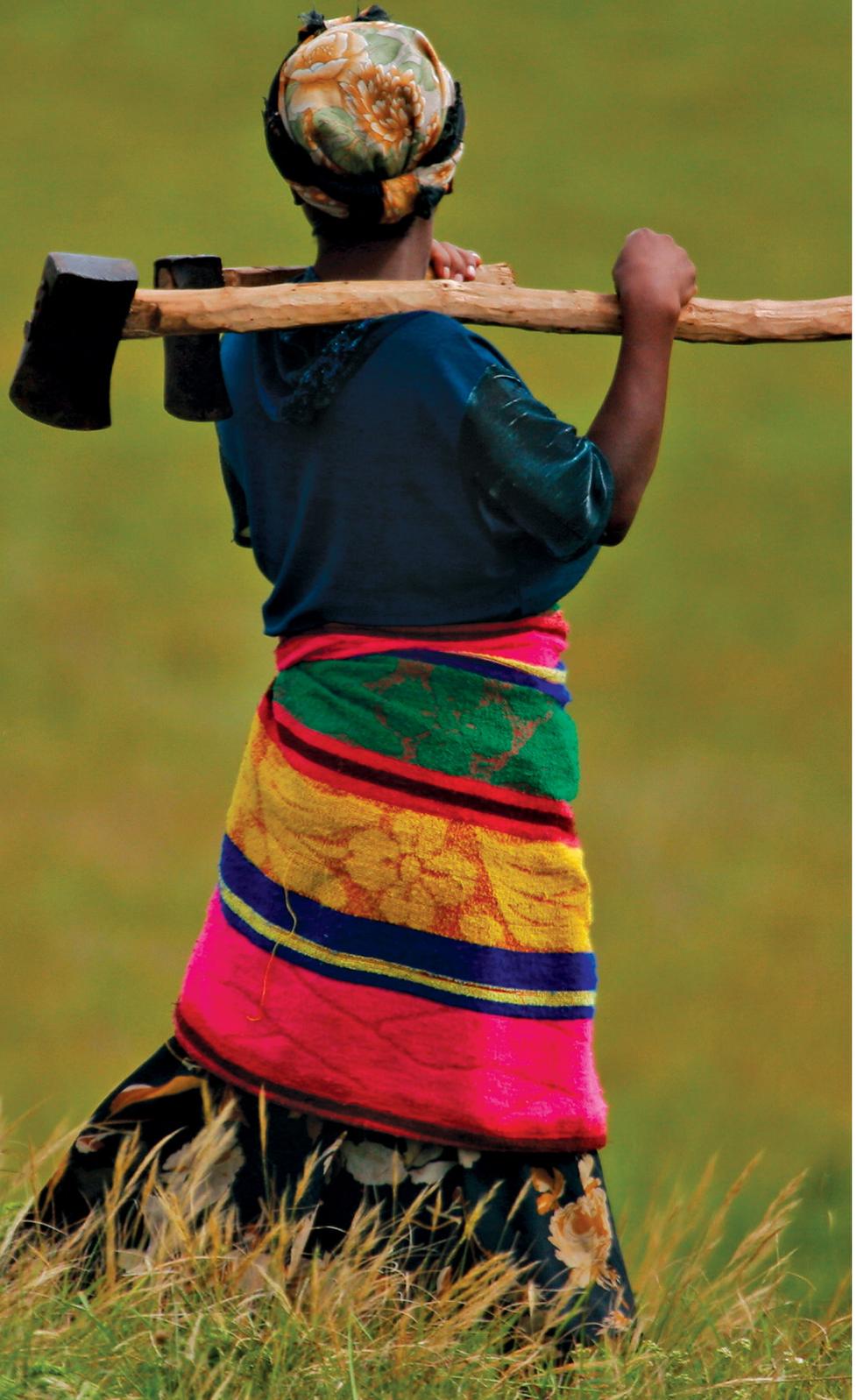


Gender and Climate Change:
A Closer Look at Existing Evidence

Global Gender and
Climate Alliance
NOVEMBER 2016



Acknowledgements

Support for this report has been provided by the Oak Foundation. The Steering Committee and Membership of the Global Gender and Climate Alliance (GGCA) is grateful to the following colleagues whom have reviewed and given feedback to this report: Liane Schalatek, Heinrich Boell Foundation; Gotelind Alber, GenderCC-Women for Climate Justice; Shaila Shadid, Gender and Water Alliance; Lorena Aguilar, International Union for the Conservation of Nature (IUCN); Margaret Alston, Monash University (AU); Lori Hunter, University of Colorado at Boulder; Laura McKinney, Tulane University; Farhana Sultana, University of Syracuse; Elaine Enarson, Independent Consultant; Bridget Burns & Eleanor Blomstrom, WEDO.

