

Collaboration to Counter Fresh Water Scarcity and Promote Human Security

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Abstract

In the autumn of 2017, two professors and 13 undergraduate students from Dickinson College (Carlisle, Pennsylvania, US) engaged in 3 weeks of field research in Nepal. The students were assigned to one of four teams. Each was assisted by a pair of graduate students affiliated with Tribhuvan University (Kathmandu, Nepal). Each team conducted numerous semi-structured interviews in one of four wards of the Panchkahl Municipality of Kavrepalanchok District. When they returned to the US, each student team generated a 50-page report that summarized their findings. To frame the findings of those reports, the authors of this chapter constructed a basic yet original systems model. Their analysis suggests: (1) the importance of collaboration among system participants as the key to developing the capabilities needed to adapt to fresh water shortages and enhance prospects for human security and (2) the need for further system transformation to further promote adaptation.

Keywords: climate change, fresh water, human security, collaboration, subcommunities, adaptation, systems analysis

1. Introduction

In autumn of 2017, two faculty and 13 undergraduate students from Dickinson College—located in Carlisle, Pennsylvania, US—traveled to Panchkahl Municipality of Kavrepalanchok District, Nepal, to engage in 3 weeks of field research. Fieldwork consisted of numerous interviews conducted in four different wards of Panchkahl. When they returned to the US, each team completed a 50-page research paper that focused upon the ability of the respective community members to handle risks to their human security stemming from shortages of fresh water resources. In spring of 2018, the authors studied the four reports to distill high-level themes. As well, they constructed a basic yet original systems model to frame the relationships emerging in the reports.

Via that inductive process, this chapter offers the following thesis. Although the availability of fresh water was scarce and access to fresh water was constrained: (1) a successful collaboration among the community members and nongovernmental organizations had enhanced the capabilities relevant to adaptability and resilience, and thus, human security; and (2) future progress was contingent on the additional empowerment of women as well as the ability of the government to become a more trusted collaboration partner.

2. Program design

The students and faculty who conducted the field research were participants in a semester long Dickinson Global Mosaic Program [1], “Climate Change and Human Security in Nepal [2].” The program was 2 years in the making. As part of the building process, the Dickinson professor who initiated the program traveled to Nepal on two occasions and established a relationship with the Institute for Crisis Management Studies (ICMS), a master’s program affiliated with Kathmandu-based Tribhuvan University. The director of the ICMS designated a project coordinator for the initiative.

The professor and the project coordinator negotiated the activities, locations, and logistics. The Coordinator suggested four wards as the research sites: Hokse, Kharelthok, Koshidekha, and Sathighar Bhagawati. The wards, located to the east of Kathmandu, were part of Panchkhal Municipality of Kavrepalanchok District, located in Province 3 of Nepal. As well, the Coordinator agreed to recruit ICMS graduate students who would provide general assistance to the Dickinson students and serve as guides and translators during the field-research.

Fourteen students enrolled in the program. It consisted of three phases. Phase one included 9 weeks of study in Carlisle that incorporated three courses each taught by a different professor¹ plus one team-taught qualitative research methods course.² Furthermore, in phase one, the students were assigned to one of four teams.

Phase two consisted of 3 weeks of field research in Nepal that lasted from late October to mid-November. The advantage of the four-course structure was that there were no scheduling issues when faculty and students traveled to Nepal.³

During phase three, which lasted for 4 weeks, each team generated a 50-page research report that summarized their findings. Those four written reports provided the qualitative data for this chapter.

3. Important concepts incorporated in the on-campus courses

3.1 Human security

The United Nations Development Programme [3] offered the first generally accepted description of the term human security. Many alternatives have since been proposed. One schema, designed with Nepal in mind, illustrates interconnections among ecosystems and climate security; water and energy security; food and health security; environmental security; and nuclear and biological security ([4], p. 3).

3.2 Resilience

Many definitions have also been proposed for resilience. Nevertheless, a description offered by Twigg [5] is helpful. Community resilience includes the capacities to: “anticipate, minimize and absorb potential stresses or destructive forces through adaptation or resistance”; “manage or maintain certain basic functions and structures during disastrous events”; and “recover or ‘bounce back’ after an event ([5], pp. 8-9).” A caveat he offers ([5], p. 10) is relevant to this chapter.

¹ “Global Environmental Change and Human Security”; “Climate Risks and Resilience in Nepal”; “Collaboration as a Vehicle for Creating Value.”

² “Climate Change and Human Security in Nepal.”

³ Due to personal reasons, Professor Fratantuono and one student were unable to travel to Nepal.

Individuals can be members of several communities at the same time, linked to each by different factors such as location, occupation, economic status, gender, religion or recreational interests. Communities are dynamic: people may join together for common goals and separate again once these have been achieved.

