SUMMARY OF CHANGES

Overall Summary

The accompanying manuscript has been revised throughout in response to reviewer comments. Specific changes requested in reviewer comments are outlined point-by-point below (indicated by arrow), while general changes are summarized as follows:

1) **Revision of organizational structure, with tighter conceptual focus and deeper discussion of results.** The general introduction has been cut substantially to provide an overview of key issues and outline of the paper. A revised conceptual framework follows in two parts – one section is devoted to the idea of differentiated vulnerabilities, drawing largely from insights in the fields of disaster risk reduction and gender/disaster research; the other draws from research in development studies and presents the DFID Sustainable Livelihoods model and introduces the concepts of livelihood assets, transforming structures and processes, adaptive capacity, and livelihood diversification. This tightened and focused introductory section of the paper sets the stage for almost entirely new discussion of methods (including a rationale for our focus on women as a category of analysis, articulated research questions, clarification of data sources, and context for data collection) and study site. Results and discussion are presented squarely in terms of reported findings from fieldwork, with new explanatory text about women's experiences with climate change and ecotourism-related changes in livelihood assets. Our closing ideas for related research and general conclusions are not substantially modified, but have also been revised for clarity.

2) **Clarification of focus on women, and increased attention to factors such as wealth and ethnicity.** Our original manuscript made clear our position that factors other than gender are also important in shaping livelihood outcomes. However, as discussed in our previous response to the reviewers, our goal is not to conduct an intersectional analysis of gender/power relations at the site. In this revised manuscript, we have explained and defended our theoretical and methodological reasons for seeking to examine women's experiences. Where our data allow us to do so, we have integrated new text to suggest how differences among women (e.g., in terms of relative wealth, household size, and/or ethnicity) shape their respective livelihood assets.

3) **Increased level of detail about study site and methods.** In response to questions posed by the reviewers about how and where the study was conducted, we have added new sections to address each of these areas.

4) **Attention to minor technical issues flagged by reviewers.** We have sought to edit for clarity, throughout.

Specific Changes in Response to Reviewer Comments

R1: *It would have been good to have seen a discussion of the other pathways that local people take to reduce their levels of livelihood insecurity…. The role of migration and the positive as well as negative effects could have been usefully discussed or referenced. For example the work of researchers in Nepal on migration…*
→ A more comprehensive discussion of the physical and social context for the study is included in the revised ms (Sec 4, "Study Area"). This section addresses the range of livelihood strategies in place at the site, including male out-migration for households in this context. We have also added new text about migration as a strategy in the region more generally (Sec 2.1, "Sustainable Livelihoods and Adaptive Capacity"). As suggested by our prior response, new references to work by researchers in Nepal about some of the positive effects migration have been included.

R1: *I would add to this the need to model the different livelihood choices that are being made by local people…*
→ This suggestion has been added to Sec 6.1, "Suggestions for Further Research."

R1: *The title does not fully reflect the content of the paper – I would suggest the authors consider changing it to "Gender and Climate Change in the Indian Hindu-Kush Himalayas: global threats, local vulnerabilities and livelihood adaptation."*
→ We have made changes to the title and keywords to reflect the suggestions offered by both reviewers.

R2: *Many "grand" questions are raised and unnecessarily drawn out (technical interventions, holistic approach, mitigation, north/south power imbalances, gender power imbalances, etc.) The paper needs to get the point about gender issues faster, shorten the conceptual discussion considerably…*
→ The revised introduction has been reduced considerably. "Grand" questions that are not directly related to the case study (technical interventions, north/south relations, gendered issues in the UNFCCC secretariat and related policymaking arenas, etc) have been removed. Conceptual linkages between sections have been tightened up.

R2: *The case study focuses on eco-tourism as a diversification strategy, but the links to adaptation are weak (with some mentioning in the table); the analysis therefore needs to be deepened considerably, using a tightened/focused conceptual framework…*
→ We have revised the discussion of conceptual framework and placed it earlier in the paper (Sec 2.1, "Sustainable Livelihoods and Adaptive Capacity"). We have also rewritten and added to the original discussion of our results to more fully explain the meaning of examples contained in the tables and figures (Sec 6, "Discussion").

R2: *The question of attribution needs to be addressed; is livelihood diversification solely a response to climate change, as the paper suggests, or are other forces at play as well?*
→ We have addressed this question through an entirely new section describing the study area (Sec 4.2 "Local Communities"), and revised/expanded discussion of existing livelihood challenges (Sec 2.1, "Sustainable Livelihoods and Adaptive Capacity")

R2: *Some conceptual issues require attention. The term gender is used as a way to analyze the homogenous category "women" and "men", "women's needs", etc. The paper criticizes homogenizing tendencies (i.e. Mohanty) and out-dated WID approaches but falls prey to the same uncritical tendencies without analyzing gender power relations or differentiating along class, age, marital status, etc. This needs to centrally engaged in the analysis of the case study material, and not as suggested in the paper, to have this "more sophisticated analyses" (page 22) picked up by future research. Its uncritical focus on "social systems" (assumed to be bounded entities) is problematic; it is suggested that the authors consider political-ecology concepts to analyze gender power relations, inter and intra-household gendered negotiations, etc. (as authors they cite engage).*
→ We have revised the manuscript throughout in a response to this issue. We have rewritten the introduction to link broad "gender and climate change" issues to more specific "women's" issues (Sec 1, "Gender, Women, and Climate Change"). We have included a methodological and theoretical rationale for selection of "women" as a gender category of special interest, and articulated our intended research questions (Sec 3.1, "Focus on women: why women's experiences still matter"). At the same time, we have addressed intersecting roles (played by wealth, ethnicity, etc) in shaping differences within the larger group of "women" where our data and fieldwork allow us to do so (Sec 5.1, "Gendered dimensions of climate change in the NDBR" and Sec 5.2, "Gender and ecotourism in the NDBR" and revised accompanying tables). We have also added new text to the discussion (Sec 6.1, "Directions for Future Research") to clarify our ideas about how social scientists' methodological expertise and insights can contribute to finer-scale studies about gender, climate change, differentiated vulnerabilities, and assets development. Regarding our use of the term "social systems" on two occasions in the original manuscript (which we had intended to be understood in context of the Sustainable Livelihoods model), we have revised our presentation of the Sustainable Livelihoods model to make clear that the model is intended to open a dialogue about social systems, and not to represent reality as a static set of relationships or "bounded" entities (Sec 2.1, "Sustainable Livelihoods and Adaptive Capacity").

R2: *The paper needs to be more specific regarding methodology (i.e. how many interviews, how many women, how many men, how many times each were interviewed, overall profiles of the participants, etc.).*
→ We have substantially revised the discussion of our methodology to provide the necessary details and to give context about the larger project, of which this specific case study is a small extension (Sec 3.2, "Data Sources"). We have also included two new tables (Table 2-3) to provide data about the socioeconomic and occupational profile of NDBR residents.

R2: *In the conclusion, issues of climate modeling and climate justice appear without prior context. Although the issue of climate justice and equity are important, they need to be framed beforehand (i.e. what evidence in the case study tying to climate justice).*
→ Our discussion of research directions has been slightly revised to acknowledge the goal of transdisciplinary dialogue between climate scientists, policy modelers, and social scientists represented by the goals of the originally related workshop and this resulting special issue. We have also reorganized our suggestions for research ideas to direct one set for each of these specific audiences. The conceptual tie between issues of climate change and gender equity should now be evident to readers in the conclusion, given the changes elsewhere in the manuscript (i.e., our revised introduction, newly added rationale for focusing on women, and more clear demonstration and discussion of how gendered labor practices and other cultural norms are linked to impacts of climate change). Although we retain references to gender justice (Table 4 and accompanying passages in the main text), in this version of the paper we do not emphasize the larger "climate justice" activist movement.

R2: *In several places, the authors assume or assert (i.e. "assuming", result "may be caused by...", "may well", "may result in", etc.) rather than focusing on the evidence in hand; In many places, the paper remains general, without evidence to back up/frame particular arguments (i.e. direct impacts, indirect impacts, gendered impacts, gender-differentiated outcomes, etc.).*
→ We have revised the text throughout in an attempt to avoid such statements and rewritten the material on direct/indirect/gendered impacts with more specific and direct references to our data. In some places we retain use of the word "may" as part of signaling future possible outcomes.

R2: *While the authors argue that women's resilience on natural resources is reduced, one wonders about newly added pressures of additional people (i.e. tourists) in their demand for food, fuelwood, water, etc.? Is this factored into account? If so, do they still lead to positive adaptation?*
→ We have added some new text to address the known and potential impacts of tourists in the homestay villages (Sec 6, "Discussion").

R2: *…conceptual clarity and consistency in the use of the categories "male/female" and "men/women" which are inter-mixed throughout the paper (often in the same sentence) and in the tables/figures (it is suggested adding that a short explanation on how the word gender and sex differences are understood and used in the paper)*
→ We have retained use of terms "women", "men", and "transgender" (rather than the biological terms "female", "male", and "other") as relevant gender identification categories in the study. However, some of the data reported in Table 1 were only available in biological categories so we report them as such. (We include a statement to this effect in the notes to the table.) Our new methods section also includes a note to clarify our use and intended meaning of the term "gender" in the paper (Note #1)

R2: *the use of the term Hindu-Kush Himalayas and Indian Himalayas (the paper is more focused on the latter, given there the one case study, and therefore it is advisable to drop the word "Hindu-Kush" and simply use India, or Indian Himalayas)*
→ We have made this correction.