Author: Sam Sellers

Designer: Janet Leydon

Report Coordinator: Juliana Vélez Uribe, WEDO

About this Report

Perceiving a gap in the resources available to individuals and organizations concerned about the gendered experiences of climate change, GGCA commissioned this literature review in early 2016 in order to provide the most up-to-date assessment of the current evidence base illustrating how vulnerability to climate change and climate adaptation decisions vary by gender. This is designed to serve as a resource highlighting literature addressing a broad array of gender and climate issues affecting vulnerability and adaptation capacity. While this document contains hundreds of references, due to space limitations, it is not able to provide a comprehensive assessment of every topic covered. Readers are directed to the literature reviews cited below for additional sources, as well as subject-specific references that are contained in many sections of the review, which often contain information on additional research.

It is GGCA's hope that this review provides insights for advocates, policymakers, scholars, and members of the public who seek to understand and address gender-differentiated climate experiences. Although the search was comprehensive, a select number of sources were chosen, providing a diverse array of evidence to support the advocacy and policymaking work of GGCA members. This includes evidence on gendered experiences in different geographic areas, using a variety of

research methods, and produced by scholars from the Global South as well as the Global North. Readers are encouraged to use this as a resource for their advocacy, policymaking, and research activities.

About GGCA

Launched in 2007, the Global Gender and Climate Alliance works to ensure that climate change policies, decision-making, and initiatives at the global, regional and national levels are gender responsive which is critical to solving the climate crisis. GGCA brings a human face to climate change decision-making and initiatives to **integrate** a gender perspective into policy and decision making, **ensure** that financing mechanisms on mitigation and adaptation address the needs of poor women and men equitably, **build capacity** at all levels to design and implement gender-responsive climate change policies, strategies and programmes, and **share** practical tools, information, and methodologies to facilitate the integration of gender into policy and programming.



Table of Contents

4	🚩	CHAPTER 1. Introduction
4		1.1 Background on Gender and Climate Change
4		1.2 How to Use This Report
5		1.3 Summary of Previous Literature Reviews
5		1.4 Research Included in Review
6	☁️	CHAPTER 2. The Policy Context of Gender and Climate Change
6		2.1 Gender in Climate Governance and Gender Mainstreaming
7		2.2 Climate Finance
8		2.3 Impacts of Gender Mainstreaming
8	↓	CHAPTER 3. Climate Change and Gendered Livelihoods Impacts and Adaptation Strategies
9		3.1 Livelihoods Impacts and Adaptation Strategies: Agriculture
14		3.2 Livelihoods Impacts and Adaptation Strategies: Forests
15		3.3 Livelihoods Impacts and Adaptation Strategies: Fisheries
17		3.4 Livelihoods Impacts and Adaptation Strategies: Water Resources Management
18		3.5 Livelihoods Impacts and Adaptation Strategies: Energy
20		3.6 Livelihoods Impacts and Adaptation Strategies: Urban Livelihoods
21		3.7 Livelihoods Impacts and Adaptation Strategies: Migration
22	+	CHAPTER 4. Climate Change and Gendered Health Impacts
23		4.1 Health Impacts: Mortality
25		4.2 Health Impacts: Hunger and Food Security
26		4.3 Health Impacts: Infectious Disease
27		4.4 Health Impacts: Mental Health
28		4.5 Health Impacts: Reproductive and Maternal Health
29		4.6 Health Impacts: Personal Safety during Disasters
31	▶️	CHAPTER 5. Concluding Remarks
32		Recommendations for Additional Research
34		Appendix
34		Glossary
35		Methodology/Approach
36		Works Cited



1.1 BACKGROUND ON GENDER AND CLIMATE CHANGE

The impacts of climate change are already being experienced by each and every person around the world. However, these consequences are not being experienced evenly, and certain individuals are disproportionately affected. These individuals tend to face social, economic, cultural, and political inequalities and often live in places, such as coastal regions, that are heavily impacted by disasters related to climate change. In addition, they often lack the resources and capacity necessary to adequately respond to these challenges.

