10 Gender dynamics and climate variability

Mapping the linkages in the Upper Ganga Basin in Uttarakhand, India

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Introduction

It is well established that climate change has differential impacts on people. Related disasters and impacts often intensify existing inequalities, vulnerabilities, economic poverty and unequal power relations (Brody et al. 2008; IPCC 2014). Differently positioned women and men perceive and experience climate change in diverse ways because of their distinct socially constructed gender roles, responsibilities, status and identities, which often results in varied impacts, coping strategies and responses (Lambrou and Laub 2004). There is also an understanding that lack of political influence, access to resources, gender-based labour roles and embedded cultural norms combine to render women and girls particularly vulnerable to extreme weather and other climate-related events (Adger 1999; Björnberg and Hansson 2013).

The Hindu Kush Himalayas (HKH), an area known as a climate change ‘hot spot’, provides irrigation services with the monsoon resulting in 75–90% of the water consumed for major cereal supplies in the world (Singh et al. 2011). Over the last 100 years, Himalayan warming has surpassed the global average of 0.74 ° C (IPCC 2007). This combined with regional variability (Immerzeel et al. 2010; Pellicciotti et al. 2010), geographical heterogeneity and immense socio-cultural diversity could adversely affect the livelihoods of mountain communities, especially because they are highly dependent on natural resources for their livelihood and their very survival (Neumayer and Plümper 2007; Ahmed and Fajber 2009; Arora-Jonsson 2011). Women are the most affected due to their centrality in these communities and the gendered nature of their household responsibilities (Aguilar 2009; Ogra and Badola 2015).

Hydro-meteorological information in the HKH is extremely limited and the microclimatic variations noted at elevation suggest that they are not representative of local climatic conditions (Singh et al. 2011). There are few

hydro-meteorological stations, especially at higher elevations, and inadequate long-term weather data. Simulation studies and forecasts are of limited use to the community in terms of shaping responses to future changes. After studies in Eastern Tibetan communities, Byg and Salick (2009) considered that awareness of local attitudes was essential to gaining a better understanding of the impact of climate change and recognizing problems previously ignored as a consequence of confusion about the extent and effect of weather variables at a particular location and the intensity of climate impact.

Communities whose lives and livelihoods rely on eco-system services, especially farmers, are conscious of changes and have accumulated local knowledge over decades (Chaudhary and Bawa 2011; Vedwan and Rhoades 2001), as shown in other studies conducted in the Himalayas or other mountainous regions of the world (Orlove et al. 2010). Such knowledge can contribute to empirical climate modelling and lead to increasing the coarse spatial resolution of climate predictions, important for researchers and policy makers.

Our study is built on the assumptions that (a) climate variability and change is already noticeable to, and directly affecting the livelihoods of, the people in the study area; (b) climate variability is not a new phenomenon to mountain people and they have developed a wealth of traditional response strategies; (c) change in the Himalayas is driven by a variety of environmental and non-environmental factors, not only climate; and (d) vulnerability to climate change is unevenly distributed across and within communities. Based on these assumptions, we examine gendered institutions to discuss differences between men's and women's lived experiences as formed by various social realities. This necessitates an understanding of gendered institutions and conceptualizing gender as a central part of the social framework (Scott 1986) and an integral part of community perception and processes.

Gender is, like all institutions, a result of people having different roles and conflicting interests and identities. Framing gender as a social institution thus shows how change is both resisted and accomplished over time and draws attention to the multiple features – ideology, practices, constraints, conflicts and power – affirming its complexities and multifaceted nature. Nonetheless, this change is guided by the perception of the population. Framing gender as a social institution promotes an exploration of the collective nature of institutions and people and discourages their separation into macro and micro domains. Further, gendered institutions is a notion used to explain how gender relations and the construction of femininity and masculinity are entrenched in daily institutional processes and practices (Lowndes and Roberts 2013). North (1990) defines institutions as “the rules of the game”; hence, gendered institutions are rules, norms and practices that affect, among others, the behaviour, activities, roles and relations of men and women, respectively, in differentiated ways.

In this chapter, we attempt to present an approach that uses gendered institutions to answer three questions in the context of the Uttarakhand, Himalayas: i) what are the caste-specific and gendered differentiated livelihood attributes in case study villages at specific elevations? ii) What are the prominent action situations in that area/elevation? What are the ‘rules in use’ pertaining to actors belonging to specific castes and genders? iii) what are the perceived changes in climate and its impacts on these attributes and ‘rules in use’, and what are the patterns emerging from the analysis?

Framework and methodology

Overview of the Institutional Analysis and Development (IAD) framework – a gendered approach

We utilize the above disaggregated conception of gendered institutions, rules, norms and effects to identify the corresponding interplay by applying the Institutional Analysis and Development (IAD) framework (Ostrom 1990). The framework strengthens existing analyses on gender roles and responsibilities, furthering understanding of how gendered dynamics shape differential vulnerability in the context of perceived climate change in rural agrarian settings across three elevations of the Garhwal region of Uttarakhand. Our categorization of elements within each study site according to the IAD framework yields the analytical framework in Figure 10.1.

Figure 10.1 Conceptual framework of the study.

Source: modified and adopted from Ostrom et al., 1994, p. 1.

The conceptual unit of the IAD framework is called the **Action Arena**. The action arena is shaped by an **action situation** that involves **actors** and their **interactions** in a particular context following certain rules. The action situation is referred to as a social space where actors interact, exchange goods and services, solve problems or fight; the actors are those who participate in the situation. In the present context, gendered institutions represent the action arena; action situations are activities related to agriculture and accessing water for domestic purposes; and the actors are men and women in the study sites.