R2: *Critically read the statement on page 6 referencing Neumayer and Plumper (2007), go back to the original paper….*
→ We have made this correction and removed or modified the surrounding statements in question.

R2: *the title (global threats, local vulnerabilities; gender) does not reflect the content of the paper (diversification; women); the abstract could be tighter…*
→ We have revised the title, abstract, and keywords to better reflect the contents of the revised paper.

→ We thank the reviewers for the opportunity to improve our manuscript as a result of these comments and changes.

Gender and Climate Change in the Indian Himalayas: Global Threats, Local Vulnerabilities, and Livelihood Diversification at the Nanda Devi Biosphere Reserve

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Gender and Climate Change in the Indian Himalayas: Global Threats, Local Vulnerabilities, and Livelihood Diversification at the Nanda Devi Biosphere Reserve

Abstract

Global climate change has numerous implications for members of mountain communities who feel the impacts in both physical and social dimensions. In the western Himalayas of India, a majority of residents maintain a livelihood strategy that includes a combination of subsistence or small-scale agriculture, livestock rearing, seasonal or long-term migration, and localized natural resource extraction. While warming temperatures, irregular patterns of precipitation and snowmelt, and changing biological systems present challenges to the viability of these traditional livelihood portfolios in general, we find that climate change is also undermining local communities' livelihood assets in gender-specific ways. In this paper, we present a case study from the Nanda Devi Biosphere Reserve (Uttarakhand, India) that both outlines the implications of climate change for women farmers in the area, and highlights the potential for ecotourism (as a form of livelihood diversification) to strengthen both key livelihood assets of women and local communities' adaptive capacity, more broadly. The paper intentionally employs a categorical focus on women, but also addresses issues of inter-group diversity. With this special issue in mind, suggestions for related research are proposed for consideration by climate scientists and social systems/policy modelers seeking to support gender justice through socially transformative perspectives and frameworks.

Keywords: Sustainable Livelihoods, Women, Livelihood Assets, Ecotourism, Uttarakhand, Adaptation, Adaptive Capacity, Differentiated Vulnerability

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Deleted: seasonal pastoral migration, male out-migration, and localized natural resource extraction. Particularly under conditions of heavy male outmigration, but throughout the region, mountain women play a key role in providing labor and knowledge related to the management of local natural resources, yet often lack authority in related political and economic decision-making processes. This gap has important implications for addressing the impacts of climate change:

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1. Introduction: Women, Gender, and Climate Change

> "It is increasingly evident that women are at the center of the climate change challenge. Women are disproportionately affected by climate change impacts, such as droughts, floods, and other extreme weather events, but they also have a critical role in combatting climate change." - *UNFCCC, "Gender and Climate Change" homepage (UN, 2014a)*

It is by now widely accepted that we need both adaptation and mitigation measures to deal with the environmental changes already occurring and predicted to occur with a steadily warming planet (e.g. fluctuation and distributions of annual mean temperature and precipitation, glacial melt, ocean acidification, sea level rise, storm surges, monsoon variations, ecological changes including biodiversity loss, among other direct effects). The 2009 Copenhagen Accord has already acknowledged the dangers for global mean temperature rise above 2° C, noting the particularly urgent threat for small island nations and coastal regions in terms of heightened vulnerability to both short- and long-term impacts of sea-level rise (UN, 2009). Meanwhile, at the so-called "third pole" of the Earth, there is a growing realization that environmental changes in the Himalayan mountains – the "water tower of Asia" – threatens to undermine security and well-being of a South Asian population of at least 1.6 billion people, including 40% of the world's poor (Rasul, 2014). Yet in spite of the 1979 passage of the United Nations' Convention of Elimination of all Forms of Discrimination Against Women (CEDAW) and numerous declarations of the critical and important roles for women in promoting environmental sustainability (including by the Secretariat of the United Nations Framework Convention on Climate Change [UNFCCC], above), some development scholars and practitioners are still lamenting the gap between rhetoric and action in mainstreaming gender into climate change discussions, policy negotiations, and adaptation/mitigation practice. Four decades after the

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"No climate justice without gender justice!"¶
- *Activist banner calls at the COP-17 meeting of the UNFCCC (cited in Terry 2009)*

More than 20 years after the watershed United Nations' 1992 Rio "Earth" Summit and creation of the UNFCCC, development scholars and practitioners are still lamenting the lack of adequate attention to gender issues in mainstream climate change discussions, policy negotiations, and adaptation/mitigation discourse. Two special issues of the international journal *Gender and Development* (in 2002 and 2009, respectively) have helped to provide seminal reference points and analyses of the core issues, framing a rich discourse that includes academic researchers, policymakers, donor agencies, governments, NGOs, and activists from civil society. This body of work reveals a growing consensus around the belief that climate change is likely to both disproportionately negatively impact the world's poor and "magnify existing patterns of inequality, including gender inequality" (UNDP, 2014). Nevertheless, we stand at something of a crossroads when it comes to confronting the intersections of climate change impacts, poverty and economic inequality, and gender-based inequalities. ¶
While great strides have been made in terms of envisioning technical, market-based, and policy responses to the challenges posed by a rapidly changing planet, we argue that on-the-ground change has not progressed significantly enough in ter ... [1]

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passage of CEDAW and nearly twenty years after the formation of the UNFCCC for example, Hemmati and Rohr observed that gender equality is "*finally beginning* to be accepted as one of the core principles of mitigating climate change and adapting to its impacts" (2009: 25, emphasis added).

Two special issues of the international journal *Gender and Development* (in 2002 and 2009, respectively) have helped to provide seminal reference points and analyses of the core issues, framing a rich discourse about gender and climate that includes academic researchers, policymakers, donor agencies, governments, NGOs, and activists from civil society (Masika, 2002; Denton, 2002; Sweetman, 2002 and 2009; Nelson et al., 2002; Dankelman, 2002, Lambrou and Piana, 2006; Brody et al., 2008; Terry, 2009; Seager, 2009a; Enarson and Chakraboti, 2009; Dankleman, 2010; Aguilar, 2010; MacGregor, 2010; Arora-Jonsson, 2011; Alston and Whittenbury, 2012; Sultana, 2013; WHO, 2014). Contributions made through robust transnational activist networks such as GenderCC and the Gender and Disaster Network also inform debates about gender and climate change issues. Participants in such networks have helped to popularize the rallying call for "gender justice" that activists made prominent in Bali at the 2007 meeting of the Conference of Parties to the UNFCCC (Terry, 2009). Together, this body of work demonstrates that many of the indirect impacts of climate change – e.g., increased salinization of coastal agricultural fields due to storm surge and sea level rise, drying streams, inland water scarcity and drought associated with fluctuating extremes of temperatures, disrupted growing seasons and poor harvests, and increased intensity of storms – pose critical risks for people's lives and livelihoods, and in ways that affect different groups in different ways. It reveals a growing consensus around the belief that climate change not only promises to

disproportionately negatively impact the world's poor, but that it will likely "magnify existing patterns of inequality, including gender inequality" (UNDP, 2014).

Clearly, the intersections of climate change impacts, poverty, and gender-based inequalities are complex and warrant continued attention. As guests to *ESD* and participants in the transdisciplinary 2013 workshop "Adaptation and Resilience in the Hindu-Kush-Himalayas," (held at the University of Hamburg, Germany) we seek to help readers better under the linkages between these issues through a focus on women's experiences with climate change at the Nanda Devi Biosphere Reserve (NDBR), Uttarakhand, India. In contributing details from this part of the Himalayas to a broader cross-cultural literature that documents local experiences with climate change, we also aim to complement the quantitative, model-based approaches presented elsewhere in this special issue with perspectives "from the ground." We hope that such an approach will help to deepen others' understandings of the lived experiences in remote mountain communities dealing with a rapidly changing physical environment.

This paper is organized as follows: In the next section, we present a conceptual framework for the paper that emphasizes theories of differentiated vulnerability and relevance of the Sustainable Livelihoods (SL) framework (DFID, 1999) for analysis of adaptive capacity. We then discuss methodological issues, explaining our focus on women and outlining the physical and cultural context for the paper's central case study. Through our case study, we document some of the ways in which NDBR community members report currently experiencing and responding to climate change, and suggest how differentiated impacts can be viewed through a gender lens. Applying the SL framework to the example of livelihood diversification through ecotourism around the NDBR, we find that a homestay-based model emerging in NDBR is creating conditions for participating women to feel in greater control of their incomes and to

more broadly engage in community-level development issues, which in turn delivers benefits for their larger communities. This part of our analysis shows that while some of women's livelihood assets are being undermined by climate change, such experiments with ecotourism are also strengthening assets in meaningful and specific ways. Our discussion emphasizes the types of assets that this model of ecotourism has enhanced for NDBR women, while at the same time explaining the benefits for the larger community. Yet, we also suggest that because overall household asset mix shapes livelihood outcomes, risks of capture of benefits by economic elites is a key concern. Ultimately, we use the example of women's experiences with ecotourism to demonstrate the value of an assets-based approach for improved understanding of gender-differentiated aspects of climate change, more broadly. We close the paper with examples of ways that climate adaptation practice and policy can move from "gender-blind" to socially transformative, "gender-justice" approaches and pose related research ideas for consideration by climate science and adaptation policy modelers, in particular. We also reflect on the methodological contributions that social scientists are especially well positioned to offer. Ultimately, we hold that examinations of gender-differentiated experiences related to climate change are important not only for what they may reveal about vulnerabilities and strengths, but that such examinations are also valuable in terms of illuminating the deeply personal scales at which the impacts of climate change will continue to be experienced.