One important area of inequality is that of gender, the focus of this review. Gender inequalities have social, economic, political, and cultural implications for individuals responding to climate change. Examining gender is important because women, men, boys and girls, while hardly homogenous groupings, tend to have systematically different experiences in relation to climate change based on the inequalities associated with socially constructed gender roles (1, 2).

Gender serves as an important dimension of both vulnerability and adaptation, that is, whether and how women, men, boys, and girls are affected by and respond to climate change (3, 4). Vulnerability is commonly understood as social, economic, political, cultural, or other factors which make specific groups more susceptible to adverse change (5). Adaptation is the ability to change in response to the impacts of an event in order to minimize adverse consequences (6). Although discussions about gender often revolve around women and girls, who, in some contexts, are disproportionately vulnerable to the impacts of climate change, men and boys also have unique vulnerabilities which should also be addressed through changes in policies or practices. Such change can be brought about through a process of gender mainstreaming, that is, ensuring that gendered concerns are addressed and that the policy or practice does not further existing gender inequalities (7).

GGCA views gender as a lens through which to understand individual experiences of climate change. While acknowledging that it is an oversimplification, for ease in this document, gender is discussed in binary terms, as females and males tend to have different experiences around climate change that we wish to highlight. Readers who would like to see a more nuanced discussion of gender issues are directed to resources

cited in the discussion on page 33 (For Further Reading: Feminist Critiques of the Gender and Climate Literature).

Additionally, gender is one of many dimensions of vulnerability and adaptive capacity. Differences in experiences related to climate change are not limited to distinctions between women and men or boys and girls, but also have dimensions that are influenced by other social categories, such as age, class, race, ability and sexuality, among others. The contexts in which females and males live influence how other social categories affect their experiences with climate change (8, 9). Although these characteristics are not discussed in detail in this piece due to space limitations, readers are encouraged to be mindful of them when using the evidence contained herein, as they often form an important component of the contexts in which gender-related differences in climate change experiences develop.

1.2 HOW TO USE THIS REPORT

This report is divided into sections by topic. The remainder of Chapter 1 summarizes the literature base and provides an overview of the methodology used in this review. Chapter 2 addresses policy issues pertaining to gender and climate change. Chapter 3 covers literature on gender-differentiated livelihoods impacts and adaptation strategies associated with climate change. Chapter 4 addresses the gender-differentiated health impacts of climate change. Chapter 5 offers summary conclusions and recommendations. Additional details on our search process are provided in the Appendix.

This review contains references to over 600 articles, reports, book chapters, and other documents that, in most cases, are the primary sources providing direct evidence of the gendered impacts of and responses to climate change. In order to make this document readable, detailed explanations of each source are not provided, but rather a pertinent claim or summary of the reference and then a citation. Readers are strongly encouraged to follow up and look at sources that are of interest in order to find additional information as well as to learn more about the context in which the research was conducted.

There are limitations associated with this analysis. Searches were limited to English-language material, potentially excluding important findings published in other languages. While this review covers a wide array of gender and climate change linkages, time and space limitations precluded a discussion of some material. For instance, relationships between gender and mitigation (such as how gender is associated with the production of carbon dioxide emissions) are not discussed in this review, though they are of growing

importance to gender and climate change debates and policymaking activities (10–12). Topics not addressed in this review may be covered in a future version.