The action arena is conceptualized amid a context of external factors representing the initial conditions that actors face (as presented in the first box of Figure 10.1). It establishes the possible pattern of interactions and actors' perceptions that are yielded within a particular situation. The initial conditions are broadly categorized by the underlying **biophysical conditions**, **community conditions** and **rules in use** that shape the access to and activities the actors perform. Biophysical conditions focus on tangible assets (e.g., natural, physical, and financial assets) both in terms of location and seasonal distribution present within the study site as presented in Table 10.1. Community conditions are intangible assets such as time, knowledge, social standing, networks, perception and habits (ways of carrying oneself and interacting with others) (Di Gregorio et al. 2019). These are broadly categorized into social and human assets. Rules in use refer to a range of prevailing social norms (rules) within a particular action situation and decision-making arrangements, both formal and informal. The ways actors interact and the relative importance of different action assets is shaped by the rules. Patterns of interaction hinge upon actors' perceptions and may result in outcomes that can be evaluated in terms of their efficiency, equity or other dimensions.

Table 10.1 Studied biophysical and community assets

<i>Biophysical Conditions (Tangible Assets)</i>			<i>Community Conditions (Intangible Assets)</i>	
<i>Natural</i>	<i>Physical</i>	<i>Financial</i>	<i>Social</i>	<i>Human</i>
Natural resource stocks including land, water, forest and agriculture land etc.	Access to roads, to communication such as radio and telephone, and to farming tools	Income (from on- and non-farm activities), access to credit	Time, knowledge Bonding, membership of (in) formal organizations (SHGs, Panchayat Raj) and linking networks within the village	The ability to labour and access to skills training, perceptions, habits

Moreover, gendered institutions directly or indirectly shape and are shaped by the interactions between actors and action situations. Our study framework presents the key patterns emerging from interactions within the gendered institutions in all our study sites.

Further, the IAD framework also conceptualizes multiple levels of analysis by considering nested characteristics of rules governing the institutional arrangements. It postulates three levels of institutional rules: operational, collective choice and constitutional choice. Operational rules define decisions corresponding to the set of questions on how, when, what and where. Collective choice rules define decisions that correspond to how operational rules can be changed and who can change them. Constitutional choice rules govern the eligibility of participants to change and define the collective choice rules. These rules help us inform the level of interaction between different action settings, day-to-day decision-making processes and the associated climate effect. For the present study, only the operational rules are considered. Actions are taken or decisions about future actions are made by individual actors operating at this level and are based on the set of institutional arrangements within which they operate, such as the intra-household division of labour, as explained in subsequent sections of this chapter. Who can change the rules and who is eligible to change the rules is beyond the purview of the current study, as it requires deeper studies over several points in time of the traditional and cultural system of the gendered institutions.

Data collection and analysis

The study employed a range of data collection techniques to build a narrative on perceived change in climatic and weather parameters and to understand the current roles and responsibilities and access regimes associated with both men and women across communities. These techniques include participatory rural appraisal (PRA) tools, semi-structured household interviews, focus group discussions and key informant interviews. Secondary data were obtained from various sources like the 2011 national census and the 2011 socio-economic caste census (Census of India 2011 and SECC 2011).

Transect walks were undertaken in the villages to build rapport with the people. Information on the distribution of household settlements of different ethnic groups (Table 10.2) and the different biophysical and community assets presented in Table 10.1 (natural, physical, financial, human and social) in the landscape were recorded during these walks. Further, wherever possible, seasonal calendars along with activity (agricultural and water) calendars were prepared with both men and women of different communities to understand the key livelihood activities they were involved in. Further, agricultural and water activities in the study sites where men and women engaged individually and/or collectively were documented, along with the roles and responsibilities of men and women under each of these activities. This was further augmented with data from semi-structured household interviews.

Table 10.2 Study sites (*G: General Caste; OBC: Other backward caste; SC: scheduled caste); Source: Census, 2011

Village	District	Elevation Category (masl)	Total settlement area (Ha)	Total number of households	Population		Literacy		Major caste groups	Livelihood source
					Men	Women	Men (%)	Women (%)		
Hakeempur Tura	Haridwar	Plains (268)	282.88	419	1368	1278 (37%)	60.8	39.1	<ul style="list-style-type: none"> • Saini (OBC)- 26%; • Muslim (OBC)- 32%; • Harijan (SC)- 28%; • Kashyap (SC)-0.05%; • Valmiki (SC)- 0.02% 	Primary: <i>Agriculture</i> Secondary: <i>Daily wage labour</i> (Census, 2011)
Kim Khola	Tehri Garhwal	Mid (1329)	117.5	95	170	243 (40%)	52.1	47.8	<ul style="list-style-type: none"> • Rajput (G)- 65%; • Harijan (SC) -35% 	Primary: <i>Agriculture</i> Secondary: <i>Daily wage labour, out-migration mainly in the Hospitality sector</i> (Census, 2011 and primary data)
Huddu	Rudrapryag	High (1953)	89.19	68	180	181 (37%)	57.7	42.2	<ul style="list-style-type: none"> • Rajput (G) – 75%; • Harijan (SC) - 24% 	Primary: <i>Agriculture</i> Secondary: <i>Daily wage labour, Religious tourism</i> (Census, 2011)

Subsequently, across the study villages, 12 key informant interviews with village elders were conducted to collect perceptions of long-term climatic changes. Separate focus group discussions (18 in the plains and eight in each of the middle and upper hills) were organized for women and men from different ethnic groups (Table 10.2). The participants discussed the impacts of climate variability, asset ownership, social roles and relations within the community (Table 10.3). This information was tabulated for different activities to gauge differential access to assets in each site.