2. Conceptual Framework: Differentiated Vulnerability, Sustainable Livelihoods, and Adaptive Capacity

Climate change has important direct and indirect effects that are not always immediately evident. At every scale, both between and within nations, social factors are critical in

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determining sources of strength and vulnerability to the impacts of climate change. Investigations of key relationships between differentiated vulnerability and risk in the context of natural disasters and catastrophic events offer important insights for studies of climate change (Enarson and Morrow, 1998; Poumadere et al., 2005; Neumayer and Plümper, 2007; Enarson and Chakrabarti, 2009; Mearns and Norton, 2010; Dankleman, 2010; Huang et al., 2010; David and Enarson, 2012; Seager, 2012; Sultana, 2013; Alagan and Aladukwaka, 2014; GDN 2014; see also Blaikie and Brookfield, 1987; Ives and Messerli, 1989; Wisner et al., 2004). Taken together, these analyses of the loss of life, livelihood, and security associated with specific extreme-weather events around the world demonstrate a range of differentiated and distinct impacts, intersecting along multiple lines including gender, race, age, ethnicity, class, and ability. This work demonstrates that most often, the factors contributing to vulnerability are interlinked and compound insecurity. In the Indian Himalaya, for example, many of the victims of deadly flash floods in 2013 near Kedarnath, Uttarakhand were from a single village nearby, where – in a high-risk livelihood strategy employed by very poor mountain communities – a collective of men drawn from each household reportedly set out to collect medicinal forest products in the flood zone and never returned (field interview, May 2014; see also news reports by Pand, 2013 and Gusain and Datt, 2013). In this case, the mens' poverty, ethnicity, and gender conspired to create a heightened – and discriminatory – vulnerability that is literally embodied by the victims' social and economic status. Women's vulnerabilities are often also experienced through their physical bodies in similarly gender- and class- differentiated ways: for example, heightened exposure of poor or physically isolated women and girls to criminal predators (sexual and physical assault, rape, and human trafficking) has been documented cross-culturally in the

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immediate aftermath of disaster events such as hurricanes and floods (Enarson and Chakraboti, 2012; David and Enarson, 2012; Kapoor, 2011; Aguilar, 2010).

Building on such insights from recent gender and disaster research (rapid-onset events), we can expect that slow-onset events associated with global and regional climate change will also yield differentiated impacts. But what such impacts are likely? And what enables or constrains people's capacity to best cope with these changes? The ability to successfully mitigate the impact of anticipated events or adapt to change over the long term will clearly depend on the ability to overcome vulnerability, whether at individual or collective scales. Therefore, it will be essential to find ways to promote meaningful and sustainable livelihoods for all – as well as to promote the economic security and political voice required to maintain the livelihood base. As this article demonstrates through its central case study, this is an especially salient issue for women who, even between wealth and ethnic groups meet livelihood challenges with different sets of resources (or, as we refer to them in the paper, livelihood assets) than the men with whom they share households.

2.1 Sustainable Livelihoods and Adaptive Capacity

Below, we present ways in which the Sustainable Livelihood (SL) framework (DFID, 1999) offers a robust base around which to further a discussion of differentiated vulnerabilities, adaptation and adaptive capacity, and mitigation of the livelihood-related impact of climate change. As shown in Figure 1 and discussed further below, the SL framework is designed to offer "a way of thinking about livelihoods that helps order complexity and makes clear the many factors that affect livelihoods" (DFID 1999: 2). Application of the SL framework enables an examination of how different groups of people manage and combine varying livelihood assets

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Deleted: Early work in the gender/climate change arena (e.g., as in the seminal volume edited by Masika, 2002) demonstrated that implementation of Rio outputs such as the GEF and CDM needed to consider women's needs in the project of sustainable development. In tracing some of the key issues of the time, Denton (2002) argued that women should be positioned as key stakeholders across rural communities of global south, due to their predominance as farmers and household fuel and water collectors. Reminiscent of Boserup's (1970) work,

Deleted: work in the early 2000s cautioned that unless women's needs were directly taken into account, "sustainable" development could make life worse for women. Recognizing the potential for climate change adaptation and mitigation strategies to themselves marginalize women who do not participate in the discourse, Dankleman (2002 and 2010) and others (e.g., Sweetman, 2002 and 2009; Brody, et.al., 2008; Aguilar 2010, Hemmanti and Rohr, 2009; Tandon, 2009) have also consistently argued that climate change is neither "gender-neutral" nor just a technical problem. Rather, these scholars and observers argue, it is a problem for which technical solutions address only proxim ... [2]

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available to them, and illustrates the varying influences of the institutions, policies and structures existing around them. Recognizing that the component parts of any cultural-economic system are never fixed in time or space, we find that the framework is best viewed as a conceptual model, representational of and adaptable to mutable local contexts.

In mountain regions such as found in the Indian Himalaya, where local livelihoods are highly vulnerable to failure due to the ecological shocks and uncertainties associated with climate change, adaptation must be considered to be a fundamental response option. An adaptation-based approach aims at moderating the adverse effects of climate change through a wide variety of actions and adjustments in ecological, social, or economic systems and seeks to create benefits from opportunities associated with climate change (Fussel and Klein, 2006; Ellis 2000). An optimistic perspective suggests that one "opportunity" presents itself in the form of increased intensity of attention about the seriousness of the issue and potential flow of supporting resources to the region (i.e., as part of adaptation and mitigation response by the international community and the Indian government.) Because adaptation has multiple and interlinked dimensions, adaptive capacity of local communities is governed both by internal, culturally-specific characteristics as well as by larger external social, economic, and political structures that empower or constrain action. In our view, capacity-building in adaptation is also predicated on the privilege of *choice*: a community, household, or person who lacks choice or alternatives in any situation has no real power. Thus, strengthening the adaptive capacity at any scale by expanding the range of response options is central to the challenge of addressing local vulnerabilities to the impacts of climate change, and to the goal of empowering people to be able to make meaningful and viable choices about adaptation itself.

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[Figure 1: Sustainable Livelihoods Framework]¶
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One important way to increase adaptive capacity is to support initiatives which strengthen people's combined set of livelihood capital assets (i.e., the arrangements of Natural, Financial, Physical, Human, and Social forms of capital illustrated in Fig 1). While the mainstream climate change discourse gives much attention to macro-scale, transformative structures and processes (e.g., international carbon markets, "green" energy infrastructure, expansion of hydropower grid, etc.), attention needs also to be paid in understanding the micro-scale factors that determine the lived experience of climate change. Asset analysis, in particular, needs to be achieved through the lens of differentiation in order to achieve finer-scale understanding of threats and opportunities (see Fig 1b which highlights the assets profile for generalized "poor" versus "non-poor" households). As suggested by Table 1, which provides examples of the five categories of livelihood assets with special reference to women's position in the Indian Himalaya, a gendered perspective on assets adds value even in the context of less well documented intra-group differences within economic or cultural groups. Worldwide as well, many women live under conditions of exclusion or vulnerability strictly because of their gender, with limited access to key assets such as land and other productive resources, knowledge, technology, power, decision-making, education, health care, and food (Aguilar 2010). A baseline understanding of gender-differentiated livelihoods assets is therefore essential to planning for adaptation, even in seemingly homogeneous communities. When adaptive capacity is understood in the context of mapped assets from this perspective, we believe that a more holistic approach to planning can follow.

The extent to which ecosystems and communities are vulnerable or resilient depends both on exposure to changes in climate and physical changes as well as on the ability of the impacted social system to adapt. In applying the SL framework to rural communities at risk of livelihood

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[Table 2: Livelihood assets profile in Nanda Devi Biosphere Reserve study villages]¶
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A baseline understanding of differentiated livelihoods assets is essential to planning for adaptation, even in seemingly homogeneous communities.

failure in a more general sense (i.e., not solely related to climate change), we consider three broad clusters of livelihood strategies for the rural communities that have already been identified and can be applied in context of the Indian Himalaya. These are: agricultural intensification/extensification, migration, and livelihood diversification (Scoones 1998). Given existing livelihood challenges related to larger patterns of rural poverty and the regional physical geography (e.g., steep slopes, flash flooding, landslides), agricultural expansion is not a viable long-term solution for most rural households. Agricultural intensification is already in place where households have sufficiently strong assets. Migration, similarly, is a strategy already in place throughout the region due to underlying pressures of livelihood insecurity. In addition to supplementing rural household incomes, remittances may provide additional social benefits that enhance overall assets and sense of empowerment to households as well. For example, researchers in Nepal have observed that Dalit migrants benefitted from upward social mobility through their increased income and ability to purchase land (Adhikari and Hobley, 2011). Others have found that some groups of women "left behind" by male out-migrants from the hills of Nepal were able to more effectively participate in community-based forestry initiatives and benefitted from their status as de-facto heads of household (Giri and Darnhofer, 2010). At the same time, migration must also be considered in terms of the social and emotional costs. Writing about loss of place associated with climate change-induced migration, Adger et al. (2013) note that migration under such circumstances can be maladaptive for some, because of the hardship associated with the severing of place-based attachments. Thus livelihood diversification is perhaps not surprisingly, the most prevalent strategy adopted by area residents. As discussed in the next section, diversification in the site includes niche marketing of the unique cultural heritage and ecological features of the NDBR.

