CARIAA
Collaborative Adaptation Research Initiative in Africa and Asia

Responding to uneven vulnerabilities

A synthesis of emerging insights from climate change hotspots

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Titles in this series are intended to share initial findings and lessons from research and background studies commissioned by the program. Papers are intended to foster exchange and dialogue within science and policy circles concerned with climate change adaptation in vulnerability hotspots. As an interim output of the CARIAA program, they have not undergone an external review process. Opinions stated are those of the author(s) and do not necessarily reflect the policies or opinions of IDRC, DFID, or partners. Feedback is welcomed as a means to strengthen these works: some may later be revised for peer-reviewed publication.

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Abstract

Supporting adaptation options for the most vulnerable in climate change hotspots requires a careful consideration of issues often ignored by traditional assessments. These "blind spots" include spatial variability in the nature and level of vulnerability, the interaction and complexity factors giving rise to vulnerability, landscape connectivity, human mobility, and socially-differentiated experiences of risk and responses. Despite a multitude of approaches to vulnerability assessments and risk profiling in climate change hotspots, the key challenge has been streamlining these conceptual tools to policy and practice at the local scale where impacts are felt. This paper uses examples of water and food systems to highlight the critical importance of considering these blind spots in vulnerability assessments in climate change hotspots. Emerging research highlights the need for a more nuanced understanding of multiple interacting drivers that influence socially heterogeneous communities, across various landscapes, and often in resource-constrained institutional settings.

Key words

climate change hotspots, vulnerability, water resources, food systems, gender, adaptation responses

Resumé

Supporting adaptation options for the most vulnerable in climate change hotspots requires a careful consideration of issues often ignored by traditional assessments. These “blind spots” include spatial variability in the nature and level of vulnerability, the interaction and complexity factors giving rise to vulnerability, landscape connectivity, human mobility, and socially-differentiated experiences of risk and responses. Despite a multitude of approaches to vulnerability assessments and risk profiling in climate change hotspots, the key challenge has been streamlining these conceptual tools to policy and practice at the local scale where impacts are felt. This paper uses examples of water and food systems to highlight the critical importance of considering these blind spots in vulnerability assessments in climate change hotspots. Emerging research highlights the need for a more nuanced understanding of multiple interacting drivers that influence socially heterogeneous communities, across various landscapes, and often in resource-constrained institutional settings.

Mots clés

points chauds des changements climatiques, vulnérabilité, ressources en eau, systèmes alimentaires, genre, mesures d'adaptation

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Introduction

Vulnerability assessment has contributed to understanding and responding to natural hazards and climate change, and inspired the development of decision-support tools for policy and practice (Cutter et al. 2003; Adger 2006). Despite limitations in assessing exposure, sensitivity and adaptive capacity (as per the IPCC framework), vulnerability assessments are used in efforts to mitigate risks, build social-ecological resilience, and sustain life support systems (Smit and Wandel 2006; Williams et al. 2008; Cinner et al. 2013). Yet vulnerability assessments have been critiqued as being blind to, or failing to address certain issues (Small-Lorenz et al. 2013; Tschakert et al. 2013), for example landscape connectivity: the ability for species to migrate or shift their habitat due to environmental change or conversely become trapping in unsuitable areas. Research on this topic has been largely limited so far to wildlife species, yet human mobility within densely populated hotspots can also be limited by lack of spatial connectivity. Ecosystem fragmentation can encourage communities to remain in risky areas because they enjoy services that are not available elsewhere or they would not be available during the transition (Ghosh et. al. 2018). In other cases, marginalized groups within society are excluded from vulnerability assessments, making their interests less visible to measurement (Tschakert et al. 2013). Assessments can also ignore spatial heterogeneity and complexity, failing to note places of more pronounced vulnerability, or to con-sider the interaction among different drivers of vulnerability (Findlay 2005; Jessop et al. 2008; Etzold and Sakdapolrak 2016).

Climate change hotspots are regions of the world where high probabilities of climate change im-pacts coincide with concentrated populations of vulnerable people (De Souza et al. 2015). Be-cause spatial context is very important to understanding threats in climate change hotspots (Thomas and Duraisamy 2016), but fine-grained resolution methods have become more easily available in the past years, it is imperative to consider those to simultaneously build local adaptive capacity and inform regional planning. As often argued, physical space can act as a structural barrier and influence a community's level of vulnerability as well the mediation of outcomes through local relational attributes such as power, knowledge and governance processes (Findlay 2005; Cutter et al. 2008; Tschakert et al. 2013).