Study area

To understand the dynamics of gendered institutions, information was gathered across different locations in the Hindu Kush Himalayan region of India. A river basin approach to site location was followed, and for the purposes of the study our work was confined to the Upper Ganga Basin (UGB) falling within the Uttarakhand administrative boundaries. The elevation of the UGB ranges from about 7500m above mean sea level in the northern high mountains to about 100m in the lower areas of the basin (Bharati and Jayakody 2010). Given the large topographical variations resulting from these elevations, the climate in the state varies from the valleys to the slopes, from subtropical to temperate climate (Chauhan 2010). Moreover, Uttarakhand also witnesses stark inequality between its plains and hilly districts, with a higher proportion of women in its hilly districts, a trend substantiated by the growing out-migration of men from these areas, leaving behind women to manage everyday household work. For the present study, the UGB has been divided into three elevation regions – plains, middle and high-elevation zones (Figure 10.2). One village in each elevation was chosen to explore the different interplay of nested rules for agriculture and accessing water within the village. These villages represent regions that have witnessed climatic aberrations in the past. While agriculture is the predominant livelihood across these villages, there are differences in terms of gender relations between men and women of different communities.

The study sites fall within the district administrations of Haridwar, Tehri Garhwal and Rudraprayag districts. In the plains, Hakeempur Turra village in the Bhagwanpur tehsil of Haridwar district was selected. The village is situated at the foothills of the Shivalik mountains, where the river Ganga descends into the plains. It is located 31 km west of the district headquarters Haridwar. It is well connected to the industrial labour market of Haridwar. The village is approximately 1 kilometre from the Solani river, a tributary of the Ganga. The middle-elevation village, Kim Khola, is in Tehri Garhwal district. It is located roughly 7 km uphill from Devprayag and can only be accessed on foot. Kim Khola is located in the water-scarce Hindolakhil region, which has faced severe water scarcity for many years, adding to the vulnerability of the local people. The high-elevation case study site, Huddu, is a small village in the Ukhimath tehsil of Rudraprayag district. It is located 33 km north of Rudraprayag town, the district headquarters.

Table 10.3 Perceived climatic variability in plains elevation site

Climatic Parameter	Perceptions Hakeempur Turra (Plains)			
	Saini, Muslim Communities (OBC Category)		Kashyap, Harijan and Valmiki Communities (SC Category)	
	Men	Women	Men	Women
Ground Water	Declining depth	No observation	Declining depth	Declining depth
Erraticism in rainfall	Increased	No observation	Increased	Increased
Erraticism in events of hailstorms	Increased	No observation	Increased	Increased
Winter temperature	Increased	Increased	Increased	Increased
The intensity of summer squalls	Increased	No observation	Increased	Increased
Pest attack on crops	Increased	No observation	Increased	Increased

Figure 10.2 Yearly average temperature trend in Kim Khola, Hakeempur Turra, and Huddu respectively for 1901–2015.

Demographic profile

This section highlights the gender differentials in access and control over resources according to caste and class.

The caste system observed in the lower-elevation village, Hakeempur Turra, has been in existence for generations, based on the occupational status of particular communities. This allocation of duties depended mostly on the land holding and economic need of the household. The caste groups are present among both Hindu and Muslim groups. Large sections of the land are still mostly owned by the affluent Saini caste (and Gade within the Muslim community), while the other caste groups belonging to scheduled caste, Valmiki, Harijan and Kashyap communities (or Nai and Teli communities among Muslims) either work as agricultural labourers or as off-farm

labourers in nearby factories or building works. According to the 2011 census, in Hakeempur Turra women comprise a mere 14 per cent of the total workforce. Field narratives suggested that in the census, women from the Harijan and Kashyap community households were identified as agricultural labourers as well as cultivators. Cultural taboos do not allow Muslim and Saini women to work in the fields, so that in the main worker category of the 2011 census, only 3 per cent of the total agricultural labourers are women. Muslim and Saini women were in charge of domestic household tasks, whereas the men were responsible for work outside, mainly agricultural activities.

In Kim Kholā, women constitute about 66 per cent of the total workforce in the village. Around 38 per cent of the women were in the 'main worker' category and 70 per cent of them were 'marginal workers'. Of the marginal workers, 69 per cent of the women were cultivators, while 100 per cent of the women were agriculture labourers. In Huddu, of a total of 221 workers, 52 per cent were women., Women made up 76 percent of the marginal workers, while 80 per cent of the marginal worker women were identified as cultivators. Field observations revealed high rates of men's out-migration in both the high and mid-hill villages. There are 9.49 per cent, 31.09 per cent and 27.92 per cent of women-headed households respectively in Haridwar, Tehri Garhwal and Rudraprayag districts (SECC 2011). Other than widows, no woman in these three villages held land in her own name. From secondary data and our field observations, it is evident that women's role in agriculture increases with the elevation. This can be attributed to the high migration rates of men in the higher elevations compared to the plains of Haridwar (Bhandari and Reddy 2015).

Research findings and discussion

Prevalence of climatic variability in the upper Ganga Basin

The state of Uttarakhand lies in the country's highest seismic zone. It is vulnerable to geo-hazards and exposed to many types of hydro-meteorological extremes because of its geographical location. The region is made up of large stretches of land and rivers flowing down the mountains. Floods, cloud-bursts, flash floods, glacial lake floods, hailstorms, water scarcity, drought, rockfalls, landslides, mud flows and forest fires are frequently reported incidents in one or other part of the state. The National Disaster Management Authority claims that the state is vulnerable to disasters. There have also been regular deluges and other disasters in the region in recent years (Kala, 2014). Over the years, floods originating from the Ganges river in Uttarakhand, for example, in 2010 (Bhatt and Rao, 2016) and 2013 (Sati and Gahalaut, 2013), have caused hardship for communities living both in the upstream and downstream regions. The 2013 flash floods in the Ganges affected many people and had serious consequences for local economies and livelihoods. While the nature of the events varied as we moved from site

to site, it was found that these extreme events were not limited by altitude and occurred across all elevations with varied exposure to one or the other event.