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4.1 Livelihood

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3. Materials and methods

As described below, our discussion of the gender-differentiated impacts of climate change and related case study of livelihood diversification at NDBR focuses on the experiences of women. In this section, we further explain this focus, introduce the paper's related research questions, and outline our data sources.

3.1 Focus on women: Why "women's" experiences still matter

As already discussed, analysis of climate change impacts and adaptation strategies will be enhanced through differentiated lenses of understanding. Worldwide, poor and marginalized populations already disproportionately experience the negative impacts of climate change (Mearns and Norton, 2010). It has also been argued that within poor and marginalized groups, women often experience more severe forms of poverty relative to men, due to underlying gender inequalities (Demetriades and Esplen, 2010). Discussing health impacts of climate change in the Hindu-Kush-Himalaya specifically, Eriksson et al. similarly observe that while mountain communities and ethnic minorities are already socially marginalized, within these groups women, the elderly, children, and the disabled are the most vulnerable and as such, "will suffer the most from the impacts of climate change because they often have less resources to fall back upon" (2008: 14).

At the same time, we recognize that women do not comprise a homogenous group, and we do not here suggest that gender-differentiated impacts fail to apply to men (or other gender groups). Differences in overall economic status between poor/non-poor households often overshadow gender differences such that elite women have more in common with men of their

own socio-economic group than with women of different caste/class-based or occupational groups, for example (Agarwal 1992; Rocheleau et al., 1996). Age and marital status, as we have ourselves argued elsewhere (Badola, Ogra, and Barthwal 2014) are similarly intersecting categories that may overshadow gender differences between economic groups. However, while economic security and caste/class may reinforce elite privilege at the individual scale, perpetuation of gender-based inequities within households works to undermine women's collective strategic interests (Moser 1989). Many measures of gender-based forms of violence, economic inequality, and other forms of deprivation and disparity have been shown to overwhelmingly negatively affect women as a group (Seager, 2009b). Culturally embedded and institutionalized forms of inequality such as denial of opportunities to healthcare and education, persistence of economic and political discrimination, and continued assaults on women's personal safety through sexual violence (to name a few issues) are indeed "sticky" obstacles, as phrased by the authors of the 2012 edition of the *World Development Report* (World Bank, 2012), and which together help to explain why women's issues, in particular, are still central to gender/climate change frameworks. Echoing this idea, the UNFCCC has noted the critical link between women's empowerment and climate change adaptation, claiming that the empowerment of women "will be a significant factor in meeting the climate challenge and achieving the long-term objectives of the Convention" (UN, 2014b). Situating her own analytical focus on women in the area of gender and climate change, Dankelman reminds us that all over the world gender relations are characterized by "asymmetry of power between women and men as a pervasive trait" (2010: 11). Problematizing the connections between women's experiences, gender-based inequities leading to differentiated vulnerabilities, and risks associated with climate change

therefore presents a critical opportunity to prioritize, galvanize support around, and ultimately address the long-term and "sticky" issues noted above.

Yet as development scholars Harcourt and Escobar observe, "Knowledge about women continues to be the hardest to come by" (quoted in Dankelman 2010: 11). In seeming agreement, Aguilar (2010) outlines three areas of knowledge within studies of climate change impacts that she believes must be supported through research: (1) specific conditions that shape women's (and especially poor women's) vulnerability; (2) gender-specific risk assessment and management; and (3) gendered strategies for enhancing adaptive capacity. Thus, we follow Dankelman (2010) and Aguilar (2010) by maintaining a primary focus on threats and opportunities related to women's livelihoods, highlighting the role of factors such as wealth and ethnicity where we are able to do so. We employ this approach to make visible the experiences of resident women that might otherwise be sidelined, and in the process seek to contribute to the body of related and regional literature. Responding to the political urgency of keeping women as a group methodologically and conceptually foregrounded, even as we recognize gender as a socially constructed category,[1] our central questions in this paper are as follows:

- What are NDBR women's concerns about climate change, as related to current or potential impacts to their livelihood assets?
- How can livelihood diversification contribute to a strengthening of women's assets in the NDBR?

[1] In this paper, we focus on primarily on one gender-based group (women). Though often aligned along biological sex lines (male/female = men/women), we follow social scientists' conceptualization of gender as a fluid, non-binary, changeable, and culturally constructed form of identity that varies over time and space.

3.2 Data Sources

To address the questions posed above, we draw upon both the conceptual frameworks described in Section 2 and our direct observations and interactions with women in the region. Many details reported in this paper are derived from fieldwork conducted in the context of a recent interdisciplinary study undertaken for the Wildlife Institute of India, "An Integrated Approach to Reduce the Vulnerability of Local Community to Environmental Degradation in the Western Himalayas, India" (Badola et al., 2014). Among other goals, this larger project sought to develop an updated socioeconomic profile for the NDBR, document land-use patterns and pressures, quantify key ecosystem functions of the reserve's forested landscapes, and identify possible strategies for sustainable livelihoods. Over a two-year period (2012-2014), members of a WII research team surveyed households of 22 randomly selected NDBR buffer zone villages about these topics (n=764). Respondent households were selected through a stratified random sampling approach that sought to include residents of different gender, ethnicity, age, wealth, occupational and locational categories. Against this backdrop, we were able to concurrently collect additional qualitative data in the form of perceptions about climate change and ecotourism as an emergent, alternative livelihood strategy. For this part of the study, our methods emphasized direct observation, key informant interviews, informal discussions, and household-level and women-only group discussions. The resulting qualitative information was grouped and hand-coded thematically, then analyzed in terms of the differentiated vulnerability and SL frameworks discussed above.

4. Study Area

The NDBR is a representative wilderness area in the western Himalayas, experiencing climate-induced pressures to both its physical and social systems. It is perhaps best well known for its role in protecting the world's fourth-highest mountain, Nanda Devi Peak (elev. 7,817 m) and constitutes an important reservoir of water in the form of glacial ice and snow, forests, and high-altitude biodiversity. Development activities, such as the construction of roads as well as several hydroelectric projects have rapidly increased in the region.

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4.1 Physical Setting

The Nanda Devi Biosphere Reserve (NDBR) is located between 300 05' - 310 02' N Latitude and 79012' - 80019' E Longitude, situated in the biogeographical zone of 2B (Rodgers and Panwar, 1988). The reserve has a wide altitudinal range from 1,800 to 7,817 m. and presently covers 5860.69 km^2 area, spread over Chamoli district (in Garhwal division) and Bageshwar and Pithoragarh districts (in Kumaon division) of Uttarkhand state. The basin is dominated by the Nanda Devi mountain, India's second highest peak (NDBR, 2002) and revered locally as a symbol of the Hindu goddess, Nanda (Kala and Maihkuri, 2011). The basin is also the headwater of several rivers such as Gori Ganga, Rishi Ganga, Dhauli Ganga, and Girthi Ganga which forms the Alaknanda river of the Garhwal Himalayas. Pindari and Milam glaciers are important landmarks in the region. The entire area has historically remained snow bound for more than six months of the year, with reaches above 4500m asl continually in snow (Khacher, 1978). More recent reports cite annual temperature ranges in the area between 0°C to 24°C, with average rainfall of 928.82mm per year falling mainly during July-August monsoon (Kala and Maikhuri 2011, citing 2002 figures). The area currently experiences three main seasons: winter (November to March, with heavy snowfall in the months of December, January and February;

summer (April to mid-June) and rainy season (mid-June to September). Most of the flora and fauna protected in the reserve are native and endemic, and the reserve has long held species with conservation significance across taxonomic categories. Notable animals include the snow leopard (*Panthera uncia*), Asiatic black bear (*Ursus thibetanus*), Himalayan brown bear (*Ursus arctos*), Himalayan musk deer (*Moschus chrysogaster*), Bharal (*Pseudois nayaur*), and Himalayan tahr (*Hemitragus jemlahicus*).

In recognition of the intrinsic value and uniqueness of the area, in 1988 the United Nations (UNESCO) designated the Nanda Devi National Park as a World Heritage Site. The larger biosphere reserve today includes the Nanda Devi Sanctuary (declared by the Government of India in 1939), the Nanda Devi National Park (declared in 1982), and the Valley of Flowers National Park (incorporated into the core zone of NDBR in 2000) (Green, 1993; NDBR, 2002).