Blind spots mean that the assessment of vulnerability may be incomplete or not detailed enough to act on the basis of such knowledge, and they may exclude some people, communities, or groups. Therefore, integrating such blind spots into our understanding of vulnerability to climate change is crucial to prioritize and plan appropriate responses that leave no one behind, as envisioned in the Sustainable Development Goals.

This paper analyses new knowledge on vulnerability and responses in climate change hotspots. Rather than emphasizing methods to identify blind spots in vulnerability

assessments, this paper using climate change hotspots which are spatially extended, often disconnected landscapes, and host socially differentiated communities. Examples of such hotspots include semi arid regions where livelihoods are heavily dependent on rain fed agriculture, mega-deltas where concentrated settlements of people are exposed to sea-level rise, and glacier-fed river systems where glacier retreat threatens livelihoods (De Souza et al. 2015). As exposure to risk varies spatially across landscapes, hotpots exemplify some of the characteristics that constrain vulnerability assessments. This offers an opportunity to unpack some of the blind spots that have been identified in previous vulnerability assessments, as exposure to risks is also tied to social differentiation, since socio-economic status and cultural practices strongly influence where people live. It is therefore essential that spatial variability, and the ways in which this ties to socially differentiated experiences of vulnerability, are factored in to vulnerability assessments and response strategies.

This paper provides a glimpse into the dynamic nature of vulnerability across climate change hotspots, new knowledge on the sustainability of water and food systems, and implications for best management practices towards future risks. Water resources and food systems are two do-mains of vulnerability experienced in such hotspots, and relate to issues that are commonly ignored in vulnerability assessments. Food systems include agro-ecosystems (local staples and livestock), and fisheries across the whole value chain from harvest to plate. Water resources include mountain glaciers and meltwater, surface flows including rivers and tributaries, precipitation (notably rain and snow), deltas and estuaries, lakes, and aquifers. Response strategies that address the reality of uneven and gendered vulnerability are explored. The paper also provides a rationale for reframing vulnerability and adaptation response strategies, grounded in transformative out-comes and sensitive to landscape connectivity and social differentiation.

1. The dynamics nature of water

Spatial complexity is often missing in vulnerability assessment. The ways in which water-related vulnerabilities are experienced in climate change hotspots highlight the importance of an appreciation of landscape connectivity and hydrological variability.

Glacier-fed river systems are particularly susceptible to changes in the availability of water under climate change scenarios, and display strong spatial variability in how impacts are experienced. For example, the Hindu Kush Himalaya region supplies water and other ecosystem services to more than 800 million people in the region. This region is highly vulnerable to increasing temperature and is predicted to lose a third of its current ice mass by the end of the century (Immerzeel et al. 2010; Kraaijenbrink et al. 2017). Unlike the use of bioclimatic and hydrological models that simulate water budgets under climate change (Korner et al. 2011), Lutz et al (2014; 2016) calibrated and coupled models of the cryosphere and hydrology using mass balance and downscaling techniques to assess the geographical and spatial nature of hydrological vulnerabilities. By comparing temperatures between pre-industrial and end of century for a 1.5 degrees scenario, Kraaijenbrink et al. (2017) further reveal differences in water risk in the high mountains of Asia, with the Himalayas being the most vulnerable to glacial melt and changes in stream flow. These studies demonstrate the spatial differences in which vulnerability is experienced across a land-scape, with implications for improving and sustaining water resources across sectors and jurisdictional boundaries.

The spatial dimension of vulnerability to water stress shifts as one moves downstream. Using the Teesta River Basin, Afutuzumab and Syed (2017) assess transboundary management of water resources between India and Bangladesh, and the possibilities of fostering equitable distribution of benefits. These authors highlight trade-offs between upstream users, especially for energy development in India, and downstream irrigation and agricultural activities in Bangladesh. Adaptation responses in such contexts require collaborative governance that accounts for the uneven vulnerabilities experienced by users along the length of the river system, through water sharing treaties and joint management that recognise seasonal water flux and trans-boundary needs be-tween countries.

Karpouzoglou and Vij (2017) argue that uneven development and power asymmetries affect water access and use rights as well as distribution networks that most times focus on urban regions and neglect rural areas where issues of water contamination are felt by marginalised groups. Attention to the gendered dimension of water-related inequalities should be at the center of water reforms and adaptation responses under future climate change. Moreover, pluralism in representation in decision-making, especially ensuring the inclusion of disenfranchised groups or communities is essential in how we approach water production, consumption, and disposal in the context of a changing climate.