The literature indicates a consensus that in recent years there has been a decrease in the number of rainy days and high variance in inter-annual rainfall, as well as changes in temperature trends leading to irregular weather patterns and increased climate uncertainty in the UGB. There is a clear trend of warming manifest through increases in the temperature at all altitudinal locations of the UGB. The high-elevation village, Huddu, was observed to be sensitive to spells of high rainfall, flash floods, landslides and mudflow, while the mid-elevation village, KimKhola, situated in the Devprayag block, experiences water scarcity. The low-elevation site, Hakeempur Tura, located near the river Song, gets flooded as the river expands when flows increase – especially its agricultural land. Figure 10.3 shows the annual average temperature from 1901 to 2015 collected by the Climate Research Unit, UK, in March 2017, for grids over the three villages of Hakeempur Tura, Kim Khola and Huddu. Although the data are available at a coarser resolution, the trend indicates an increase in temperature for all three villages, that is, the entire grid.

Aggregating grid-based rainfall data is difficult in the mountains due to elevation issues. The same grid may have multiple points of increase and decrease due to the valleys and the mountain peaks. This argument also holds true for temperatures. Hence, the rising temperature trends exhibited in the three locations are merely indicative. While there are no clear trends in precipitation, erraticism is reported to have increased from all the elevations, with reduced rainfall in the monsoon season. In certain cases, increases in intensity have also been reported, with increased incidences of cloudbursts, flash floods and floods. Landslides and mud flows have also increased over the years.

Figure 10.3 Water Resource Map for Hakeempur Turra Village.

In the following section this data is triangulated by combining it with the community's perception of climatic variability trends over the past few decades.

People's perception of climatic variability and its perceived impacts

The literature stresses that environmental and climate perceptions are constructed by people who identify threats and risks based on their way of understanding and perceiving them (Hopkins et al., 2001). Douglas and Wildavsky (1982) found that the understanding of climate change is a social process of specific threats and fears conditioned by social relations. Climate variability is identified and established through social and cultural factors (Kasperson et al., 1988). Wolfe (1988) states that climate change is experienced at least as much in relation to social factors as to quantified projections. Gender is considered a significant axis of differentiation within a society (Hopkins et al. 2001) and thus an important factor in climate vulnerability perceptions and experiences.

Owing to the differences in socio-economic backgrounds, exposure to risk varies considerably in each site across the elevations where the study was focused. Overall, communities pointed to changing trends in climatic parameters that have been witnessed in the recent past. Field interviews reveal that water stress, declining water availability, temperature changes and declining agricultural productivity are perceived in each site across the elevations on which the study was focused. Overall, communities pointed towards uncertainty in arrival of the monsoon, distribution of rainfall and increasing temperature.

Perceived climatic variability in the plains

The frequency and intensity of rainfall can be seen in the form of changing water availability, giving rise to issues of no water or excess water during the monsoon period. In a discussion with a Harijan community in Hakeempur Turra, a woman noted: "Earlier each spell of the monsoon showers would continue for three to four days. Nowadays the rainy days have decreased." Further, men from the Saini and Muslim communities often linked the falling levels of groundwater to "reduced overall rainfall" and correlated this with their increasing dependence on groundwater for irrigation and domestic purposes. Further, men farmers stated that temperatures have been rising during the winter but the intensity of summer squalls has reduced, and winter hailstorms have become erratic, adversely impacting standing wheat crops. A man from the Muslim community said: "The difference between what was perceived as summer and winter seasons has reduced." From discussions, it was clear that until the 1960s, farmers in the plains relied on soil moisture and surface water for farming on their fields and near the river bank. Now they rely on groundwater irrigation, using diesel or electric pumpsets. From the interviews and FGDs, men farmers from the Saini

and Muslim communities in the plains showed greater awareness of the consequences of climate variability than the women. They mentioned the challenges they faced due to newer pests and diseases affecting the crops at different stages.

Perceived climatic variability in mid- and high elevations

In the mid-hills and high hills, the women farmers were more responsive than the men. They shared how uncertainty in rainfall is making them change sowing timings of their rainfed crops. A 70-year-old resident of Kim Khola, describing the climatic variability within his lifetime, said: "Fifty years ago, it used to snow for 8 to 10 days and the snow cover would last for at least 15 days. Now it does not snow at all. Rainfall has become erratic and the amount is lesser. Discharges have reduced to half the previous levels in two springs in our village. One spring that irrigated even small patches of land has completely dried up." In the middle-elevation region (Table 10.4), agriculture is largely rainfed. Changes in precipitation therefore impact agricultural livelihoods, with erratic rainfall damaging standing crops. In Kim Khola, villagers faced a water crisis due to the drying up of springs. The domestic water supply was interrupted for 10 days before intervention from external private and government agencies to augment the supply from newer sources. Women had to go 3,000 metres to collect water, which added to their workload.