4.2 Local communities

Zonation and human use categories at NDBR are based on the United Nation's Man and Biosphere (MAB) reserve concept of balancing basic human welfare and with environmental protection through a zonation approach. The biosphere reserve is comprised of two core areas (the Nanda Devi National Park and Valley of Flowers National Park, respectively), a buffer zone (47 villages), and a transition zone. The core zones of the reserve are free from human settlement and have remained largely undisturbed due to inaccessibility and protections from human interference afforded by the National Park designations. The NDBR buffer zone encompasses areas distributed over the Chamoli, Bageshwar and Pithoragarh districts. Lata and Reni villages remain among the best known settlements in this region due to their central role and involvement in the "Chipko" forest preservation movement of the 1970s-80s and their

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Deleted: As a region, the NDBR is comprised of three main zones: buffer, transition, and two core areas: the Nanda Devi National Park and Valley of Flowers National Park. There are 47 villages in the buffer and 33 villages in the transition zone. *Bhotia* and *Garhwalis* are the main ethnic groups of the area. Historically, local livelihoods for both communities have been based on trade and marginal agro-pastoralism. As in many Himalayan communities where women's labor is critical to household viability, women have traditionally held a high status in both groups. However, daily responsibilities and expectations in NDBR generally follow gender-based divisions found throughout the region; in both ethnic groups, traditional practices tend to assign control of money and capital to adult men, while their female counterparts have greater control over household resource allocation in day-to-day living (Badola et. al., 2013).

proximity to desirable trekking route start points. The nearby town of Joshimath is a regional transportation hub that provides the surrounding upland villages with secondary school, hospital, and market facilities. Joshimath also serves as a base for religious pilgrims and other tourists, with state-sponsored and privately-run facilities for dining, lodging, and transportation.

The dominant ethnic and religious communities residing within the NDBR are represented by the indigenous Bhotiya community and the Garhwali *pahari* (literally, "of the mountain") Hindu communities. Traditional livelihood strategies of the Bhotiya tribe were historically based on transhumance and seasonal migration to Tibet associated with long-distance trade, but trans-border trade ended in the 1960s due to conflict between India and China. Bhotiyas also suffered hardship in this period from loss of their winter settlements under the Zamindari Abolition and Land Reform Act of 1960 (Kala and Maikhuri, 2011). Throughout the NDBR, villagers in both groups are today dependent on a harsh and often remote environment which limits livelihood strategies to a relatively small range of forest- and agriculturally-based options (Table 2-3). Families mainly practice rain-fed tree crop mixed farming similar to other parts of the central and northwest Himalaya, cultivate terraced fields for marginal subsistence agriculture and limited cash cropping, and rear cattle and sheep for milk. Supplemental income-generation practices such as beekeeping, floriculture, and cultivation and collect of medicinal plants are in practice, but not as widespread as in the past. Bhotiya communities also practice a traditional craft of weaving, raising sheep for wool as well as meat. Other sources of income include wage labor and short-term employment associated with the 2005 National Rural Employment Guarantee Act (NGERA) and sale of land for hydroelectric or other infrastructure projects. While we do not have sufficient data to report frequency of male out-migration and associated remittances, key informants reported to us that this is also an important aspect of

Deleted: In response to the growing demand for nature based tourism in the area and with an aim to develop stakes of local people in biodiversity conservation, ecotourism is currently being promoted by residents of several villages. Tourism is pertinent to the region because of the peculiar opportunities and challenges of the context. Key opportunities include, for example, sensitive ecosystems that require protection, communities that require alternative livelihoods to reduce dependencies on natural resources, and a landscape that has been traditionally attractive to tourists for religious and recreational purposes. Tourism can also present solutions to livelihood-based challenges in the region by offering alternative development trajectories leading to strengthening of assets. This is particularly relevant because the State-led development in the region has focused on transportation and hydropower infrastructure projects and failed to promote sustainable local livelihoods, while simultaneously creating additional threats to biodiversity and natural resources.¶
As a part of ecotourism, the facility of "homestays" is being promoted in the peripheral villages of the NDNP which provides monetary benefits to the communities. On the surface, it would seem that the benefits of this arrangement accrue inequitably: Male members of the local communities are mainly involved in the monetized tourism- related activities in the area such as serving as trek guides, porters, cooks, and fee collectors, while women are typically only involved in unpaid, low-status domestic tasks such as preparing food and fetching additional firewood and other biomass resources. However, in the face of increasing pressures for men to out-migrate and in the context of increasing vulnerability of traditional agriculturally-based livelihoods to climate change, ecotourism has the potential to become an important part of a larger adaptation strategy that strengthens adaptive capacity for both women and men in the mountain regions. Below, we briefly examines the ways in which ecotourism appears to be changing the assets of hill women and men in different ways. Though we have intentionally limited the discussion to women for purposes of this discussion at the risk of (mis)representing them as a homogeneous group, intersecting vulnerabilities associated with economic status or age (for example) would certainly need to be included in a more comprehensive analysis. ¶
The narrative below is based largely on qualitative ethnographic fieldwork (e.g., open-ended and semi-structured interviews, group discussions, and personal observations) achieved through repeated co-author visits to the site since 1995, and incorporate related findings from a recent interdisciplinary study of 22 NDBR villages (conducted over the past five years by a team of researchers affiliated with the Wildlife Institute of India; see Badola et. al., 2014 and Badola et. al., 2013). ¶
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4.2. Ecotourism and Gendered Livelihoods at NDBR¶
For communities experimenting with ecotourism in the area, some improvement of livelihood assets for women has been observed. In the households that have homestay facilities, for example, the women had more opportunity to interact with the tourists due to their role in activities like cooking and cleaning. This resulted in their being more aware of conservation and development issues as wel ... [10]

contemporary household income-generation. Yet emigration of household members also carries a cost: As one such informant casually commented, "Everyone wants to go, but not all have the money for it."

Most importantly for villages located near road and trekking route heads, adventure/nature tourism has been an important source of income through local employment of NDBR residents as porters, trekking guides, cooks, hotel workers, and drivers since the opening up of routes to the Nanda Devi peak in the 1930s (Kala and Maikhuri, 2011; Von Hedemann 2010). Trek guiding is a particularly important occupation, albeit practiced by only a minority of residents today for whom the income can be substantial: In one analysis of NDBR guides' self-reported income, annual earnings averaged INR 30,000 (Von Hedemann, 2010). Gifts from adventure tourists also comprise a minor but socially important resource (Maikhuri et al., 2001). However, the closure of the core zone to tourists and trekking expeditions in 1982 caused significant hardship; in some communities over 90% of youths were employed as porters and guides (Kala and Maikhuri, 2011). Religious tourism associated with shrines in the area have also long been economically important to the regional economy, with pilgrims representing 60% of the total tourists in the Uttarakhand Himalaya by some accounts (Kala and Maikhuri, 2011).

Continued demand for nature based tourism throughout the area and a desire to derive additional benefits from biodiversity conservation has led to the promotion of ecotourism in some of the NDBR buffer zone villages. In the earlier tourism models in this area, the males were largely employed as porters and guides to accompany trekking parties leading to their absence for long periods of time. This resulted in additional burden of domestic and agricultural work on the women, without recognition of or compensation for their labor. It also led to employment for only a small number of people, mostly men with access to the main tourism

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nodes and who were directly employed in such activities. More recently, a culturally-linked, "homestay" based form of ecotourism is currently being promoted by residents of several villages within the NDBR. Such village-based ecotourism generates significant income for participating households and remunerates the labor contributions made by the entire family. According to a 2010 study of self-reported homestay operator incomes in the buffer zone villages of Tolma, Lata, and Urgam, most of their guests are international nature tourists who pay approximately INR 300 per day and whose visits earn operators an average annual homestay-based income of INR 1,950 (Von Hedemann, 2010). Self-reported estimates of the number of tourists per year in that study ranged from just 4 to as many as 500; removing outliers, the average for these areas in 2010 was 21 tourists per year, concentrated in the months of May-September (Von Hedemann, 2010). Thus, village-based ecotourism provides an opportunity for NDBR residents to supplement uncertain seasonal incomes and engage in the possibilities of both alternative development trajectories and strengthening of assets. This is particularly relevant for NDBR communities because the State-led development in the region has focused on transportation and hydropower infrastructure projects and failed to promote sustainable local livelihoods, while simultaneously creating additional threats to the site's rich natural and cultural resources.

As described by long-term NDBR researchers, "The socio-cultural fabric is as interesting as the natural" (Kala and Maikhuri, 2011: 89). Both communities maintain rich traditions of song, dance, weaving/handloom arts, and linguistic and culinary traditions unique to the mountain environment. As in many Himalayan communities where women's labor is critical to household viability (Badola, Ogra, and Barthwal, 2014), our observation is that Bhotiya and Garhwali women in the NDBR have both traditionally held (and continue to hold) a relatively

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high status and expect decision-making in the household to be a shared activity between members. At the same time, daily responsibilities and expectations appear to follow gender-based divisions of labor found throughout the region, where control of money and capital lie primarily with adult men (i.e., as recognized heads of household and wage earners) and adult women in the household have greater control over household resource allocation in day-to-day living. While agriculture is practiced widely by both men and women, men also seek work for wages. Women in the sites we visited were responsible for household food production and distribution, agricultural labor in the form of weeding and cultivation, weaving, sale of NFTP and milk, and collection of water, fuelwood, fodder, and domestic NTFPs. NTFP collection is not confined to women, however: The highest-value NTFP *Ophriocordyceps sinesnsis* (a caterpillar whose cocoon hosts a fungus used in traditional Chinese medicine) is collected mainly by men, and comprises an important source of supplemental income. As shown in Table 1, larger patterns of asset distribution nevertheless place women (as a group) in a position of strategic disadvantage compared to men (as a group).