Semi-arid lands demonstrate similar patterns of spatially differentiated vulnerability to water stress. In the Ahmednagar District of India, groundwater offers a critical alternative to rainfall for farmers during drought periods. Thomas and Duraisamy (2017) demonstrate that access to ground water is strongly influenced by 'place', or where one lives physically in a landscape. Where individuals and communities live, and settle, is influenced by social standing and income. Therefore vulnerability differs spatially across landscapes. In Senegal, spatial variability in the landscape and associated livelihood activities have inspired integrated approaches to land use planning and watershed management (Toure et al. 2016).

Deltas and estuaries present different types of water-related stress. Urbanizing areas and maritime industries are susceptible to flooding and sea-level rise due to interactions among upstream, downstream, and coastal regions. Welch et al. (2017) assess adaptation responses in major deltas considering current and future climatic hazards and the interactions within biophysical systems. Hazards identified included saline intrusion, subsidence, coastal erosion, river erosion, river flood, cyclone and earthquake. Overall, hard engineering infrastructure such as sluice gates, pumping stations, and embankments (e.g. levees) are the most common interventions in contrast to soft options such as beach nourishment, afforestation, and other forms of spatial planning tools. Some of these hard engineering interventions contribute to the livelihoods of communities living in the deltas, but also fragment previously connected systems and reduce their buffering capacity with respect to extreme events. Other interventions, such as upstream damming and water diversion for agriculture, disconnect the river landscape and the basin scale, reducing mechanical, ecological and thermodynamic stability and robustness of the deltas (Day et al, 2016).

Hotspots also provide insights on migration and mobility of people and resources. Emerging les-sons from the Volta and the Ganges-Brahmaputra regions in Ghana and Bangladesh, respectively, points to migration as an outcome and determinant of vulnerability that is uneven across various households and regions. Migration is strongly influenced by multiple social and ecological factors and exacerbated by drought, flooding, and extreme events. In the Indian Sundarban delta for example, saline intrusion and flooding affects agricultural productivity in a very heterogeneous and spatially diversified way, encouraging individuals to migrate to locations where the prospect of employment offers the opportunities for remittances (Hardra and Ghosh, 2018). In the Mahanadi delta in India, the lack of easy land connectivity between highly-exposed coastal villages and the mainland slowed planned resettlement processes, reinforcing vulnerability in the areas that send and receive migrants (Ghosh et. al., 2018). In such a situation, spatial disconnection inhibits service provision and is reflected in social fragmentation, forcing households to choose between remaining vulnerable or moving to a place with fewer services and less sense of community.

The reasons people migrate, and their expectations for integration and resettlement, are shaped by local and regional governance as well as policy on access rights and tenure. Integrated policy responses need to integrate both climatic and non-climatic drivers, in

order to enhance the resilience of individuals and households in both sending and receiving regions.

2. Food systems

Where agro-food systems are concerned, access to capital assets, gendered division of labor, and effective governance mechanisms have emerged as key issues. Climate variability threatens the temperature and rainfall that agro-food systems depend on during the growing and harvesting seasons, with implications for food security and agrarian livelihoods (Gregory et al. 2005). Adaptation responses need to be sensitive to equity, inclusion and complement the sustainability of food systems in climate change hotspots. Adaptive capacity in agro-food systems is strengthened through capital assets, including human, physical, natural, financial, and social capital. For example, Thapa et al. (2016) identify how equitable cropping activities, inclusive labor markets, and participatory decision-making enhance food security among small-scale farmers in Nepal.

In Pakistan, the prospect of climate change has prompted testing of underutilised but nutritional crops as part of a strategy to address food security. Such crops not only promise tolerance to water stress but contribute to biodiversity conservation and the nutritional well-being of women and children under five who are the most vulnerable and undernourished (Adhikari et al. 2017). In Senegal, children in agrarian communities were found to be the most at risk in terms of malnutrition as they are exposed to double burden of climate-induced drought and increasing food prices (Lazzaroni and Wagner 2016). Here, the level of coping mechanisms and adaptability depends on household structure, gender roles, ethnicity, and access to assets. Matrilineal Wollof women were found to be better placed to respond well to these shocks owing to their bargaining power in the community compared to patrilineal Tukulor women. This suggests a need to look beyond house-hold income and physical capital when targeting nutritional programs and adaptation interventions.