Compared to the other elevations, agricultural lands in the low elevation were found to be more productive and certain crops like red kidney beans or vegetables produced good yields. The challenges of producing at economies of scale and target markets have, however, rendered agriculture largely

Table 10.4 Perceived climatic variability in mid-elevation site

<i>Climatic Parameter</i>	<i>Perception Kim Khola (Mid-elevation)</i>			
	<i>Rajput Community (General Category)</i>		<i>Harijan (SC Category)</i>	
	<i>Men (non-migrants)</i>	<i>Women</i>	<i>Men (non-migrants)</i>	<i>Women</i>
Spring Discharge	Significantly Reduced	Significantly Reduced	Significantly Reduced	Significantly Reduced
Erraticism in rainfall	Increased	Increased	Increased	Increased
Snowfall events	Decreased, almost negligible	Decreased, almost negligible	Decreased, almost negligible	Decreased, almost negligible
Winter temperature	Increased	Increased	Increased	Increased
Pest attack on crops	Increased	Increased	Increased	Increased

Table 10.5 Perceived climatic variability in high-elevation site

Climatic Parameter	Perception Huddu (High-elevation)			
	Rajput Community (General Category)		Harijan (SC Category)	
	Men (non-migrants)	Women	Men (non-migrants)	Women
Spring Discharge	No effect	Decreased	No effect	Decreased
Hailstorms	Increased	Increased	Increased	Increased
Snowfall	Decreased	Decreased	Decreased	Decreased
Winter temperature	Increased	Increased	Increased	Increased

subsistence in the mid- and high elevations. A large part of the agricultural land is left fallow and is uncultivated. Falling productivity and damage to crops by wildlife have been highlighted as major reasons for abandoning agriculture, and have also been triggers for out-migration and shortage of labour in many cases. It is mostly men, including young boys, that have out-migrated. Due to a combination of the many factors highlighted above, women reported an increased dependence of households on market-based products, which had not been the case before.

In the high-elevation region (Table 10.5), there has been a decline in snowfall. Although at present this does not give rise to water stress, reduced recharging of aquifers over the next two to three decades may lead to water scarcity. The implications are being felt in terms of day-to-day water requirements. In Huddu, a retired 70-year-old man perceived “greater diurnal variation” in temperature: “It gets hot during the day. Often in the evenings the temperature falls considerably. We cannot be sure about the weather these days.” Women farmers here perceived that average winter temperatures have risen compared to even two decades ago. In an FGD, some of them said: “Fans were not needed 20 years ago. The need was felt recently and table fans were introduced in most homes. Earlier we used light blankets in the summers too. Now blankets are used only at the onset of autumn.” Moreover, because of the variability in temperature, farmers also believe that pest attacks have increased.

Gendered institutions: the action arena

Climate variability has intensified competition for water and agricultural resources. In this section, we explore the ‘rules in use’ and pattern of interactions in two action situations: (i) accessing water for domestic use; and (ii) agricultural activities.

Action situation 1: accessing water for domestic use

Water availability is changing in all three villages, with issues of both water scarcity and excess of water. It was observed that the interactions between men and women actors are governed by socio-cultural norms, especially along caste lines (Table 10.6). Interestingly, it was pointed out that caste and gender often intersect to influence actors' degrees of participation in accessing water, defining their social power. The source from which water is collected varies in most cases, reflecting differential vulnerabilities across social strata. The intra-household division of labour has been passed down the generations. In all study villages, it was mostly women from all socio-ethnic communities who performed the tasks of water collection from various sources and water storage for all domestic purposes.

The study village in the plains, Hakeempur Turra, displayed rigid conformism in water access, resulting in inequalities and social exclusion based on caste and gender. Each household in the village has traditionally depended on hand pumps at the depth of 55 ft. Villagers reported contaminated water from the hand pumps, suggesting a decline in water quality over the past two decades, making it unusable for domestic purposes. They attribute this decline in quality to multiple factors, including reduced rainy days leading to lower recharging of ground aquifers and rapid industrialization in the Bhagwanpur belt near the village.

In response the government of Uttarakhand installed about 30 government taps, randomly placed in the village, to cater to the domestic needs of all households. However, the participatory mapping exercise conducted in the village (Figure 10.4), revealed that these taps were concentrated around the Saini and Muslim community households (regarded as affluent castes) and sparsely scattered around the Harijan, Kashyap and Valmiki communities (the poorer/lower castes) (Table 10.6). This implied that women from Harijan, Kashyap and Valmiki households had to travel longer distances and spend more time than women from the Muslim and Saini communities fetching potable water on a daily basis. On further enquiry, it was noted

Table 10.6 Distribution of potable water source in Hakeempur Turra

<i>Community</i>		<i>No. of households</i>	<i>No. of government water stand post</i>	<i>No. of private taps (private submersible pumps)</i>
Muslims (OBC)	Gade	120	10	6
	Teli	11	3	0
	Nai	7	2	0
Saini (OBC)		150	12	22
Kashyap (SC)		22	4	2
Harijan (SC)		120	1	2
Valmiki (SC)		9	1	0

Figure 10.4 Map depicting the study sites in the high, mid- and plain regions of Uttarakhand.

that power dynamics had played a major role in deciding the placement of the government taps, hinting at inadequate opportunities for lower-caste communities as compared to the affluent castes (Table 10.7).

Apart from the government water taps, a few individual households had personal submersible water pumps at a depth of 250 ft. These personal submersible water pumps, which required an investment of Rs. 30,000, were mostly owned by Saini and Muslim households. In the case of unavailability/lower discharge of water from government taps in the village, women from Harijan, Kashyap and Valmiki communities are often not allowed to share the water sources located in Muslim or Saini neighbourhoods. However, sometimes children from these communities buy water from Muslim or Saini private submersible pump at locally determined fixed rates.