5. Results: Women, Climate Change, and Livelihood Diversification through Ecotourism

5.1 Gendered dimensions of climate change in the NDBR

Models seeking to understand the long-term effects and physical drivers of climate change in the Himalayas are discussed elsewhere in this issue, and suggest the depths, limits, and shifting terrain of our understanding. As we discuss further in this section, the meaning of these changes from a social perspective varies geographically and between groups of people, depending largely on the range of assets and capabilities available for coping and adaption. With Himalayan farmers already in a heightened position of vulnerability due to reliance on rain-fed

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agriculture and natural resources associated with the forests of the NDBR, it is important to understand how climate change may further impact members within a household. This holds both within households, as well as between households that hold different markers of wealth. To give context and a sense for the range of interconnected impacts of climate change already being perceived at the local scale, in this section we summarize impacts reported and observed in the field. Figures 2 and 3 present these impacts in terms of differentiated vulnerabilities for women and related impacts on women's livelihood assets. Narrative highlights, below, help to give context and examples for these broad trends.

Residents readily spoke to us about livelihood-related losses that they perceived to be related directly to climate/weather. When we asked people to describe environmental changes that they had noticed over the past 15-20 years, increased intensity of sun, warmer overall temperatures, unfamiliar rain and snow patterns, and reduced glacial extent ("Where it used to be snow, now we walk on land") were all cited as examples. However, while mixed-gender groups agreed on problems facing their community and described changes in precipitation and temperature, women's responses emphasized their knowledge and direct experience as cultivators and laborers in their households' agricultural fields. Indeed, loss of generationally-communicated, "traditional" environmental knowledge (e.g., about traditionally cultivated crops and related food preparation techniques, knowledge of identification and extraction techniques for important NTFPs such as edible and medicinal species) was specifically cited by women as an indirect yet important impact of climate change that warranted their concern. Women also reported specific impacts of climate variability and change such as more intense hail storms with "much larger" sized pellets that damaged apple flowers, "untimely" frost that damaged rajma flowers, and increased fungal disease and unfamiliar insect pests in the grain crops that were

believed to be caused specifically by unpredictable and "late" rains. Insect infestation was a recurring complaint. Reflecting dependence on monsoon-fed agriculture, the theme of "late rains" was prominent in all of our discussions of agroecological impact. Heavier rainfall was also believed to be the cause of an increase in weedy species in the fields.

Due to combined changes in hail, frost, rainfall, and crop-raiding, the women we met with consistently reported that the resulting crop loss was contributing to local food insecurity and increased dependence on market-based but less nutritious varieties of vegetables and grains. According to these women, this contributes to reduced well-being for all members of the household. At the same time, our direct observations suggest that as food preparers for the family who prioritize the nutritional and caloric needs of others in the family, women's well-being in this regard is affected to a greater degree. This is particularly the case for poorer households, for which crop failure or loss from damages are more pronounced in impact.

In group interactions, some households also noted that unreliable harvest and uncertainty associated with rain had motivated them to shift away from agriculture and in favor of intensified animal husbandry, although increased crop-raiding (by monkeys, boars, porcupines, bears, and mice) was also sometimes a factor. Conversely, others told us that families are now reducing their total number of animals because of livestock predation problems associated with leopards and bears. Still others took no action, as in the words of one woman: "We cannot do anything."

Changes in the availability of important NDBR resources such as water, medicinal plants, grass (for fodder) and fuelwood constituted another key indicator of a changing environment and reflected women's labor-based knowledge despite differences in ethnicity and wealth. We were told that that the extent and variety of trees has been decreasing and the height of native grasses has reduced. In describing the indirect effects, women pointed to drops in milk production in

their cattle due to lack of high-quality fodder species. Grassland and forest degradation was also a major concern, reported to not only increase the overall time and distance required for women to collect fuelwood and fodder, but also their increased risk and concerns of "falling from rocky slopes." Some reported a decision to purchase fodder in response to declining supplies and increased personal risk; others suggested that the increased wildlife sightings in the forest and fear of attack by wild animals was similarly a motivation to purchase fuelwood.

Loss and degradation of land associated with flash floods and landslides was largely recognized as "cloudburst" damage and perceived to be beyond villagers' control ("Disaster is natural"). However, in areas where hydroelectric power construction activities constituted the dominant driver of local environmental change, women raised concerns about the exacerbating effect of frequent dynamite blasting and land clearing. Construction activity in such sites was perceived to increase vulnerability to landslides, drive local deforestation, and cause the drying up of local springs. Indiscriminate and unsustainable fuelwood cutting from nearby forests by migrant laborers was heavily blamed for both fuelwood shortages and forest degradation, in particular.

A final set of concerns were reported in terms of intangible, but important indirect social impacts related to cooperation between women of different households. The change in timing of common tasks related to agricultural and forest work was believed to be responsible for fewer opportunities for women of different backgrounds and households to work together, and competition for limited natural resources is starting to contribute to intra-household stress. Moreover, women told us, the younger generation aspires to move away from traditional livelihoods based on agriculture and use of forests. The lack of established (or properly functioning) village-based institutions where women can gather to discuss such village-level

problems and work cooperatively to address them (e.g., traditional women-only institutions such as *Mahila Mangal Dal*) adds to the impact of the loss of important yet time-bound social spaces.

5.2 Gender and ecotourism in the NDBR

With the above discussion as context, in this section we apply the SL framework to the case of ecotourism in the NDBR. In addition to summarizing reported climate-related threats in terms of livelihood assets for women, Figure 3 also illustrates how ecotourism has the ability to strengthen specific types of assets. These examples demonstrate the links between gender, climate change, and potential for increased adaptive capacity of communities through livelihood diversification. Following the SL framework, we have identified site-specific examples of *human* (e.g., education, knowledge, cultural practices), *social* (e.g., networks, arenas of status/power), *natural* (e.g., environmental resources), *physical* (e.g., infrastructure) and *financial* (e.g., income, wealth, land, livestock) assets.

Our observations in NDBR communities experimenting with ecotourism suggest improvements of key livelihood assets for women in participant-networked households, particularly with regard to development of human, social, and financial capital (areas that are often weaker for NDBR women as a group, as shown earlier in Table 1). In the households that have homestay facilities, for example, women reported that they benefitted from the opportunities to interact with the tourists afforded through their home-based activities such as cooking, cleaning, and creation of a welcoming space for guests. The resulting cultural interaction and mutual exchange of ideas led to the women feeling that they were now more aware of conservation and development issues, as well as feeling more self-aware in the areas of personal self-development, such as increased attention to self-care (personal hygiene,

appearance) and knowledge of the surrounding areas. We also observed that while wealth largely determined which households were able to directly participate in the homestay offering, the wider homestay economy carried social benefits that were distributed more broadly through multiplier effects in the villages. For example, those unable to host tourists directly still benefitted from development of public social spaces (village paths, tea-stalls, etc.) where tourists and villagers could interact spontaneously beyond the homestay sites. In this way, the village itself plays a key part in its role as the larger "host." Similarly, neighbors of homestay operators benefitted from interactions and insights achieved through informal visits. Through participation in less formalized social networks created and facilitated by the homestay model, women also cooperated more with each other and earned respect as a group through recognition of their key role in raising cash income for their families.

Greater financial resources at both village- and household level have also translated into assets development for women, as personal investments into village facilities for the comfort of tourists (such as preparing time-consuming written applications for improvement of electrical grid and sanitation infrastructure) contribute to strengthening of physical capital assets across wealth categories. Village- and household-level improvements such as increasing the availability of clean water and expansion of toilet facilities promote women's assets by addressing sanitation/hygiene issues that disproportionately negatively impact women and children. In addition, homestay-providers reported that a diversified income base associated with ecotourism led to less reliance on natural resource extraction in the nearby forests, due to practical reason of the extractors being "gainfully" employed. A reduction in women's forest-based labor for domestic fuel, water, and fodder collection opens up opportunities for women and their daughters to strengthen their human capital assets (e.g., self-care outcomes, education,

job-skills development). However, even for households with sufficient funds to purchase fuel/fodder, demands for "women's work" continue to include forest-based resource collection. (Reasons include house location and relative proximity to transportations links (remoteness), cultural traditions associated with use of the *chullah* (cooking fire) and the need for warmth/comfort associated with wood-fueled fires in winter.)

Finally, we informally observed that in families which were getting regular tourists for their homestays, there was less need for long-term male migration. We can tentatively suggest that successful ecotourism operations may thus promote family integrity (human capital) through reduction of long-term male outmigration and promotion of a more integrated/cooperative model of income-generation. Compared to the standing model of labor participation in the regional tourist industry (in which benefits accrue to families primarily through the contributions of male members working as porters, guides, cooks, and drivers), homestays represented a more inclusive model where both the women and men work together. Although the tasks are still more or less defined and implemented along lines of gender, the overall approach is a visibly complementary one (i.e., as compared to the earlier version where both worked on different activities and there was little overlap between their work, and in which women's domestic labor was not economically valued). In other words, in the ecotourism homestay households we visited, women and men were both positioned to be valued contributors to a larger, cooperatively-based "productive" economic/domestic system.