3.3 Collaboration

In recent decades, the environments confronting citizens and professionals in all domestic and global settings have exhibited rapid change and increasing complexity [6]. Those developments have made collaboration among organizations an increasingly relevant way to achieve objectives beyond the reach of any single entity. For example, Goal 17 of *Sustainable Development Goals* [7] views multi-stakeholder partnerships as an “important vehicle” for making progress toward “the achievement of the sustainable development goals in all countries, particularly developing countries.”

3.4 Approaches to adaptation

In 2010, Nepal’s Ministry of Environment released the *National Adaptation Programme of Action (NAPA) to Climate Change* [8]. The report reflected the results of a 2-year, multi-stakeholder effort. After the Dickinson Mosaic Program had concluded, a Ministry of Forests and Environment report [9] also pointed to the need for collaboration. At the outset, the latter described the NAPA as an ongoing process that “will leave no one behind”; included numerous functionally based working groups; and recognized the need for engagement by multiple types of stakeholders ranging from local to national levels.

3.5 Basic system concepts

Meadows [10] explains that a human system has three essential components: elements; interconnections; and a purpose. Elements may be either physical items or intangible items. Interconnections are the relationships that hold the elements together: for human systems, they include customs, rules, or laws. The purpose of the system reflects intended outcomes. Since systems can be nested within systems, purposes can be nested inside other purposes.

She also explains that systems have three important attributes: self-organization, hierarchy, and resilience. Self-organization is the “capacity of a system to make its own structure more complex” ([10], p. 79). Hierarchy is the arrangement of systems and subsystems that tends to arise when self-organizing systems engage in the “process of creating new structures and increasing complexity” ([10], p. 82). In a manner consistent with Twigg [5], Meadows says resilience arises from the rich structure of many feedback loops that can work in different ways to restore a system even after a large disturbance. Resilient systems can be dynamic in nature and evolve over time.

3.6 Qualitative research methods

A few weeks into the semester, the three Dickinson professors assigned the students to one of four research teams. The teams were asked to develop questions for three different types of semi-structured interviews. Each type was intended for one of three different groups of interviewees: individual household members; key informants; and focus group participants. The teams shared proposed interview questions with the professors, took their comments, and engaged in fine-tuning.

<p>Thank you for taking the time to talk with us today. We are a group of students from Dickinson College in the United States and we are working with the Institute for Crisis Management Studies of Tribhuvan University in Kathmandu to learn about your community and the challenges it faces. The goal of the interview is to understand how weather and climate-related events and other hazards have affected your community and how resilient you and the community are in anticipating and adapting to these events and disasters.. .. Participation in the conversation is totally voluntary.. .. May we have your permission to audio and video record the conversation?</p> <p>To what hazards is the community currently exposed?</p> <p>Prompt: Disasters (large storms, landslides, earthquakes, floods, and disease)</p> <p>Prompt: Weather or climate related (heat, drought, erosion, and rainfall)</p> <p>Please write answers on the cards. Let us place the cards on the table and discuss the results.</p> <p>Of the weather and climate-related hazards you noted, which have gotten more frequent or intense? Over what time period: 5, 10, or 15 years?</p> <p>How have the hazards you described affected the community?</p> <p>Prompts: Food availability/production, water, health, livelihoods, and income.</p> <p>What areas of the community are most at risk to the hazards?</p> <p>What members of the community are the most affected/impacted?</p> <p>Prompts: Women/men, poor/wealthy, and caste/ethnicity</p> <p>Why do you think this is?</p> <p>What actions has the community taken to reduce the impacts of the hazards?</p> <p>Have the actions you described improved the situation and/or reduced risks?</p> <p>How does the community work together to cope or respond to changing conditions?</p> <p>Where does the community get information to improve the situation?</p> <p>If something happens (weather event, disaster, etc.), where does the community turn for help?</p> <p>Do you seek assistance (financial, resources, and training) from groups outside the community?</p> <p>Has it been helpful? Do you think the community has a clear understanding of actions that can reduce risks associated with hazards?</p> <p>What more do you think should happen to address the hazards and to meet the community needs?</p>
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Table 1.
Example of a focus group survey instrument: Subset of comments, permission requests, and questions.

When ready, each team forwarded their work to the ICMS graduate students, who provided further comments to the students and translated the survey instruments. All four teams used the “Toolkit for Measuring Community Disaster Resilience” [11] and Twigg [5] as their points of reference for designing their surveys. To illustrate, **Table 1** provides a condensed version of the focus group survey instrument created by one of the four teams.

4. Context for the field research in Nepal

4.1 Geography and climate

The geography of Kavrepalanchok District, and Nepal more generally, includes five major zones. From the lowest elevation to the highest, they are the Terai, Siwalik, Middle Hills, High Hills, and the Mountains including the Himalayas.

The two major agricultural regions that served as the focus of the Nepal Mosaic were the Terai and the Siwalik. The Terai has a warm, subtropical climate, and land that can be irrigated to grow rice and vegetables. The Terai generates most of Nepal’s agricultural output [12].