Similar trends were observed in the mid-elevation village Kim Khola, where caste often becomes a determinant of gender roles, adding to women's workloads. The village is affected by water scarcity and reduced numbers of rainy days resulting in reduced soil moisture, infiltration, recharge and discharge in springs. During interviews, it was noted that there are four perennial springs in the village used for domestic and livestock-rearing purposes. These springs used to be the primary source of water for domestic purpose. On further discussion, however, villagers mentioned that since the 1980s, the discharge from all the springs has drastically declined while one of them has dried up completely. The springs have now been replaced by two overhead tanks with water supplied from the Bhagwan Pumping Scheme in the Devprayag cluster. The Harijan caste relies on the community water tank, which is separate from the tank serving the Rajputs. For

Table 10.7 Rules and implications for actors in action situation 1: accessing water for domestic use

Action Situation: *Accessing Water for Domestic use*

Activity: *Fetching Water for Domestic use*

Actors: *Men and Women from different communities in each study site*

General Rule-in-Use: *Women performed the task of water collection from all communities in all study sites*

<i>Study Village</i>	<i>Ethnic Groups</i>	<i>Rules and Implications</i>
Huddu Village, High-elevation	Rajput (G) and Harijan (SC)	<p>Rules-in-use in the institutional setting: Rajput community rely on gravity led water supply from the spring. Women responsible for collecting and storing water from the pipeline near their household. Whereas, Harijan community rely on community spring uphill their settlement. Harijan women are responsible for collecting water directly from the spring by travelling 7km uphill and spending 5-6 hours each day.</p> <p>Implication for the Actor: Differential water access is a major barrier for Harijan women. Increases drudgery in case of scarcity</p>
Kim Khola Village, Mid-elevation	Rajput (G) and Harijan (SC)	<p>Rules-in-use in the institutional setting: For the Rajput community water is supplied through a well-distributed network of gravity based piped community taps while the Harijan community rely on the community tank. Rajput women collect water either from the community pipe near their house or the community tank, whereas, Harijan women are responsible for collecting water directly from the community tank.</p> <p>Implication for the Actor: Differential water access is a major barrier for Harijan women. Enhances drudgery in case of scarcity</p>
Hakeempur Turra Village, Plain elevation	Saini, Muslims (OBC), Harijan, Kashyap and Valmiki (SC)	<p>Rules-in-use in the institutional setting: Differential distribution of government water pumps which were sparsely scattered in Harijan, Kashyap and Valmiki community settlement area. Women responsible for collecting and storing water from all households.</p> <p>Implication for the Actor: Differential Water Access is a major barrier for lower caste women. Enhances drudgery in case of scarcity.</p>

the Rajputs, the tank supplies water through a well-distributed network of gravity-based piped community taps, as the Rajput settlement is downhill from the tank. The Harijan settlement, being uphill from the water tank, lacks a gravity-enabled network of community taps. Although the distance from the Harijan settlement to their water tank is less than 2 km, Harijan women need to make this trip to access water, while Rajput women have access to water source in their home. If the water supply is affected, these Harijan women need to journey nearly 4 km to collect water, spending nearly 4–5 hours of every day on water collection. Harijan women reported that the task of collecting enough water from the community tank to meet the requirements of the whole family is exhausting, given the low yields during the summer months.

Similar caste differentials in water access were noted in the high-elevation village Huddu due to location of the settlements vis-à-vis the springs. The Rajputs live uphill of the Harijans. Traditionally, water is supplied through pipelines from separate springs to both communities. The Rajput spring is located above their settlement and gravity takes the water to each household through the pipeline. The Harijan spring is at a lower elevation than the settlement, so the pipeline does not function. The Harijan women have to spend 5–6 hours every day on a 7-km uphill walk to collect water directly from the spring. On further questioning, Harijan women stated they need external support to install diesel pumps in their settlement area to ease this drudgery..

Action situation 2: agriculture activities

Agriculture was observed to be the primary source of livelihood across all sites. It was informally noted that division of labour within agricultural activities varied between different communities. The dynamics of each community were complex and discrete in terms of the nature of the work they performed. The different roles within the household were shaped by several factors that in some cases restricted the women's role, and hence had an impact on their vulnerabilities.

In the low-elevation village, Hakeempur Turra, the division of labour largely assigned women to the reproductive sphere of the home, while men were engaged in the public sphere of production and employment among the OBC communities. This includes all agricultural work and dealing with the market (Table 10.8). They plan the crop cycle and take all the major farm decisions. In Muslim households, women are tied to the house and perform reproductive chores. Though some younger women have started moving out of the village for higher education and technical jobs nearby, FGDs revealed that they were mostly unaware of the location of their fields. Within the SC communities, however, there is greater diversification of livelihoods. Lower dependence on agriculture reduces their vulnerability to climate shocks. Most SC landholdings are less than 10 bighas (1 bigha = 0.4 acres), and women and men are equally involved in farming activities

Table 10.8 Rules and implications for actors in the high hills, mid hills and plains in action situation 2: agriculture-related activities (✓ rule in use, *non-migrants, # applicable only for plains, Highlighted cells shows activities taken by men and women together)

Action Situation: Agricultural Activates

Activities: Preparation of land (ploughing); Sowing, Plantation; Weeding; Leasing land; Harvesting; Irrigation; Application of water on fields; Saving Seeds; Buying seeds, fertilizers and pesticides#; Buying seeds; Adoption of new technology; Access to telecommunication for farming

Actors involved: Men and Women farmers from Rajput and Harijan communities in Huddu and Kim Khola village and Men and Women farmers from Saini, Muslim, Harijan and Kashyap communities in Hakeempur Turra

Perceptions on climatic variability: Decreased land productivity, changing cropping pattern, reduced rainy days

General Rule-in-Use for high and mid elevation: Farming is a woman centric activity; Men are only engaged in land preparation activities.

General Rule-in-use for plains: Division of labour within the wider economy assigned women to the reproductive sphere of the home and everyday farmwork while men were allocated to the public sphere of the production and employment. but in marginalized communities, both men and women take up equal roles for income generation.