6. Discussion

This paper has been devoted to illustration of links between gender/climate change, with a particular focus on women's differentiated experiences and assets needed to strengthen

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Deleted: [Figure 2: Women's Vulnerabilities to Impacts of Climate Change: Transformation of Adaptive Capacity Through Ecotourism as Alternative Livelihood Strategy]¶
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adaptive capacities. We have offered details from regional ecotourism experiences to suggest ways that livelihood assets can be strengthened, as part of a larger climate adaptation approach that employs a differentiated framework as its basis. We have shown that women experience gender-differentiated outcomes related to climate change, and that these outcomes relate closely to critical livelihood assets required for sustainable and equitable development. Our experiences in the field suggest that gender-based impacts of climate change cut across social categories such as ethnicity and caste – particularly for women whose households are dependent on seasonal agriculture – due to a gender-based division of labor that is not (as we have so far observed) specific to these larger social and economic categories. Income, migration status, and household size do however appear to be crucial aspects for sustainable livelihoods development, and are related directly to household assets and overall capacities.

The climate change impacts we have reported here for NDBR are consistent with women's climate-change experiences emerging in other parts of the Himalayas, for example elsewhere in Uttarakhand (Negi et al., 2010), in Himachal Pradesh (Kapoor, 2011), and in the mountains of Nepal (Leduc, Shrestha, and Bhattarai, 2009; see also Eriksson et al., 2008 and Gentle and Maraseni, 2012 for similar reports about climate change impacts to women's health in Nepal). As at NDBR, views from the ground in these other locations show that gendered labor practices and other gendered norms strongly shape women's knowledge and experiences with climate change. As such, women's knowledge and prioritizations for action need to be made central in broader discussions of adaption. However, additional and larger-scale research is needed to generate the comparable datasets that will be required for differentiated action plans. We believe that in seeking women's participation in such studies, as attempted here, externally supported adaptation/mitigation planning can more closely reflect their priorities and thus be

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supported more effectively. Further work should continue inquiry of the role of difference within gender groups. If regional infrastructural and economic development resources are going to come to residents in the name of adaptation and mitigation to the impacts of climate change, it should happen in a way that reflects relevant patterns of differentiated knowledge and impacts. Investing in adaptive capacity of communities in this manner thus also represents a key opportunity to invest in and promote women's empowerment, a goal whose achievement is widely held as a prerequisite for sustainable development (e.g., as suggested by the Millennium Development Goals)

This study of the NBDR also suggests that household responses to crop failure and decreased agricultural yields are constrained in a range of ways that make it particularly difficult for poor families to enhance or diversify their income sources. For women in poor families, however, the hardship is compounded. Women from cash-poor households, for example, do not have the option of purchasing fuelwood or fodder; thus, the risks and labor costs that women in our study reported as inherent to their work increases in the absence of alternative assets. Similarly, in the face of recurring climate-induced crop failures or poor yields, switching from agriculture to animal husbandry may be a viable strategy for generation of cash but could also ultimately undermine household nutrition and food security (overseen by women). As others have also observed, Himalayan women are typically "the last to eat and also eat the least" (Negi et al., 2010: 75).

Our research also demonstrates that ecotourism related to NDBR, as an experiment in livelihood diversification, is slowly changing the assets profiles of participating women. On the surface, it would seem that the benefits of this arrangement accrue inequitably in terms of gender: Men strengthen their financial and personal assets, status, and role as "breadwinners"

through participation in the formal and monetized ecotourism industry; meanwhile, women are typically involved only in unpaid, traditionally low-status domestic tasks such as preparing food, cleaning, and fetching of fuelwood and other natural resources. However, our research shows that women's assets *are* being strengthened, albeit in different domains from men. Increases in women's cooperative arrangements associated with strengthened social capital are particularly important, however, because they may ultimately support emergence of new cooperative institutions (e.g., new ecotourism/ecodevelopment committees) or enable meaningful changes in existing ones (e.g., village-level governance bodies, *Van Panchayat* [forest council], revival of traditional groups such as *Mahila Mangal Dal* [women's group] or *yuva mandal* [youth group]). Rather than remaining silent spectators in formal institutional settings or limiting their participation to simply adding their names to member attendance rosters, strengthened human and social capital assets would help women to take a greater voice in decision-making regarding their economic activities as well as about management and use of the natural resource base.

Involvement of women in ecotourism activities at NDBR has also benefitted the wider community, by broadening the spectrum of tourism beneficiaries and expanding the skill sets now held by people engaged in related activities. It is also setting positive examples for others and modeling the potential for change to occur through cooperation and challenging of previously held beliefs about obstacles and limitations. In the face of increasing vulnerability of traditional agriculturally-based livelihoods and pressures for men to out-migrate, we believe that under the right conditions, ecotourism has the potential to become an important part of a larger adaptation strategy that strengthens families' adaptive capacity and resilience of livelihoods for the mountain regions. These early findings resonate with longer-term experiments elsewhere in the region. For example, a larger-scale formal homestay program organized and run since 2002

by the Sarmoli village *Van Panchayat* (forest council) in the Pithoragarh district of Uttarakhand has been linked to both women's empowerment and improvement of the local village economy (Macek, 2012). As in our study, Macek (2012) reports that in their role as hosts, Sarmoli women demonstrate leadership through cooking, interaction with guests, and education of guests about their lives and lifestyles; he further notes that for some families, the homestay has positioned women of the household as the primary income-earner and is helping villagers to overcome barriers posed by tradition.

At the same time, participation in homestay-based ecotourism is shaped strongly by wealth and other household-level livelihood assets. A recent study of NDBR homestay operators found that related home investments averaged a total of INR 172,417 (Von Hedemann, 2010), a figure nearly twice the amount of the reported average annual incomes of households in our study area. Because of inter-group differences, the risk of widening gaps between strongly and weakly endowed households is therefore a key concern. As previously discussed, those most negatively affected by climate change are likely to possess fewer livelihood assets than wealthier (or more educated, effectively networked, or mobile) counterparts who are better positioned to be able to cope with the stresses of climate change. Such counterparts are also more likely to directly benefit from investment in ecotourism and hosting tourists. For this to be a strategy that accrues benefits in an equitable, community-wide manner, capture of benefits by elites must be anticipated and avoided through participatory approaches to planning and benefit-sharing that recognize and develop capacity of all potential beneficiaries. Otherwise, homestays risk spreading environmental and cultural costs over the entire village, whilst only those wealthy enough to invest reap the lion's share of benefits. In addition, while gender concerns remain important as an entry point into understanding distribution of benefits at a finer scale than the

household, we note that access to benefits will also be linked to other factors in equally critical ways. Though we were not able to focus on age in the present study, our previous studies of ecodevelopment efforts (including ecotourism) at a range of Himalayan sites suggested that age/gender together shaped benefit flows in important ways (Badola, Ogra, and Barthwal, 2014). Similarly, a study of caste interactions and patronage ties between tenant farmers and landholders in the mountains of Nepal found that although climate change adaptation options were shaped by caste, they simultaneously reinforced existing and unequal gender norms related to division of labor and opportunities for income-generation (Onta and Resurrecction, 2011).

Effective use of assets-based models will remain an important tool for better understanding the relative strengths, weaknesses, constraints, and opportunities facing individuals, households, or communities in the context of climate change. As suggested by our case study, ecotourism can contribute to the promotion of non-consumptive use of mountain resources and (under the right circumstances) can be an important tool for providing well-defined livelihood enhancement opportunities, but this is just one example of an alternative livelihood strategy. We do not wish to suggest that any one adaptation strategy will be a panacea, or that all NBDR communities or households should now invest in homestay-based ecotourism. Our goal in discussing the ecotourism experiences at NDBR is to demonstrate the value of bringing an assets-based approach to questions of adaptive capacity. Indeed, in other areas ecotourism has led to weakening of assets (Coria and Calfucura, 2012) or led to concerns of cultural and social erosion (Scheyvens, 1999). Tourism of any type also carries its own footprint. Increased instances of littering of non-biodegradable trash, improper waste disposal and contamination of water sources along trekking routes are existing impacts at the NDBR, itself (Maikhuri et al., 2011) and homestay-based accommodation poses the risk of dispersing

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such impacts over the host villages as well, if not carefully anticipated. In addition, the needs of homestay operators for additional fuel, food, and water will all contribute to local human and environmental costs.

6.1 Suggestions for action and further research

Climate change obviously poses myriad challenges, which we believe will increasingly demand a team-based research approach that brings together climate scientists, policy/systems modelers, and social scientists. The range of observed physical changes already demand, as well, that as researchers we work collaboratively to conceptualize the problem at all scales – global/national/regional/local as well as intra-community/inter-community. It is perhaps from this latter perspective that differentiated impacts, as seen through a lens of gender (in conjunction with other stratifying categories), can best help to inform an applied research agenda. Our examples illustrate that because the impacts and burdens of climate change are clearly differentiated, adaptation strategies will need to be conceived in ways that are both gender sensitive in the short-term – and ideally, socially transformative in the long-term (Figure 4). In addition to technical interventions aimed at reducing differentiated impacts of climate change, responsive institutional and research-related practices such as gender mainstreaming and gender budgeting (e.g., for data analysis, project assessment) will be key to advancing the paradigm shift from gender-blindness to socially transformative visions of gender justice and equity. However, as shown in the SL model itself (Figures 1 and 3), such changes cannot occur without enabling changes in the surrounding institutional, economic, and cultural landscapes. This has implications for the research, policymaking, and financing landscapes as well as for the communities we aim to support through our endeavors.

