basic services (Pandey & Bardsley 2015). A survey of local perceptions of climate change in the Kali Gandaki basin revealed that citizens already witnessed a decline in snowfall quantity, temporal variability in precipitation, decreased flow of springs and rivers, greater rate of floods, and diminishing production of pasture (Bhusal & Subedi 2014).

Central to my exploration of water use and its transformation in rural mountainous landscapes will be aspects of adaptation literature forwarded by geographers, economists, and anthropologists attempting to quantify and qualify how communities are able to respond to ecological crises. Though prescriptive and specific in its stated goals, I am choosing to augment the SES framework with adaptation analysis in order to underline the social histories inherent in a community's ability to adapt to a changing climate. As vulnerability to climate-related

hydrological change is examined throughout this paper, the potential and capacity for adaptation become vital characteristics to measure and analyze. Many social scientists in the past two decades have focused on analysis of adaptive capacity to combine structural and biophysical influences on the ability to manage the changing climate. For example, work by Adger highlights how adaptation moves beyond simple physical mechanisms of transformation and into the social realm populated by people and their considerations of their own socio-ecological position (Adger 2003) (Adger et al. 2003). They use an analysis of adaptation to argue that existing social inequality and stratification will only become exacerbated by worsening effects of anthropogenic climate change. Naess foregrounds the role of what they call "local knowledge", referring to what is commonly known as "traditional ecological knowledge," in driving adaptation—in opposition to a traditional model in international development which has historically offered solutions to ecological problems without input from local sources of traditional ecological knowledge (Naess 2013). Clay, considering climate adaptation and commenting on the common state of NGO and governmental development projects, proposes a methodological and theoretical approach which seeks to combine sustainable livelihoods approaches with assessments of adaptive capacity to climate change (Clay 2018). This analytical tool highlights combining the assessment of two distinct future realities, adaptation to climate change and transformation of livelihood strategies, into a cohesive search for appropriate reallocation and reconstitution of everyday activities. In considering Nepal's precipitous future at the hands of climate change, such a nested, mutually constitutive approach must be considered.

Vulnerability to climate change is established both quantitatively and qualitatively as how likely communities are to experience climatic disturbance and how severe that disturbance might be. Often conversations around vulnerability, again mimicking that of adaptation, center

around the tendency for the most vulnerable communities to be among the least advantaged communities. Like adaptation, this paper will engage with vulnerability analysis to augment the SES framework to both quantify and elucidate how communities compare in their vulnerability to climate change. Vulnerability is often measured as an index including three major variables: exposure, sensitivity, and adaptive capacity (Pandey & Bardsley 2015). By using established indices, relative vulnerability of communities is compared. Vulnerability analysis has proven valuable for other researchers concerned with measuring community preparedness for climate change or other similarly destructive situations. Ahmed et al., using a vulnerability analysis, finds and reminds us that the volatility attached to climate change often leads to increased volatility in poverty stricken areas (Ahmed et al. 2009). Aryal et al. offer meaningful insight in mapping how three transhumant populations in the Himalaya conceive of their own vulnerability with the changing climate (Aryal et al. 2014). Gupta et al. indicate how vulnerability can be constructed by environmental and social factors. They establish how higher elevations generally tend to be more vulnerable to anthropogenic climate change (Gupta et al. 2020). McDowell et al. outline major concerns regarding climate change and the ecosystem services water provides in Khumbu, Nepal (McDowell et al. 2013). They determine four region wide vulnerabilities greatest affect Himalayan communities: reduced access for household use, declining crop yields, reduced access and ability to meet the needs of tourists, and reduced hydroelectricity generation. In order to appropriately define and compare community and livelihood vulnerability to climate change, the tool of vulnerability analysis will prove invaluable.