1.3 SUMMARY OF PREVIOUS LITERATURE REVIEWS

This GGCA review is not the first review of the gender and climate change literature. A variety of other organizations and individuals have surveyed the gender and climate change literature in the past decade, often with particular thematic focuses, including on agriculture (13), nutrition and health (14), vulnerability to natural disasters (15, 16), climate adaptation (3), and economic empowerment (17). Other reviews have surveyed the literature more broadly (18–24). In addition, various anthologies and books have addressed different aspects of gendered vulnerability to climate change as well as research on how climate adaptation practices are often gendered (25–29), or have examined specific elements of the gender and climate literature in greater detail, such as examining the role of gender in natural disasters (30–32), gender, environmental change, and water resources (33), and gender and climate finance (34). Moreover, white papers have examined literature on specific climate change-related issues through a gender lens, such as food security (35), resilience in drylands systems (36), smallholder farming (6), clean energy technologies (37), climate-friendly microfinance (38), cities (11), and climate adaptation in general (2, 39, 40). Arguably the most comprehensive document on gender and climate that has been published to date is a 2015 IUCN and GGCA publication, *Roots for the Future*, exploring the gender-differentiated impacts of climate change, as well as the changes in public policies needed to address these impacts (41). This document is highly recommended for individuals seeking additional detail and examples of the issues brought up in this literature review, particularly around issues of policy. This review is designed to complement, update, and expand upon earlier reviews, by providing an in-depth look into the gendered impacts of climate change with an emphasis on livelihoods and health, as well as addressing how climate adaptation strategies are often heavily gendered.

Since many of the pieces cited above were published, the literature base on gender and climate change has grown significantly, highlighting a growing interest in the linkages between gender and climate change. However, a disproportionate number of studies focus on sub-Saharan Africa and Asia (42). Moreover, adaptation studies (as opposed to vulnerability studies) tend to address gender issues more rigorously (42). There is also a relative lack of research on gender and mitigation compared to research on adaptation and impacts. These discrepancies can be seen in the base of

literature discussed below. Although some earlier literature suggests that part of the problem facing advocates of gender mainstreaming is a lack of sufficient gender-disaggregated data on climate change issues (43), this is becoming less of a problem as more organizations recognize the importance of gender and climate linkages and changing their data collection practices accordingly, allowing for the development of many of the publications cited in this review. For example, IUCN has developed an Environment and Gender Information tool, which provides gender-disaggregated data to explore questions around climate policymaking and gender (44). As additional gender-disaggregated data are collected on climate change impacts and responses, it is likely that future reviews will contain even greater geographic and sectoral specificity, allowing for more nuanced, context-sensitive understandings of these issues.

1.4 RESEARCH INCLUDED IN REVIEW

Broadly speaking, this review summarizes findings on gender that were generated in one of four ways. Each of these methodologies has respective strengths and weaknesses. By including evidence using all of these methods into a single review, a more complete picture of the gendered dimensions of climate change can be gathered than from the use of any single method. These methods include:

- Statistical models, which use a gender-related criterion, typically along with numerous other demographic, economic, social, and environmental variables, in order to assess correlated factors and in certain cases, predict a particular outcome. For example, a recent study on factors influencing drought-tolerant maize adoption in Uganda uses gender of the household head as a predictor of adoption (45).
- Qualitative research techniques, which use interviews or focus groups with persons believed to be directly or indirectly impacted by climate change in order to generate in-depth understandings of gendered vulnerability to and adaptation strategies. For example, research from Australia explores how farmers are being adversely affected by climate change, and how conceptions of masculine self-reliance and stoicism make it challenging for farmers to seek assistance from others (46, 47).
- Case study reports, which provide context concerning the gendered dimensions of climate change for a particular geographic area and/or the gendered effects of a particular intervention related to climate change. Such reports often use descriptive and qualitative methods, and are often prepared by an NGO or intergovernmental body. For example, WEDO published a report in 2008 exploring how climate change and gender interrelate in the specific

geographic area and/or the gendered effects of a particular intervention related to climate change. Such reports often use descriptive and qualitative methods, and are often prepared by an NGO or intergovernmental body. For example, WEDO published a report in 2008 exploring how climate change and gender interrelate in the specific contexts of Senegal, Ghana, and Bangladesh (48).

- Literature reviews, which are incorporated as sources throughout this report, particularly when such reviews provide additional detail on a sector with gender-differentiated climate effects that space constraints do not allow for detailed discussion in this document. For example, we cite two reviews (including one chapter from the 2014 IPCC 5 report) in order to provide additional background on the issue of food security (49, 50).

Additional details on the databases, search terms and parameters used to locate this literature can be found in the Appendix.

Chapter 2. The Policy Context of Gender and Climate Change

Gendered vulnerability and adaptive capacity to climate change is affected by the work of policymakers at all levels of government. Gender balance in access to policymaking spaces helps ensure that the needs and perspectives of women and men are adequately addressed in policymaking processes. Additionally, promoting the importance of gender mainstreaming in climate policies, practices, and research, including activities around climate finance, is important for ensuring that projects which seek to help women and men reduce their vulnerability and adapt to the impacts of climate change are carried out in a way that addresses the gendered experiences of women and men.