At the time of the research, teams learned that farmers of the Siwalik primarily planted maize and millet as their major subsistence crops on terraces dug into the hillsides. Rainfall was a major source of water in the zone, but the land did not retain much of the water that resulted from rainfall. Springs, streams, and natural aquifers were other important water sources that were supplemented by man-made water-channeling infrastructure and water-storage ponds and facilities. Land in the

Siwalik was subject to landslides. Far more devastating, in April of 2015, an earthquake of magnitude 7.8 on the Richter scale, centered in Gorkha, a district near Kathmandu, killed 9000 people and resulted in billions of rupees in damage. In the wards of Panchkhal located in the Siwalik, the earthquake destroyed buildings and homes, and disrupted aquifers and water-infrastructure.

Due to the elevation differences, each zone had its own microclimate. Nonetheless, all models forecasted increases in temperatures at the country level in coming decades that ranged from 2° to 6° Celsius, increases more pronounced than those at the global level. Projections for rainfall trends were even more varied than those of climate change, yielding results that ranged from a 30 percent decrease to a 100 percent increase by 2100, when compared to the 1970–1999 average. Moreover, climate change could destabilize the monsoon season, leading rainfall to increase and become more intense during a shorter season [13].

Those factors led Nepal's Ministry of Population and the Environment ([14], p. 1) to say:

Nepal is one of the most vulnerable countries to climate change, water-induced disasters and hydro-meteorological extreme events such as droughts, storms, floods, inundation, landslides, debris flow, soil erosion, and avalanches.

4.2 Demography and economy

Nepal's population tripled between 1960 and 2010. As of 2017, it totaled approximately 30 million people and was expected to continue to grow into the future, though at a slower rate. Nepal was characterized as a Least Developed Country by the United Nations. Roughly one in four people lived below the international poverty level of US\$ 1.25 per day. Agriculture accounted for nearly one-third of Nepal's GDP; thus, the onset of climate change had contributed to the struggles of the people ([15], p. 17). Furthermore, Nepal had inadequate infrastructure and was not a destination for foreign direct investment, factors that together suggested a shortage of the technological and financial resources needed to adapt to climate change.

4.3 Political context and governance structures

Nepal broke into a civil war in 1996, fueled by sharp disparities in living standards between rural and urban populations and by discrimination against social classes, women, and indigenous ethnic groups. A peace agreement was signed between insurgents and authorities in 2006. An Interim Constitution agreed in 2007 ended the 240-year-long Hindu Monarchy. In the ensuing decade, nine different coalition governments were formed. In September of 2015, the current Constitution of Nepal replaced the 2007 Interim constitution.

In the decade following post-war reunification, government reform was slow in coming. For example, the first local elections in 20 years in the wards of Panchkhal took place in the summer of 2017 [16], only a few months before the Dickinson research trip. At the outset, local governments were headed by unelected bureaucrats or community leaders, leading to increases in corruption [17]. During that era, building capacity for local governance was clearly not a priority. To fill the void, community groups emerged and worked alongside nongovernmental organizations to help promote collaboration and resilience in the face of challenges.

As of 2017, the governance structure of Nepal consisted of seven provinces, which collectively comprised 77 districts. In turn, each district was made up of municipalities, each municipality of wards, and each ward of various villages or clusters of people who did not have their own formal governance structures.

5. On-the-ground research in Nepal

Once in Nepal, the Dickinson student teams were partnered with a pair of graduate students—one male and one female for each team—who served as guides, and as language and cultural translators. In the field, each of the four teams conducted interviews in accordance with the semi-structured interviews they had previously created. Each team managed to conduct about 20 household interviews, six or so expert interviews, and two focus group interviews. (In each case, teams asked for participants' permission to record the interview.) Given the outmigration in some wards by single young men and by husbands in search of more stable income for their families, women were more highly represented than men in the interviews.

While in the field, students took turns each day asking primary and follow up questions and taking notes. Each evening, the teams reviewed what they had heard, and revised and upgraded their notes. When the teams returned to campus, they spent the final 4 weeks of the semester further refining their data and revisiting course materials and other sources as they completed their respective 50-page team-written research reports.

6. A model of community resilience and human security

In spring of 2018, Ms. House and Mr. Weisman, students who had both participated in the program, enrolled in a special co-research course with Professor Fratantuono. Together, all three carefully reread and discussed the 50-page papers submitted by each student team at end of 2017. As they did so, Professor Fratantuono took the lead in shaping a systems-model that synthesized concepts from the program and themes that emerged as all three authors interpreted the reports. As the model evolved, it served as a framework for describing data. First versions of this chapter were written in spring of 2018. Since that time, Professor Fratantuono has revised the model and the chapter.