While vulnerability can be a generic term used across many fields to denote a wide range of exposure or susceptibility, I intend to use the term as established by the IPCC 4th annual report and expanded upon by numerous scholars. Specifically related to climate change impacts,

vulnerability is measured by assessing and describing the sensitivity, exposure, and adaptive capacity of a social, ecological, or economic system (Pandey & Bardsley 2015). Measures of vulnerability ultimately assess these three dynamics as a conceptual whole while recognizing that countless socio-economic, political, and ecological factors combine to make one group or individual more vulnerable than the other. It is important to remember that vulnerability is a, "context-specific state that emerges as a result of the interplay between biophysical changes and existing socio-economic/political conditions" (McDowell et al. 2013). I will use vulnerability to connote the dynamic intersection of both these environmental and anthropogenic situations.

Methodology

I will seek to answer the above research questions through a meta-analysis of existing literature to both provide contextualized experiences and to elucidate common and disparate narratives of hydrological change in Himalayan regions of Nepal. I will conduct this meta-analysis in the United States choosing to focus on existing qualitative studies which outline adaptations, vulnerability, and experienced hydrological variations.

There are obvious limitations to this method; I will not interact with Nepali citizens or other stakeholders involved in the response to climate change effects and doing research about a specific location without spending time in that location may miss numerous relevant aspects or dynamics. On the other hand, I will be able to gain a broad understanding of how these communities are currently vulnerable and how some have begun to address this vulnerability. Additionally, this format will provide broad access to qualitative studies elucidating how livelihood patterns have changed across multiple communities which share similarities and differences. After engaging with the existing literature, I will have a more comprehensive

understanding of areas for further research and development. This approach will allow me to comprehensively understand the issues and to find any gaps in existing literature.

The main methodological tool for conducting this research is the Socio-Ecological Systems framework. As previously mentioned. The SES framework, an outgrowth of the IAD framework developed by Elinor Ostrom, seeks to find why and how particular ecological resources are managed, if their management is successful, and ultimately what conditions provide optimum long term management. Centered around the concept of the focal action situation, the SES framework involves numerous internal and external variables spread through multiple tiers to analyze specific interactions and outcomes in a particular socioecological environment (Ostrom 2007). Figure 1 provides a basic understanding of the interactions between first tier variables and related systems.

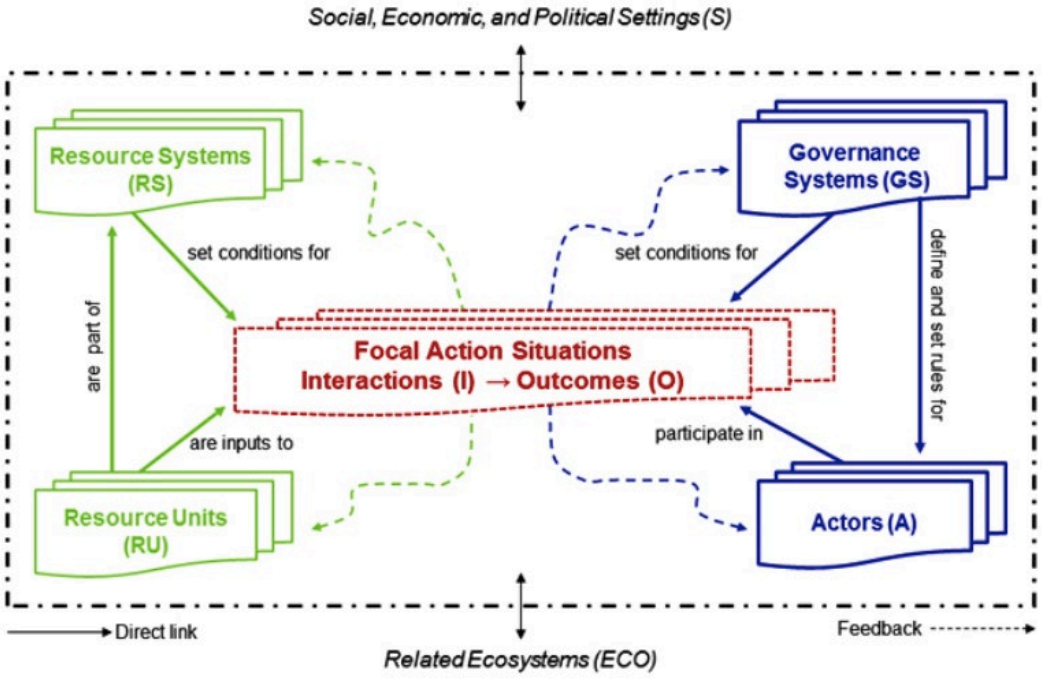

Figure 1. Socio-ecological system framework with first tier variables and related external variables. Arrows denote direction and flow of interaction between variables. Focal action situations and corresponding interactions and outcomes are constituted by the multiple first tier variables (McGinnis & Ostrom 2014).