Action Arena: Agricultural Related Activity	High elevation				Mid-elevation				Low elevation			
	General (Rajput)		SC (Harijan)		General (Rajput)		SC (Harijan)		OBC (Saini and Muslim)		SC (Harijan and Kashyap)	
	Men*	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Preparation of land (ploughing)	✓		✓		✓		✓		✓		✓	
Sowing		✓		✓		✓		✓	✓		✓	✓
Plantation		✓		✓		✓		✓	✓		✓	✓
Weeding		✓		✓		✓		✓	✓		✓	✓
Leasing land	✓		✓		✓		✓		✓			
Harvesting	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Irrigation, Application of water on fields		✓		✓		✓		✓	✓		✓	✓
Saving Seeds		✓		✓		✓		✓				
Buying seeds, fertilizers and pesticides#	✓	✓	✓	✓	✓	✓			✓		✓	✓
Adoption of new technology, Access to telecommunication for farming	✓				✓				✓		✓	

on their own land or in the fields of the OBC families. Consequently, SC women acquire productive skills in addition to reproductive ones, increasing their say in decision making.

Agriculture in the mid- and high hills is largely subsistence in nature, unlike in the plains. The majority of people depend on agriculture as their main livelihood, along with construction and labour work. The land is largely fragmented and scattered with very small landholdings, making it challenging for the communities to produce enough for the markets, still less to produce surpluses. Men here have migrated, whereas women continue with agriculture, which requires a major labour contribution from women throughout the year. Men only plough the fields using bullocks or help with harvesting if they are home. When the men are away, women hire labour to plough the fields. Women's roles in households with migrants and those without are almost the same. It was observed that men out-migrants interviewed during their return to the village for holidays had little awareness of climate variability and its impacts on natural resources in the area.

Fodder collection is also one of the primary activities for women a considerable amount of time is spent daily carrying fodder long distances on their heads, backs and shoulders in addition to fetching water and firewood. As well as increasing their workload, this increases their physical burdens. Livestock was once a steady source of income. However, due to out-migration and reduced availability of fodder, families have reduced the number of domesticated animals they keep. The reduction in agricultural yields, male out-migration, stress and workload seem to have increased among women over the years. Lower-caste communities were found to have less land holding and therefore, apart from working as agricultural labourers, these families mostly engage in off-farm livelihoods such as building and other forms of casual labour.

The cropping system is traditional, and unlike in the plains, decisions regarding changes in crop patterns are taken jointly by women and men, often even solely by women if men have out-migrated. Overall, land tenure is associated with men in all elevations, so decisions related to the lease and exchange of land are made by men, though in consultation with their women. Land or any asset is in the name of a woman only if she is widowed, although in this situation the final decision would be taken by the eldest son of the family. Women in this region are heavily involved in agriculture, as in other mountain states – except for ploughing the fields, culturally associated with men. However, with the growing out-migration (predominantly of men) witnessed in the villages of Uttarakhand (Ghosh et al., 2007) this activity is also now being performed by women.

To sum up the action situation, distinct divisions were seen in different communities, resulting in a lack of skill development for women in a few communities. In the lower-caste households, due to smaller land holdings and major economic need, women also assisted male family members in the field and worked as labourers. This resulted in a higher workload but the acquisition of more better skills in productive activities along with

their household duties. Similar results were found in a study conducted by Djoudi and Brockhaus (2011). Due to the higher involvement of men in agricultural activities in the plains, they had greater powers of decision in the household.

Exploring gender relation patterns in the three elevations

As discussed in the previous sections, both action situations (accessing water and agricultural activities) involved interactions between women and men and were often influenced by availability of and access to assets, which in turn were governed largely by the actor's perception and the intrinsic rules in use for each study site. It was also noted that climate variability impacts each action situation. In this section, we evaluate the key patterns emerging from interactions within the gendered institutions across the elevations.

Gendered institutions: dynamic, complex and diverse?

Gender shapes social relations and situations in profound ways. Through the institutions of norms, rules and values, gender becomes an underlying structure embedded in everyday interaction and expressed in "perceptual, interactional and micro-political activities" (West and Zimmerman 1987). Narratives from the field suggest that women and men are a heterogeneous group, with overlapping ethnic, class and caste identities that result in multiple forms of marginalization and exclusion. An exclusive focus on women glosses over differences between women and their interests. Caste and gender often intersect to influence individuals' degree of influence in the community, or in short, their social power. Addressing gender requires an understanding that women (as well as men) are not a homogeneous category and the continued assumptions made around a single homogeneous class of 'mountain' women would reflect an incomplete picture. This highlights the dynamic, diverse and complex nature of gendered institutions.

Gendered rules, norms and rights: rigid, flexible or fluid?

The intra-household division of labour plays a key role in defining vulnerabilities to climate change. Often, within the literature, the division of labour generates gendered processes that are classified into separate 'reproductive (private)' and 'productive (public)' spheres, characterized by specific priorities and privileges. This results in women being assigned to the reproductive sphere of the home and everyday farm work while men are involved in the public sphere of production and employment, with differential access/rights to livelihood resources. Field narratives depict that in the high and mid-hills, due to the high out-migration of men over the years and the higher involvement of women in agricultural activities, women make the immediate decisions regarding the crops to be grown. But in the plains, due to higher caste conformity, women from OBC communities were less empowered to make decisions and had little knowledge about agricultural