The model incorporates ideas and imagery suggested by Meadows. She illustrates systems using stocks, flows, flow valves, and feedback loops. She explains that systems may display sub-optimal or problematic behavior. If so, she proposes 12 leverage points to promote system alteration ([10], pp. 145-165). Although Meadows does not make the distinction, the three authors say that the 12 alterations may be of two types: system modification or system transformation. Modification entails adjusting, repairing, rearranging, or embellishing components of an existing sub-system or system. Transformation entails either changing the membership, rules, purpose, or even the conceptualization of an existing system; or incorporating a new sub-system into an existing hierarchy. The model—a diagrammatic representation [18]—is presented in **Figure 1**. **Figure 2** is the Legend for the symbols in **Figure 1**.

Recalling Twigg [5], the upper left corner of **Figure 1** identifies four relevant types of community members: households and proprietors, organized community groups, nongovernmental organizations, and local government officials.

The model includes three tiers. The left-most stock of the upper tier represents tangible resources (people and economic resources) and intangible resources (trust, legitimacy, intercultural competency, and goal-related knowledge) available to community members. The second stock represents capabilities (organizational and operational) relevant to a community's efforts to adapt to challenges, and hence relevant to the community's resilience in the face of fresh water shortages Twigg [5].

The upper tier also includes two flow valves. Flow valves control the volume and rate at which information, water, money or other factors flow from stock-to-stock.

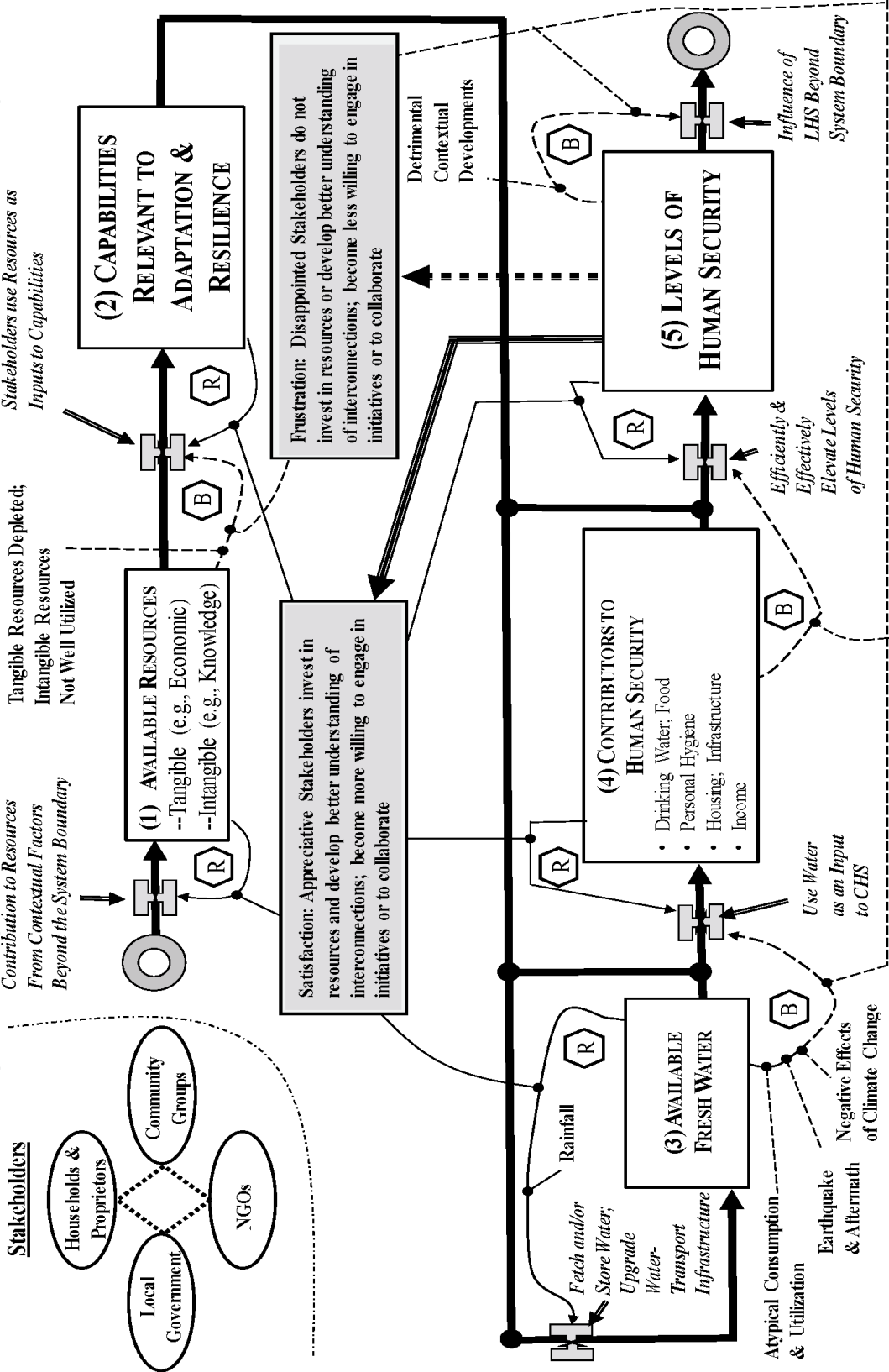


Figure 1.
 Model of elements and interconnections that promote human security.