Typically used to analyze particular interactions in case study communities, the framework depends on careful cataloguing of each specific variable to map interaction and influence to ultimately determine why or why not a particular resource management system works or does not work.

The first tier categories, outlined in Figure 1 by solid boxes, are typically broken down into multiple tiers to highlight specificity while keeping the broader framework in mind. The variable resource systems (RS) refers to the properties which define the particular system in question such as its productivity and size. Resource units (RU), conversely, describes the individual characteristics of the resource that are part of the RS. For example, RU can refer to the resource units' mobility and economic value. Resource units are constituent features of resource systems and both the RU and RS variables represent the ecological aspect of SES. The government systems (GS) variable expectedly consists of the various rules and organizations which manage the use of the RS and RU. Actors (A), or first conceptualized as users (U), are the human components of the system; A describes those that use the RU and RS within the boundaries of the GS. The A variable includes number of actors/users, history of use, and the socio-economic situation of the actors/users (Ostrom 2007). Each of these first tier variables consists of numerous second tier variables which can be flexible and dynamic based on the particular case study. Figure 2 provides a basic list of second tier variables.

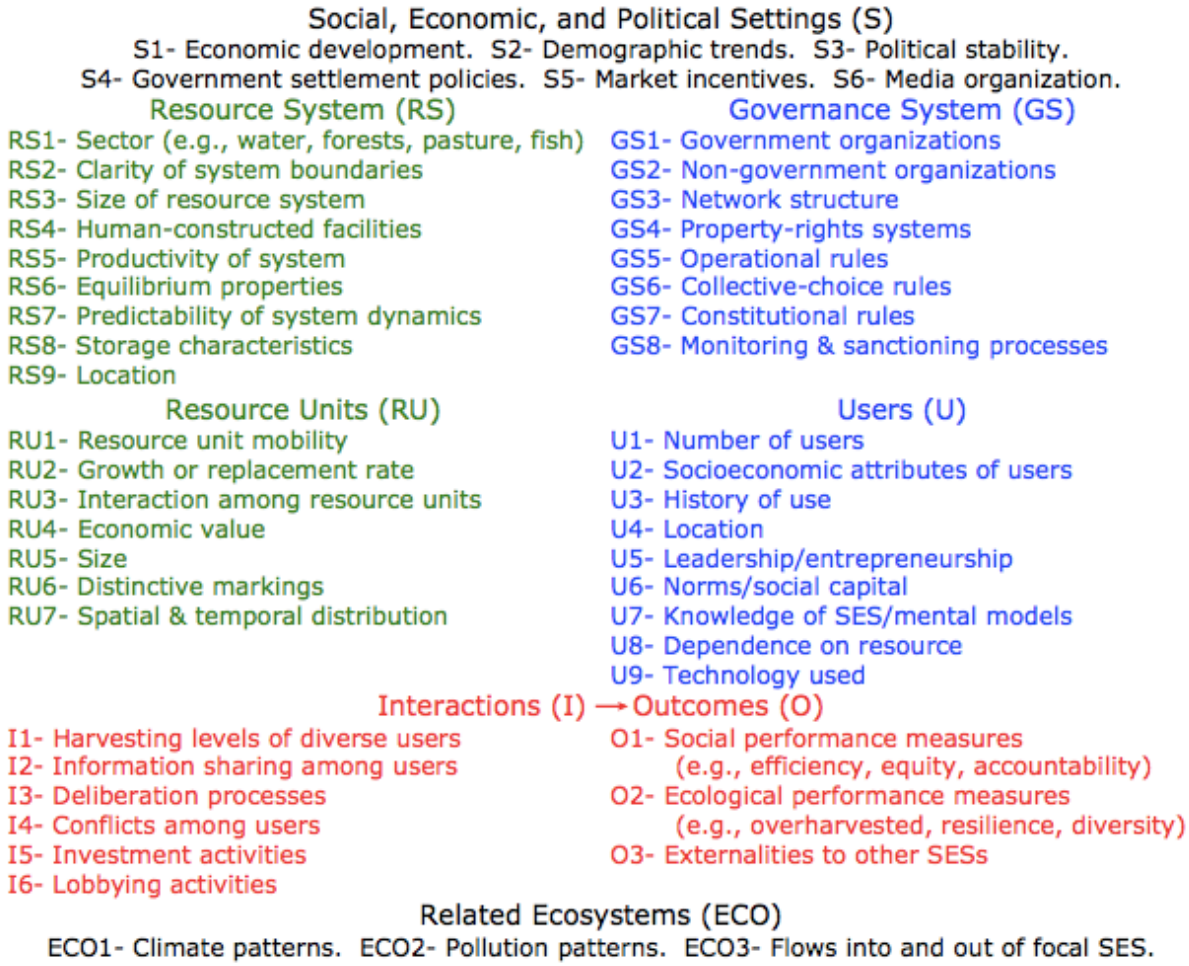

Figure 2. Socio-ecological systems framework with second tier variables arranged under corresponding first tier variables (Ostrom 2007).

These four first tier variables are involved in the action situation. As described in figure 1, each first tier variable has a role in defining how resources are used and what the resulting situation becomes. To place the particular system being analyzed in a larger context the variables of social, economic, and political setting (S) and related ecosystems (ECO) are included.

The framework works to provide findings about resource management and broader workings of SES's because it is built on a robust platform that supplies direction to the researcher without being entirely prescriptive. Using the framework to analyze a SES involves careful identification of second tier variables nested within their respective larger categories.

After identifying the applicable second tier variables, the researcher traces their interactions and connections, represented by arrows in figure 1. Once these relationships between first tier variables are understood, the job of the researcher then becomes analyzing how all the variables meet in the focal action situation whereby interactions between A/U and GS concerning RU within the RS lead to particular outcomes. In the analysis of the focal action situation, the S and ECO variables become important in determining the broader context of the SES and the implications of given outcomes. Ultimately, the SES framework allows the researcher a prescriptive yet dynamic tool to map the numerous forces at play in the management of a resource in a particular location.