activities, since they were only associated with household responsibilities. This highlights that social and human-environmental interactions often challenge gendered norms, rules and values. While some boundaries and relations seem to be rigid, others are more flexible or fluid. Further, institutional networks prefer men and assume them to be heads of households. Interestingly, the position of village head (*Pradhan*) in the plains and high hills is reserved for SC women. This should imply that the *Pradhan* represents the voice of her community's women and introduces measures that might reduce their drudgery. Interviews with them revealed, however, that major decisions regarding natural resource management and livelihoods are made by either the elected *Pradhan*'s husband or father-in-law. In accordance with social norms, a man in her family is recognized as *Pradhan* by society, even when the actual position has been won by the woman, limiting her ability to voice her opinions. There was also a difference in the participation of women in meetings held at the village institution (Panchayat) level. In the mid- and high hills, when asked about their dependency on groundwater/springs, women expressed their wish to revive the community water harvesting pond but also expressed their inability to do so, given the power dynamics. Further, no women's self-help groups (SHGs) were found in the high and mid-hills study sites. Only one SHG was identified in the plains, in which only women of the Kashyap caste (SC community) participated. This highlights the power dynamics between different caste groups: more static in the plains and more dynamic in the mountains.

Social relations, position and mobility: inclusive, partially inclusive or exclusive for all?

People are positioned differently in terms of their access to and control over assets. While some have direct control, others access these through mediators, often requiring extra effort. This shapes women's and men's capacities, incentives and preferences for how to access, use and control the assets defining their social position. Narratives presented in the previous sections show evidence of vulnerability and its impact on people lower in the socio-economic hierarchy, irrespective of their elevation. In the mid- and high hills, differential water access was seen that indirectly resulted in increased drudgery for women from SC households, while in the plains, we found no uniform distribution of government taps. This highlights the need to focus on changing gender relations around water to yield a better understanding of the impacts of drinking water supply interventions on women's quality of life, rather than estimating impact simply in terms of conventional indicators of women's water burdens.

Further, it was observed that women across all communities acquire agricultural land through men (i.e., mainly husbands) who inherit, own and control land. It was also observed in the plains that for educational purposes, the men of the family may be sent outside the village to attend university or diploma courses, which increase their chances of getting jobs

outside farming. Women attend educational institutions within a 3–4-km radius of the village and are often married off after their education. However, they make take up jobs like teaching within the village. This trend was also observed in the high and mid-hills sites, where men belonging to socially dominant castes, having better access to education, financial resources and social networks, were more likely to migrate. Further, differential labour force participation and wages was seen at all elevations, with women employed in private construction earning lower pay than men for the same job role (Rs. 250/day for women and Rs. 300/day for men). This again highlights that social relations, position and mobility might not be inclusive for all, and differ in different social, political and economic settings, dynamically shaping “gender as a critical variable in shaping resource access and control” (Rocheleau et al., 1996).. However, how social position and mobility will play out in terms of climate change is yet to be fully seen and was not explored through this research.

Willingness to learn, evolve and adapt to climatic variability: intrinsic or socially contingent?

Operational rules that define the roles and responsibilities of men and women have been intrinsic to gendered institutions. These rules have been evolving very gradually in all the elevations, with men and women starting to diversify their livelihoods to cope with the changing climate. From field observations it was noted that operational rules are interwoven with the cultural mesh of the system that defines the level of conformism to caste norms and customary principles. Therefore, evolution at the level of collective choice rules and constitutional choice rules will always hinge on the ability of men and women from communities to resist and move away from, rather than conforming to, the operational rules. Accordingly, in the high and mid-hills, with an increase in men’s out-migration, women have a greater say in both productive and reproductive activities and find themselves more aware within their households. But differential access based on caste still exists, which shows that the strains of social conformism are still strong. In the plains, the degree of conformism is greater, meaning that any change in the operational rules will take place at a much slower pace. Therefore, in all sites, the actual empowerment of the lower-caste (SC) communities is very slow, hinting that willingness and social conformity should be seen in unison in order to represent a more realistic picture.

Conclusions

This chapter has focused on the impacts of climate variability on men and women engaged in accessing water for domestic purposes and in agricultural activities, using the IAD framework. Observations demonstrated that men and women across diverse communities and elevations interpret, experience and respond to climatic and non-environmental changes concurrently, yet differently.

Differentiated impacts of climate variability within gendered institutions were manifested that are due to unequal distribution of roles, responsibilities and resources for men and women from different communities in all study sites. These factors had a direct impact on their assets, their access to livelihood attributes and the options available to them for pursuing optimal livelihood strategies. Moreover, the gendered division of labour between men and women reflected a strong dichotomy between 'reproductive' and 'productive' work in all the study sites. It was noted that the actors whose livelihoods are linked with natural resources are more confident to report on the changing biophysical parameters and climate-related awareness. It can be said that differential water access for domestic use made women, especially those from SC communities across all elevations, more exposed to the impacts of climate variability. In the high and the mid-hills, due to men's out-migration in search of productive economic activities, women from all communities found themselves performing both agricultural activities and household work. In the plains, women from OBC communities were tied to the home and had restricted mobility, while SC women were better equipped with livelihood diversification skills, as they were involved in both productive and reproductive activities. Socio-cultural conformism was seen as the prime cause limiting the voice of OBC women in decision making, education and participation in formal and informal institutions.

The institutional perspective to understanding gender dynamics facilitated our ability to bring out the gendered differences in social institutions on the basis of the intrinsic socio-cultural norms across elevations, as all the study sites are within the same state-level administrative boundary. Moreover, our analysis has emphasized the need to take account of both the characteristics these institutions exhibit and the necessity of situation-specific climate change interventions. To gauge the resilience of these gendered institutions to climate change, inherent properties of the system like equity and adaptability can provide an appropriate scale for deepening our understanding of the context, thereby improving the design and implementation of climate change-related interventions in the future.

Note

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