In Kenya, Bedelian and Ogutu (2017) examined the potential synergies between pastoralism and wildlife conservancies during climatic variability in the Maasai Mara. Diversified opportunities provide more reliable and supplementary payments to landowners who are conservancy members especially during periods of prolonged drought. Yet the benefits from such opportunities also accentuated gender inequalities as a limited number of female headed households were involved, and non-conservatory members had neither the supplementary income nor access to grazing lands. A deeper interrogation of social norms and access rights is needed to reduce trade-offs between pastoralism and eco-tourism by renegotiating stakeholder partnerships, land use planning, and wildlife management.

In coastal Bangladesh, agriculture and fisheries (including aquaculture) remain dominant livelihood activities. Given vulnerability to flooding and saline intrusion, the focus has been on infra-structure, enhanced crop variety, and cropping techniques that are resilient to changing climate (Saha et al. 2016). Synergies among responses can buffer against climate variability and contribute to resilient development. For instance, inclusive gender development has been a national priority but could be strengthened in climate adaptation practice, especially given the important role women play in seafood value chains (Saha et al. 2016). More gendered adaptation practices offer opportunities for boosting household incomes through training and access to finance as well as improving on women's participation in regional economic development. The conversion of paddy rice fields into fish ponds for export-oriented shrimp aquaculture presents new opportunities to take advantage of saline intrusion. The government proposes an expansion of shrimp farming and mixed farming practices as resilient and profitable alternatives (Akber et al. (2017), yet will re-quire substantial inputs and services if farmers are to become small-scale producers and turn climatic threats into opportunities.

Gender and other forms of social differentiation are thus key considerations in efforts to support adaptation strategies in agro-food systems in climate change hotspots. The research cited here highlights that vulnerability assessments tend to be blind to socially-differentiated experiences of risk.

3. Transforming vulnerabilities

While underscoring how vulnerability varies across space and time and between social groups is important, one cannot lose sight of the simultaneous and multiple interacting drivers of change to which people are exposed to in climate change hotpots. The work towards decreased vulnerability can be understood in the context of the theory of complex transitions, or transformations. In addition to human development challenges, the frequency and occurrence of climate-related disasters and natural hazards have increased to the point where incremental adaptation is sometimes not enough (Kate et al. 2012; Pelling et al. 2013), and larger transformations are needed. The financial and social costs required to adapt to these climate-related disasters are monumental, resulting in calls for new ways of addressing multiple interacting drivers of change especially for the most vulnerable. Few et al. (2017) argue that both transformative and transformational adaptation are required, depending on the local context. The key difference between the two is that the transformative change involves fundamental shift in a practice, while transformational change is about an initial shift that may be even small scale or incremental, but ends up transforming larger systems.

In the context of societal transformations, embracing a landscape approach is crucial to address spatial and temporal complexities. For example, transboundary strategies for

pastoral corridors must consider not only climatic stressors, but the socio-political realities for land reforms. Gen-der is another dimension of heterogeneity that remains poorly understood in both the adaptation and development contexts, although efforts to provide tangible lessons are emerging (Arora-Jonsson 2014, Njuki et al. 2016). Gender is frequently perceived as a dichotomy between men and women, ignoring issues around intersectionality such as class, race, ethnicity, culture, education, religion, and power (Carr and Thompson 2014).

In an assessment of gendered vulnerabilities across eight countries in Africa and Asia, Rao et al. (2017) identify lived experiences and instances where differences in risk perception, household structure, institutional mechanisms, social networks, and ethnicity are influenced by power and decision making that affect people at the bottom of social hierarchies. For example, in South Africa women were more concerned about heavy rains and flooding, while men were often concerned about drought. These two types of hazard affect different livelihood activities, expectations, and decision-making process. Similarly, in patrilineal systems in West Africa (and South-East Asia), inheritance and access to resources such as land and cattle are often dominated by men who mediate and control the household decision making (Ahmed et al. 2016). Female-headed households and low-income women have poor access to resources and assets, the burden of household chores, and limited entrepreneurial skills. Such disadvantaged contribute to multiple tiers of vulnerability. Rao et al. argue that responses to such vulnerabilities need to go beyond seeing "women as victims" and understanding of resilience through consideration to social well-being, inclusive decision making, and opportunities that promote adaptive capacity.