This paper will engage with the SES framework to compare case studies regarding the vulnerability and response to climate related hydrological change by Himalayan communities in Nepal. I will apply the SES framework analysis to each individual case study, analyzing focal action situations after mapping the appropriate variables and outside influences of each individual location. The framework provides a replicable process for understanding a specific scenario and simplifies comparison as well as contradiction. Ultimately, I will list findings provided by the SES framework that may or may not establish common characteristics of community adaptation to hydrological and climatological vulnerability.

Findings

My analysis of existing literature through the SES framework produced numerous significant findings related to the alteration of livelihood and socio-ecological relationship dynamics in rural mountain communities of Nepal. Though individual case studies provided insight into particular stresses to and responses from rural communities, the following findings

were typically present in multiple study areas using the SES framework. Findings will be listed here and analyzed in the upcoming section:

I. Diminishing water resources in water dependent rural communities creates strife between communities attempting to continue livelihood and daily life practices.

II. Outmigration and remittances provide families with greater sources of income, but the majority of Nepali families continue to rely on agriculture/pastoralism.

III. Community based resource management (CBRM) practices are often threatened as the labor provided by citizens typically used to sustain systems migrates for greater economic opportunity in urban or foreign communities

IV. The Greater Himalayan Range provides water for 1.3 billion people and some of the most rapidly expanding areas of the world. Thus, any major change to the water regime will have enormous consequences for downstream communities.

V. Communities and families with greater income diversification generally score as less vulnerable to climate change and those that depend on the exploitation of natural resources are more vulnerable

VI. Across multiple studies, there were many significant characteristics of hydrological change: reduced water access for household use, declining crop yields, reduced water access for meeting the demands of tourists, reduced hydro-electric energy generation, variation in rainfall, decline in snowfall, recession of rivers, increased flooding, and lower pasture production.