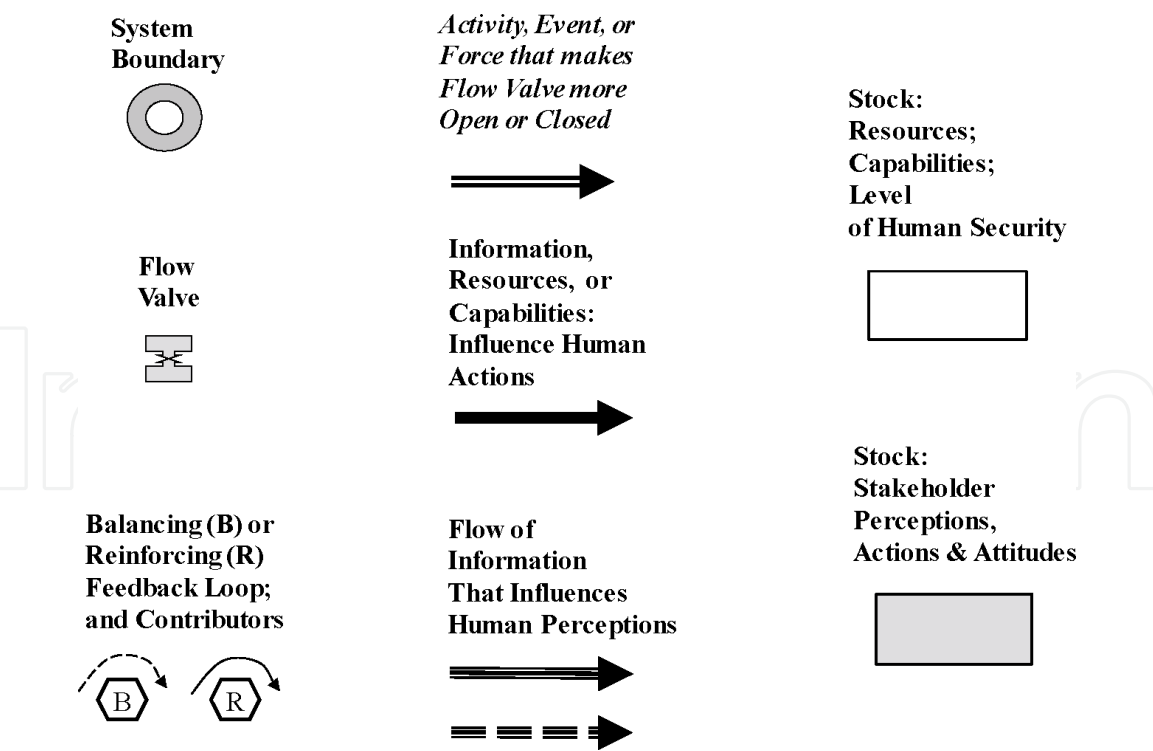


Figure 2.
Legend for Figure 1.

Valves are adjusted by either natural forces or human actions. The left-most valve indicates that developments beyond the system boundary contribute to resources available to a community. The second indicates that members will use the stocks of available resources as inputs to capabilities ([19], pp. 103-105).

The bottom tier of the model includes three more stocks and four more flow valves. The first three valves suggest the ability of members to leverage one or more of the capabilities included in stock 2 as they engage in actions that, respectively, influence flows into one of the three stocks. The fourth, right-most valve indicates that the level of human security attained in a community may have implications for developments beyond the system boundary. Of note, stock 2 and stock 5, labeled in larger font, are the most important to the specification of the model: contingent on human actions, Capabilities enabling Adaptation and Resilience in the face of fresh water scarcity contribute to rising Levels of Human Security.

Balancing and reinforcing feedback loops are present throughout the model. The loops influence the degree to which human actions open or close a flow valve. In this model, while balancing loops amplify actions that deplete a stock's magnitude, reinforcing loops amplify actions that restore or elevate a magnitude. In the top and bottom tiers, the model includes loops between one stock and one flow valve.

For example, in the bottom tier, the flow valve that precedes the stock of available water represents actions by community members—for example, fetch water—to make fresh water available for use. A reinforcing loop indicates the ability of rainfall—perhaps enhanced by new storage methods—to restore or amplify the stock. In turn, the valve that follows the stock represents actions that draw down the water stock. The associated balancing feedback loop (illustrated with a dashed arrow) indicates that both the use of water, plus other contributing factors such as a hotter climate, will draw down the magnitude of the stock.