The strong relationship between climate variability, water stress, food production, and well-being warrants an intersectional focus on household structure. This is crucial to both transformative and transformational responses. Scholars and practitioners have drawn attention to gendered agrarian livelihoods, especially the post-harvest stage during climate impacts (Garcia and Wanner et al. 2017). Through up-scaling interventions and value chains, this focus might have transformational impacts as these economic sectors are often dominated by women and contribute to both food security and livelihood diversification. In their analyses of gender and vulnerability, Morchain et al. (2016) argue for including fundamental principles of inclusion (intra-households and marital dynamics), participation and representation, and equitable access to resources and knowledge. Perceptions about gender roles often intersect with ethnicity, class, income and social norms to influence decision-making and often exacerbate conditions for the most vulnerable (Baron et al. 1996; Rao et al. 2017).

Migration has been an important adaptation strategy across hotspots, but also has a vehicle to transfer vulnerability across gender groups and spatial scale to reinforce inequalities. Unlike the livelihood approach that is place-based, migration links different locations and is governed at multiple scales across various jurisdictions. This highlights opportunities and challenges for both sending and receiving areas. In Northern Ghana, migration is often

undertaken by young (and able) men, with women staying in vulnerable households to cope and address the brunt of the disasters (Ahmed et al. 2016). In India, this is further aggravated by caste and ethnicity that in-creases the level of vulnerability through increased household responsibilities and further disenfranchisement (Rao and Mitra 2013). Both climatic (prolonged drought or flooding of croplands) and non-climatic factors (labor mobility) influence migration decisions with benefits such as remittances, skills development and livelihood diversification (Hajra and Ghosh 2018). Still in India, multi-stage migrations from rural coastal areas towards the suburbs of large cities like Kolkata or Bhubaneshwar contribute to the emergence of new semi-urban centers along the main road and rail infrastructure. Yet these new centres are poorly serviced and mix the traits of cities and resettlements camps. Resettlement issues around environmental migration during disasters high-light human right concerns, yet are often misplaced in favor of labor market opportunities that ignore existing inequalities between migrants and local settlers (Bettini et al. 2016).

Retrospective analysis into land use and land cover changes over provides an opportunity to in-corporate new ways of climate proofing development practices through strategic visioning (Toure et al. 2016). Such emerging insights have been the foundation for inputs into National Adaptation Plans and in meeting the Sustainable Development Goals (SDGs). In this light, Szabo et al. (2016) identified a key suite of indicators at multiple scales in monitoring progress towards developmental outcomes especially the SDGs.

Given the strong interactions between the SDGs and the water-food-energy nexus (Rasul and Sharma 2015), there is a need for reliable and useful information on climate science that fits the needs for local action (Singh et al. 2017). While local decision makers tend to need short term weather forecasts, climate science relies on global circulation models, with longer-term decadal or end of century projections (Kraaijenbrink et al. 2017). Strengthening local scientific institutions to generate and share knowledge is central to the landscape approach for transformative adaptation in the short-term, medium-term, and long-term (Singh et al. 2017).

4. Summary and Conclusion

Assessing vulnerability to climate change in a way that takes account of spatial and social differences requires going beyond merely counting who is most vulnerable. Climate change hotspots have unique features that characterise biophysical risks and socio-political dynamics that mediate response strategies based on the governing contexts. Reframing vulnerability to account for uneven spatial realities and social differentiation promotes new forms of knowledge that are relevant for informing adaptation responses for the most vulnerable. Place-based interventions matter, as a sense of place influences and fosters local adaptive capacity and community resilience during climatic disasters. Attention to the large expanse of vulnerable regions where climatic stressors undermine major natural and social capital assets is also important, as such conditions compel people to migrate or seek alternate options to mitigate such disasters. To this end, understanding spatial complexities and landscape connectivity provides opportunities for devising approaches such as cattle corridors in semi-arid regions in Western Africa (Ahmed et al. 2016) transboundary water treaties in the Teesta Basin in South East Asia (Afutuzumab and Syed 2017), embankments for flood controls (Welch et al. 2017), and migration as response strategies (Bettini et al. 2016; Hazra and Ghosh 2018). An intersectional approach to gendered vulnerabilities highlight the need for power sharing arrangements, inclusive decision making, and policy reforms to ownership and tenure regarding natural capital endowments (Ahmed et al. 2016; Bedelian and Ogutu 2017; Rao et al. 2017).

Climate change hotspots are useful for such an analysis as they respond to multiple drivers of change (environmental, economic and social), and allow us explore various policy entry points in achieving both climate adaptation and other development outcomes. As seen with issues around water and food security, responses that are gender sensitive and socially inclusive have impacts beyond climate policy to include social well-being, economic development, and contribute to the SDGs. Climate change adaptation responses that underscore uneven vulnerability offers a novel approach to addressing and responding to multiple challenges with potential transformative outcomes.

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