VII. Greater political influence (including presence of tourism) leads to less climate vulnerability. Conversely, the presence of the tourism industry influences the crops local communities grow often towards more water intensive ones.

Analysis

Given the above findings gleaned from case studies and previous research, each community and SES experiences differentiated effects of hydrological change either influenced from aspects within the system or from the outside represented by the S and ECO variables. Between the broad socioeconomic patterns of outmigration in Nepal combined with rapid urbanization and growth in population in cities within the Himalayan watershed, significant pressures from the regional social climate foreseeably affect life in rural communities. Often, as the RS changes and becomes less viable, the GS and the A are slow to adapt or incapable of adapting because of extenuating socioeconomic circumstances. In this section, the previously mentioned findings will be explained using the language and analysis of the SES framework.

In the first finding, a hydrological regime change driven by climate change in Upper Mustang created hostility between downstream and upstream communities. As water in the Lumbuk River became scarce, two communities, Dhakarjong and Phalyak, disputed each other's right to access the remaining resource (Bhusal & Subedi 2014). Generally referring to historical use, each community claimed historical residency and initial engagement with the river. Before the productivity of the stream began to change, no significant conflicts occurred according to memory of community members (Bhusal & Subedi 2014). In this instance, as the RS transformed and diminished, unclear and undefined inter-village water use rights (GS) creates hostility. Ultimately, these incongruities lead to interactions that produce outcomes of overuse. Given the nature of ecosystem services provided by rivers and the effect of upstream use on downstream communities, careful planning and cooperative governance systems must be enacted between villages relying on the same source.

A significant social pressure on mountain communities and corresponding SES's is the potential economic gain present in outmigration. As significant proportions of rural communities

younger demographic searches for higher paying work in Kathmandu or further afield, they often plan to send remittances back to their families (Nusser et al. 2019) (Dangi et al. 2018). Though individuals and their families may receive economic gain from this practice, the majority of Nepali citizens remain dependent on agriculture for sustenance in some capacity. Thus, while rural communities shrink and urban populations swell, the amount of agricultural or pastoral work in rural communities does not necessarily shrink too. Many rural communities have relied on some form of community based resource management (CBRM) to control water resources. As more citizens move from rural to urban spaces, the labor typically provided by the Actors is no longer present, leading to the degradation of the monitoring and administrating infrastructure (a sub-variable of GS) (Nusser et al. 2019). In this case, outside influences of from the social, economic, and political setting (S) impact the necessary workforce (A) to maintain water management system infrastructure (GS). As members of these rural communities continue to rely on agriculture and pastoralism, access to resources, though they may be diminishing, remains important. Stresses from outside the local SES have the capacity to bring unforeseen challenges to resource management.

The productivity of the Himalayan watershed is well documented. The mountains, through glacial melt and precipitation fed into its rivers, provide water for 1.3 billion people (Mukherji 2015). Some of the countries and cities within the watershed are among the most densely populated and fastest expanding communities in the world (Mukherji et al. 2015). Thus, as water availability decreases steadily over the upcoming century, demand from growing cities and nations for water will only increase. Such incongruity between the RS and the A will create troubling situations as evidenced in finding I in Mustang. Governance systems must adapt in the

face of significant change in the social, economic, and political setting as well as the resource system.

Though potentially self-explanatory, it remains important to focus on how diversification of income generation provides greater adaptive capacity and ultimately lower sensitivity and vulnerability to climate change. Numerous studies found that those families with multiple revenue streams were more capable of weathering the economic damage wrought by hydrological change (Nusser et al. 2019) (Aryal et al. 2014) (Pandey & Bardsley 2015). Because their economic success does not depend annually on the performance of agriculture or pastoralism, a fluctuation in productivity because of alteration in precipitation or stream flow does not necessarily cause significant stress. Conversely, those engaged solely in agriculture or pastoralism or a combination of the two are much more likely to be vulnerable to changing hydrological conditions. Within the larger Actor variable, the A8 (or U8) sub-variable identifies a given community's dependence on the resource. As the RS and consequently the RU's decrease, agriculturalists or pastoralists have to face dire economic situations. The most significant way to abate vulnerability is to generate income from multiple economic sectors.