The middle tier includes two lightly shaded stocks: satisfaction or frustration experienced by community members resulting from the outcome of previous efforts to enhance human security. As suggested by the various rays, respectively, emanating from those two stocks, satisfaction will enhance the influence

of reinforcing loops throughout the model, and frustration the influence of balancing loops.

7. Insights via a system lens

7.1 Unequal vulnerability to scarcity of fresh water

The students did encounter subcommunities that had different vulnerabilities to shortages of fresh water.

7.1.1 Spatial disparities

In Koshidekha ward, located in the Terai, members explained that many people had to travel long distances to collect water from a holding pond, or from the Sun Koshi River. In Hokse ward, while some farmers worked the land of the Siwalik, others worked the land of the Terai. A subset of the latter group, those working the valley floor and growing crops near a stream, had reliable access to water for field irrigation, resulting in larger crop yields and higher incomes than those realized by farmers working the nearby hills, who had to carry water to their crops.

In both wards, location-related factors created disparities in the vulnerability of some people: those who resided the farthest from sources had to work much harder at water fetching and storage (stock 3 and the associated inflow valve). Furthermore, at that point in time, there were no capabilities (stock 2) that could be leveraged in the short-term to overcome those location-related challenges.

7.1.2 Disabled children

In Kharelthok ward, located in the Siwalik, the research team interviewed a teacher at a school for disabled children. She explained that her students had historically been socially ostracized by other ward members and thus disadvantaged. As well, the level of human security of the children (stock 5) was fragile, since their capacity for adaptation was quite limited (stock 2) and they required more fresh water resources than other community members to perform activities that supported contributors to human security (stock 3 and stock 4 and associated flow valves). To illustrate, their education involved training in self-care skills such as using the toilet, and they needed to bathe and have their clothes washed more often than did other same-age children. Essentially, the training was intended to help them leverage the capabilities relevant to the three sets of inflow valves in the lower tier of **Figure 1**.

Given efforts by the school to raise awareness, community members had begun to recognize the children's basic rights, to respect their participation in the community, and to recognize they needed support in times of need. Enhanced recognition and ensuing social validation elevated the children's human security (stock 5).

7.1.3 Women

In Nepali society, husbands and fathers often dominated a household. In community meetings, the voice of men could override the opinions of women; or worse, women were sometimes discouraged by men from using newly formed skills. Those dispositions made it difficult for women to advocate their interests and to express their insights with other ward members about ways that water might be more effectively and efficiently utilized (inflow valve to stock 5). Those factors

essentially acted as constraints on the influence of reinforcing feedback loops on the intangible stocks of knowledge and on capabilities relevant to adaptation and resilience (stock 1 and stock 2), and as well increased frustration (shaded stock) among women.

Furthermore, women were disproportionately impacted by the shortage of fresh water. They bore the responsibility for making difficult daily decisions about priorities and tradeoffs in order to conserve scarce water for their families (flow from stock 3 to stock 4).

More dramatic, fresh water shortages and existing social mores had implications for a woman's health (stock 4 and stock 5). For example, the strenuous chore of collecting and carrying water (inflow valve to stock 3) could lead a woman to suffer a prolapsed uterus.

As well, women who attempted to maintain hygiene during menstruation were challenged by a lack of fresh water (stock 4). Even more troubling, the leader of a women's group located in Hokse explained that the general water shortage had led farmers to turn to various chemically based products such as pesticides to boost productivity; thus, when rains did occur, chemical residuals included in water runoff resulted in health threats when women used the supposed fresh water for personal care (stock 5).

Furthermore, women of the Kharelthok and Sathighar Bhagawati wards said other challenges arose when a woman was pregnant. That is, since some men prioritized water use for agriculture (inflow valve to stock 3), a lack of fresh water for properly preparing food could reduce a woman's intake of important sources of nutrition, thereby threatening the health of both the woman and her unborn child (stock 5).

7.2 General frustration with government initiatives

Frustrations were often associated with Government Initiatives. As a first illustration, in Sathighar Bhagawati, in the wake of the earthquake, one person said that a local NGO had to pressure the government to bring relief. Another said that when providing relief, the government did not deliver all the funds it had promised and that the funds had been unequally shared (stocks 1 and 2 and associated inflow valve to stock 2). As a result, community stakeholders were unsure whether they should wait for the remaining promised funds and projects or should themselves take the first steps. The uncertainty hindered progress toward improving community resilience (balancing feedback loops influencing stock 2).

One farmer took issue with the arms-length relationship the ward office had with community members. Although receptive to immediate needs, the office had little interest in prevention and rarely visited locales to get a first-hand understanding of a reported problem. That disposition squeezed information flows and detracted from the government's ability to provide in a timely fashion appropriate resources to enhance capabilities and strengthen resilience. As well, those factors increased frustration and thus the detrimental effects of the balancing feedback loops associated with stock 1 and stock 2.