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[Figure 3: Climate Change Adaptation Practices – Gender Intervention Typology]¶
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In the spirit of speaking across the disciplinary boundaries represented by this issue of *ESD*, before closing this paper we offer some questions and ideas for further study. We hope that this discussion stimulates readers to ask themselves how their own inquiries and methodological approaches can add to this starting list. First, areas for consideration by Himalayan climate scientists and policy modelers: How can models of changing monsoon patterns be improved to reflect possible implications for the food crops preferred by women cultivators, in comparison to cash crops promoted by State-based or corporate/multinational agricultural extension agents? Knowing that certain groups of individuals in the high-altitude Himalayas (farmers, elderly residents, and trekking guides, for example) possess tremendous knowledge about agro-ecological, glacial extent, and forest-based biodiversity changes, how can models of environmental change more directly take into account gendered and locally produced knowledge? In what ways can predictive models better reflect the hazards associated with "small-scale" disasters (localized landslides or weather-related crop failures, for example) for different groups – or provide finer-scale data about shifting monsoons, wind patterns and land cover changes, as suggested by IPCC working group members (IPCC-WG2, 2014)? Can spatial models of flood hazard for the region incorporate practices from participatory GIS to intentionally reflect the location of gender-based and activist network hubs, as researchers in the area of disaster studies elsewhere have suggested (e.g., Leduc, 2009 and Gaillard, et al., 2012)?[2]

Existing lines of climate change and livelihood research undertaken by social scientists and policy/systems modelers can also be reframed and enhanced through a team-based approach

[2] Recent work in the field of gender and disasters has shown that relief services and support are frequently gender-segregated, functionally excluding transgender communities such as *hijras* in India, *warias* of Indonesia, *baklas* in the Phillipines, and LGBTQI/genderqueer communities in the USA (Balgos et. al., 2012; Dominey-Howes et. al., 2014; Knight et. al.,2012). These gender-fluid communities are, at the same time, connected through networks that can be important resources for disaster-related information, services, and support. In breaking away from binary analytical models, such research reflects new directions and paradigms for gender/climate change studies.

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5.1 Suggestions for Further Research¶
In 2009, Hemmanti and Rohr argued that the conceptual notion of climate justice represented an effective entry point for larger reflection about the meaning of gender equality in the context of climate change impact mitigation as well as a concept that carries powerful implications for future climate negotiations regimes. They observed that gender equality is "finally beginning to be accepted as one of the core principles of mitigating climate change and adapting to its impacts" (2009:25). Five years later, we close this article with a few examples of possible questions for HKH climate scientists that can reflect an interdisciplinary commitment to gender justice through new lines of research

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Existing lines of climate change and livelihood research can also be reframed and enhanced by taking a team-based approach that reflects a commitment to gender justice/climate justice:

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Deleted:) motivate us to ask? For policymakers and social systems modelers: How does climate-related information flow throughout a community? Bearing in mind that land tenure and land rights are highly gendered and class-/caste- differentiated in the HKH, under what tenurial and natural resource management regimes are national and regional carbon sequestration goals best achieved? How are decisions taken regarding best practices for community- or household-level adaptive response to a changing climate? What will it take for economic growth or income-based models, disaster response plans, alternative livelihood strategy designs, integrated conservation-development initiatives, and other critical resources for sustainable development planning to be routinely implemented with reliable, sex-disaggregated datasets that not only include the formal sector but also take into account the vast informal sector that otherwise overlooks the tremendous economic contributions of women? What information do people *need*, in order to more effectively plan and make choices about adaptive response?

that reflects a commitment to socially transformative research and which operates across scales. For example: Through what pathways does agro-ecological and climate-related information flow throughout a community – and how, if at all, are they gendered? Are there groups of people who are not captured in these webs, and if so, how can policy interventions reach them more effectively? For ecotourism to be a socially as well as environmentally sustainable alternative livelihood, can models of cost and benefit more explicitly take into account the value of women's largely unremunerated labor? How can dominant livelihood choices, such as migration, be better represented in models of climate change response, to better understand the drivers underlying these decisions as well as the contribution to adaptive capacity for both men and women?[3] Bearing in mind that land tenure and land use practices are highly gendered and class-/caste- differentiated in the Indian Himalayas, how will "sustainable energy" infrastructure or land-use projects targeted for the region (such as hydroelectric power plants) be implemented in ways that strengthen, rather than undermine, differentially held assets? Under what tenurial and natural resource management regimes, and at what scales, will national and regional carbon sequestration goals most equitably achieved?

Finally, social scientists with expertise in fine-scale analysis can play an especially key role in generating the ethnographic and methodological perspectives required to adequately analyze the complexities revealed by individual experiences. What information do different groups of people *need*, in order to more effectively plan and make choices about adaptive response? Gender and development scholars have long called for economic growth and income-based models, disaster response plans, alternative livelihood strategy designs, integrated

[3] Work in the field of masculinity studies (e.g., Cornwall et. al., 2011) similarly pushes researchers interested in gender/climate change to centralize men's experiences, in seeking to better understand the lived experiences of fathers, brothers, and sons who leave their families in climate-stressed areas in order to serve as remittance providers.

conservation-development initiatives, and other critical resources for sustainable development planning to be implemented with reliable, gender-disaggregated datasets (and ideally operate at even finer and non-binary scales). Yet outside of small scale, time- and labor-intensive qualitative case studies or broad-brush quantitative analyses of difference from large-scale surveys, it is difficult to envision how sufficiently detailed knowledge about differentiated vulnerabilities, strengths, and needs in the region will be achieved at the scales and speed required. One must ask: In an area with such topographic and cultural complexity, how can logistical, financial, and methodological limitations be overcome so that best practices can be more clearly identified and communicated? These are some of the questions that drive our own continued research.

There is clearly still so much work to be done, and a need for research on the specific outcomes that climate change is likely to bring to Himalayan communities. Ultimately, we would urge that researchers of climate change impacts employ frameworks that include differentiated vulnerabilities, wherever possible – to analyze not only vulnerabilities obviously shaped by poverty, but also by gender-differentiated vulnerabilities in all their variants. It is with this foundation that we will be able to move more effectively toward adaptation/mitigation strategies that build, rather than weaken the livelihood assets for not only women, but for all facing risk – and in so doing, heed the UNFCCC's calls to conceptualize women's empowerment as a "significant factor" in meeting the overall climate change challenges ahead.

7. Conclusion

The integration of frameworks based on differentiated vulnerabilities offers an opportunity for climate change researchers and policymakers to contribute to the ensured

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Deleted: Finally, although, the sex-disaggregated data we call for here will continue to be critical for informed policymaking about how best to adapt to climate change events and long-term scenarios in "gender-transformative" and "gender-just" ways, we must stress that this is likely only the beginning of achieving true gender justice in the pursuit of sustainable and equitable development. This is not to diminish the value of the current trajectory within the gender/climate change arena, but simply to underscore the evolving complexity of the challenges that lie ahead. Eventually as researchers of environmental change, we will all need to move on to more sophisticated analyses of how gender functions as a social *structure* (i.e., not just treated as a "data" category) to shape vulnerability as well as to offer opportunities for strength and resilience; we also need to find a larger range of ways to analytically incorporate the intersectionality of gender with other socially stratifying and often discriminatory structures (such as race, class, caste, ethnicity, age, and so forth). These are critical methodological challenges which will require going well beyond sex roles and division of labor analysis. It is in this arena that feminist scholars can be of particular value as part of interdisciplinary climate change research collaborations. Indeed, some such scholars in the field of disaster risk reduction (DRR) have by now dispensed with the simple, binary conceptualizations of gender employed in this discussion, advancing our understanding of how for example, transgender (e.g., *hijra* communities in India, *meti* individuals in Nepal, *baklas* in the Philippines) and LGBTQI individuals in the United States experience differentiated vulnerability to the impacts of disasters such as floods, earthquakes, and discrimination in their efforts to seek recovery/relief (Balgos et.al, 2012; Knight et.al., 2012; Dominey-Howes et. al., 2014). Similarly, emerging work about the way masculinity is experienced offers valuable insights about what different groups of men are experiencing in the face of climate change, particularly with regard to the migration experience and what women's empowerment means for (especially male) members of their families (Cornwall et. al., 2011). ¶
The pursuit of gender justice, as part of the larger climate justice agenda,

viability of the mountain communities by *a)* avoiding the trap of gender-blindness in research, policy, and intervention designs, and *b)* seeking to develop and strengthen livelihood assets of vulnerable populations, while *c)* simultaneously working to promote the transformation of enabling structures. In the Indian Himalayas, we believe that this requires recognition of the largely unacknowledged yet productive livelihood contributions of mountain women, and a prioritization of women's assets development to help promote adaptive capacity at a range of scales. Research and policy collaboration with local institutions will also be important to expanding forms of social capital and networks of support, in the face of livelihood uncertainty and ecological change. For researchers, increased dissemination of climate-related information and relevant research findings to all affected communities can be a related goal. Information supports choice, and choice is required for empowerment and action. By investing our time and inquiries in ways that integrate gendered perspectives into larger questions about differentiated vulnerabilities, adaptive capacity, and equity, we can help to provide the support required for Himalayan residents to envision and develop new sources of strength, themselves.

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