In addition to diversification of income, access to the tourist economy and the political clout inherent in that access leads to less vulnerability as well. As Nepal's economy is built largely around tourism, often the high altitude communities that serve trekkers and other visitors receive government aid first (McDowell et al. 2013). In addition to the Nepali government, these communities, like those on the Annapurna Circuit or the Everest Base Camp treks, often garnered international development attention and received help from INGOs. Such political and economic assistance typically led to increased participation in a wider economy and technological or procedural support for agriculture or pastoralism (McDowell et al. 2013). This

national significance tends to lead to less vulnerability. Conversely, though tourists support local economies, local citizens attempting to cater to them occasionally substitute native crops for more water intensive crops that may be more familiar to the European or American tourist. In doing so, the Nepali farmer has increased their vulnerability by introducing somewhat inappropriate crops into the SES (McDowell et al. 2013). Thus, the social, political, and economic setting (S) of a particular SES becomes an important factor in determining outcomes.

Across multiple case studies, similar natural phenomena caused by hydrological regime changes have begun to arrive in communities in the Himalaya. Each of the following effects was present in multiple study locations: reduced water access for household use, declining crop yields, reduced water access for meeting the demands of tourists, reduced hydro-electric energy generation, variation in rainfall, decline in snowfall, recession of rivers, increased flooding, and lower pasture production (Bhusal & Subedi 2014) (McDowell et al. 2013) (Pandey & Bardsley 2015) (Dangi et al. 2018) (Xu et al. 2009) (Gupta et al. 2020) (Aryal et al. 2014) (Mukherji et al. 2015) (Nusser et al. 2019). Each of these effects of climate change brings unique challenges to a community, and the need to understand appropriate adaptations and the health of socio-ecological systems will be imperative in responding to the crisis. The first step in planning to accommodate hydrological and climate change is understanding the potential changes and most likely the combination of impacts likely to befall a community.

Limitations

There were numerous limitations in my study and analysis of the transformations wrought by hydrological change in the mountain communities of Nepal. Foremost among them, I was unable to conduct my research in these communities because of the COVID-19 pandemic, and correspondingly I was forced to study existing literature remotely. Studying distant

communities from afar undoubtedly creates missing links between my perception of the situation and the lived experience of the citizens of these rural communities. Researching and drawing conclusions remotely necessarily demands reliance on the assumptions, skills, and conclusions of other researchers. Additionally, I did not interact with any stakeholders or other community members throughout my research. Perhaps the most significant limitation, my lack of communication limited the complexity and depth of my analysis as well as topics available for discussion.

While researching remotely, I consistently found case studies pertaining to my research objectives, but often these researchers operated using a different framework or theoretical perspective than the SES. Thus, I found myself translating vocabulary and ecological, social, or economic dynamics mapped by other researchers into the variables described in the SES framework. In addition to being cumbersome, I realized that many of these studies, though attempting to answer questions similar to mine, used different means and analytical tools that may have limited information that would have been useful for me. Consequently, I learned that using this framework for an analysis of existing literature may detract from the very complexity and subjectivity that the framework promotes. Relying on the framework to answer all the questions and to provide neat and tidy solutions may have been misguided. I learned throughout that the framework can only go so far in solving problems, complex and adaptable it may be. This research was limited in its assumption that the SES framework would provide clean and comparable answers to complex and subjective problems.

Conclusion

The changing climate will exacerbate existing inequalities and challenge the adaptive capacity of mountain communities of Nepal. In these communities, varied hydrological changes

will continue to challenge expected livelihood practices and transform the landscape. As Nepali individuals and communities reckon with the changing climate through water, staying cognizant of every community's eventual reckoning with the same issue lends urgency to this project. The impending climate crisis necessitates conscious understanding and inquiry to investigate how the changing climate transforms society.

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