A technician working at an agricultural cooperative said that the government had not provided enough support after the earthquake. That perception eroded trust in government and caused both decreased political engagement and lower voter turnout in subsequent elections.

Perhaps most provocative, a person in Kharelthok explained that the 2015 earthquake had damaged homes and other infrastructure throughout the ward. Water (stock 3) was needed to do construction; but water was also in short supply for other uses. The government announced an initiative to build a road that ran

upward from the valley, through the village of Manesau, and then further upward to the village of Manegau. To help finance the project (stock 1), the ward office collected NPR 15,000 (US\$ 134) from each Manegau household. Nonetheless, construction stalled, leading villagers to claim that ward officials had misused the funds. A budget released by the ward office included reimbursement; but that did not quell the anger of villagers. In protest, they cut off supply from a water tap running downhill to Manesau. Experiencing an extreme shortage of fresh water, the downhill community chopped down trees to further impede access to Manegau. At the time of the research, local leaders were holding hearings to resolve the conflict; but the team could not stay on site long enough to hear the outcome.

7.3 Successful collaborative efforts

In contrast to the previous set of examples, the following set illustrates that successful collaborative efforts generated satisfaction among stakeholders.

7.3.1 Women's self-help groups

Across the four wards, the research teams met women who had been motivated to form self-help groups in which they had autonomy and that enabled them to provide inclusive, informal support to one another and other villagers. Despite challenges, including a shortage of financial resources (stock 1), the women's groups had earned trust and legitimacy both within the community, and with external organizations.

Some women's groups tried to help poor and uneducated women by reaching out to them via pamphlets posted on community information boards about their activities. They initiated training programs to improve various skills, including IT and computer courses and unemployment training (stock 2); and supported sewing shops that employed women (stock 4). As well, one team found that the group they interviewed collected funds and provided loans in times of hardship (stock 1), a model based on historic self-help councils.

Women had sometimes benefitted from external assistance. For example, the Red Cross had provided training in rudimentary medical matters to members of one group, who then passed their knowledge on to other villagers (stock 1). Through hard work, those women had become authorities on healthcare and livelihood training (stock 4) in their respective villages.

Collectively, those initiatives suggested capabilities associated with two thematic arenas of resilience suggested by Twigg [5]: knowledge and education (stock 1); and risk management and vulnerability reduction (stock 2).

7.3.2 Agricultural cooperative

In Hokse, the team interviewed the Vice President (VP) of an agriculture-focused cooperative that was active among several villages of the ward. The organization was the product of a merger between two previously existing but independently operating cooperatives. The first had provided seeds, tools and water pumps to farmers at subsidized rates; the second had concentrated on helping manage villagers' savings. When founded in 2012, the cooperative had 30 members. By 2017, membership had expanded to roughly 800 people. Cooperative members had to be Nepali citizens and residents of a ward within the municipality. Membership fees ranged from \$3 to \$25; but nonmembers could make contributions.

Although staff at the local cooperative level reported to the district cooperative association, they did not get much technical support from the district—that general

support came from regional and national organizations. Nonetheless, the local cooperative did receive loans of up to four million rupees (approximately \$62,500 in 2017) from the district office at a low rate of interest. Those resources enabled the co-op to extend loans of up to \$1000 that could help farmers harvest crops or purchase livestock and land (stock 1). The VP noted that loans were typically repaid in full and on time; but sometimes, a bad harvest would force farmers to delay their payments until the following year.

The VP explained that if more funds were to become available, then the cooperative could extend loans to help rebuild homes that had been impacted by the 2015 Gorkha earthquake and were still in a state of disrepair. Furthermore, women could apply for loans at a reduced rate of interest that enabled them to explore entrepreneurship.

The VP also offered insights on a few other matters. The expansion of the cooperative had prompted new methods for two-way communication among community members and the cooperative, including a Facebook page, phone calls, and notice boards; an insurance program for local crops and cattle; and training to farmers to introduce organic farming methods (inflow valve to stock 4).

7.3.3 Navjyoti

Navjyoti is affiliated with the Sisters of Charity of Nazareth, an international congregation. They became active in Nepal in 1988. They focused on the poor and on women via educational initiatives. Community members appreciated their efforts (shaded Stock of satisfaction).

A worker for the organization explained that prior to the earthquake of 2015, among other activities, they had provided skills training for women (stock 1 and inflow valve to stock 2) and had channeled funds to women's-groups for farming or economic development (stock 3). Following the disaster, Navjyoti expanded outreach to the broader Koshidekha community.

At the time of interviews by the research team, several households shared water from a single tap that ran for only part of the day at very low pressure. In response, Navjyoti planned to support the Sun Koshi River Project, an effort to expand the number of pumps that could force-feed water to communities. When completed, the additional pumps would give community members greater access to fresh water (stock 3) that would be used to enhance the Contributors to Human Security (stock 4).

However, the Project would require substantial monetary resources. Although Navjyoti was willing to cover 60 percent of the cost, they hoped to receive contributions from households to cover the remaining 40 percent. Since many households could not afford the fee, Navjyoti was also ready to recruit volunteers to contribute their time and labor in lieu of money.

7.3.4 The red cross

In Kharelthok, the Red Cross maintained an active presence. It had helped establish a committee of community members that met each month to identify problems and develop proposed solutions to the Red Cross workers. Ward members explained that the Red Cross had provided different types of assistance, ranging from hearing aids for the elderly to funds for a disabled young woman so she could start a business and support herself (stock 4).

Community members also noted, however, that Red Cross efforts were sometimes off-target. To illustrate, while some farmers explained the organization had shared seeds (stock 1) with the community that were no longer useful in the dryer

climate, others noted that although it had subsidized animal husbandry (stock 2), cattle and goats required a disproportionate amount of water.

8. Final comments

8.1 The key to human security: access to fresh water

In retrospect, in the four wards visited, the stock of fresh water was being drawn down both by typical activities and as well by the influences of climate change, the residual effects of the Gorkha earthquake on water infrastructure, and the atypical need to use water for construction projects to repair earthquake-related damage. Access to fresh water, often determined by locational factors, was a key determinant of human security.

8.2 Capabilities relevant to adaptability and resilience

The capabilities required to enhance access to available stocks of fresh water and to more effectively utilize stocks were significant contributors to the level of human security in each of the four wards. In turn, the presence or magnitude of such capabilities was contingent on the degree to which stakeholders had engaged in collaborative efforts. Successful collaborations contributed to positive feedback loops and additional collaboration: success bred success. In contrast, government shortcomings as a collaborator indicated that the bureaus had further work to do in order to be trusted partners.

8.3 System modification: provision of additional resources

System modification had taken place in the wards visited by the teams. Two sets of initiatives had increased information flows. First, the agricultural cooperative used numerous communication strategies to learn about community members' needs, address those needs, and inform the community about services. Second, the Red Cross and Navjyoti had provided education and training dedicated to enhancing the knowledge of various community members, thereby allowing communities to navigate tough circumstances.

Looking ahead, members of various wards identified access to additional financial resources as their most immediate need as a first step toward gaining access to fresh water and thereby enhancing human security. An illustration was associated with the efforts by the agricultural cooperative. Even more striking were the funds sought by Navjyoti to help finance the Sun Koshi River Project, dedicated to installation of numerous water pumps to provide fresh water to communities in the Terai.

8.4 System transformation: initial progress, but more to do

Meadows [10] says that while "the rules of a system define its scope, boundaries, and degrees of freedom," ([10], p. 158) self-organization in human systems reflects the ability to "create whole new structures and behaviors" ([10], p. 159). The authors regard alterations of those types as transformations.

A striking development in the four wards had been the emergence of citizens groups (women's groups; agricultural cooperative) and international nongovernmental organizations (Navjyoti; Red Cross) as system stakeholders. Those changes took place in the space left open by immature local government. As a qualification, however, although international NGOs had successfully encouraged communities

to generate their own responses and at the same time provided resources to make those responses successful, initiatives that were off target prevented the community from self-organizing and ultimately decreased its ability to respond to its own problems. Nonetheless, and more important, interviews suggested that in most cases, those stakeholders who engaged in collaboration in different subcommunities were the most reliable and effective target for new stocks of tangible and intangible resources.

Alterations associated with rules and self-organization had begun to spill over to goals. That is, efforts by IGOs to cooperate with members of villages and wards had for the most part strengthened the capabilities relevant to adaptation and resilience and ultimately to human security. Nevertheless, although increased self-organization had challenged traditional power structures and created new hierarchies, self-organization had also led to conflict as was the case for the protesters who cut off the water flow between Manegau and Manesau. Such instances tended to reduce the levels of trust community members assigned to collaboration partners. At the same time, governments at the ward level—and in some cases even the district level—had not yet earned legitimacy in the eyes of most community members. Essentially, to move on from those types of outcomes and enhance community resilience, there was a need for more learning-by-doing among community members as well as for further maturation and engagement of local government as a system stakeholder.

While communities had made progress in their efforts to promote human security, there were of course avenues for additional progress associated with system transformation. In the wards visited, there was some early evidence of changing paradigms. The most poignant illustration surfaced in the interview with the woman who headed the school for the disabled. She noted that a greater number of community members had come to recognize the fundamental right of their disabled compatriots to dignity and full status.

Furthermore, in the wards visited, there was also some evidence about the rising status and autonomy of women. As a counterpoint, however, there was also evidence that long-held existing paradigms had prevented women from being able to make important decisions regarding water use, elevated threats to their health, reduced their voice in community forums, and constrained their opportunities to develop independent sources of income. The latter set of circumstances suggested that deep-seated cultural dispositions would not be transformed in a short period of time.

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