2.1 GENDER IN CLIMATE GOVERNANCE AND GENDER MAINSTREAMING

A key approach for improving the capacity of women to cope with climate change are the efforts of many GGCA members, and others, to push for increased female representation in environmental governance institutions, as well as for gendered language in national and international climate policies. Because of gendered social roles, women and men often have different perspectives and understandings, and both women's and men's knowledge are needed to address

issues related to climate change (51). However, women have been historically underrepresented in managerial roles in environmental policymaking. For instance:

- **In the European Union, women make up only 26% of individuals in high level government positions responsible for energy, transport, and environmental policymaking as of 2011** (52).
- **Only 12% of federal environment ministries globally are headed by women, as of 2015** (53).
- **At the World Energy Council, only 4% of chairs and 18% of secretaries are female** (53).
- **At the UNFCCC COP 20 meeting in 2014, 36% of government delegates were female** (44). While gender balance has yet to be achieved at COP meetings, this situation is an improvement from previous meetings, where women were less represented. While countries in the Global North tend to be closer to gender parity in their ministerial roles and delegations, there is wide variation among countries in the Global South, with countries from Latin America generally close to gender parity, while countries in the Middle East and North Africa are the furthest (54, 55).

Complementing the efforts to ensure gender parity in climate leadership roles, there are also growing efforts to mainstream gender into policies and practices in a variety of climate change-related sectors. While space limitations preclude an in-depth discussion of sector-specific mainstreaming practices, some examples include recently published gender mainstreaming policies or discussions of best practices in agriculture (55–57), forestry (59–61), fisheries (62–65), energy (66–69), water (70–72), health (73–75), and disaster management (76).

Ensuring that gendered language remains at the forefront of climate policy efforts is a continual struggle, however. In some cases, these efforts are succeeding, such as at the 2015 COP 21 meeting in Paris, which included language in the final agreement on ensuring climate policies are gender-responsive (77). In other cases, efforts are lagging behind. Recent evidence examining national reports to the Ramsar Convention on Wetlands indicates that mentions of gender-related terms have actually decreased since national reporting began in 1999 (78). Recent analyses from Uganda note that climate policies in that country are increasingly using gendered terminology, an important step forward, but that the language used is largely not gender-responsive. For example, Uganda's national climate change policy mentions that women are likely to experience particular challenges as a result of entrenched gender inequalities in Ugandan society, yet provides no actions or policies for addressing these problems (79, 80).

Gender mainstreaming practices should be incorporated into all types of climate change policies, projects, and research, although such changes can be challenging at first. Fortunately, a variety of resources for practitioners have been produced to help readers mainstream gender into their climate change-related activities. Box 1 contains a list of toolkits that can serve as resources in making this transition.

2.2 CLIMATE FINANCE

Another area of climate policy with gendered implications is climate finance projects (34). Climate financing is an important mechanism for funding projects designed to mitigate and adapt to the impacts of climate change in developing countries that are likely to experience some of the greatest impacts of climate change, but often lack the necessary resources to develop infrastructure and institutions to address its effects. Such projects include renewable energy development, habitat restoration, sustainable infrastructure development, and capacity building to develop climate-resilient livelihoods practices (81). In the past 25 years, several international mechanisms have been developed to finance these projects, including:

- **The Green Climate Fund (GCF)**, established by the UNFCCC in Cancun in 2010, with a goal of directing funding to adaptation and mitigation projects in developing countries, receiving \$10.3 billion in pledges to date (82).
- **The Climate Investment Funds (CIF)**, sponsored by the world's multilateral development banks, which consist of four separate funds totaling \$8.3 billion in pledges, with the bulk of pledges (\$5.6 billion) targeted at expanding the use of clean technologies, such as renewable energy or sustainable transport (83).
- **The Global Environment Facility (GEF)**, which works closely with United Nations-backed institutions and multilateral development banks to channel funding to environmental projects around the world, including projects focusing on climate change, and is poised to spend \$4.3 billion on an assortment of these projects between 2014 and 2018 (84).
- **The Clean Development Mechanism (CDM)**, which developed countries that are signatories to the Kyoto Protocol to finance the development of climate mitigation projects in developing countries (85).
- **The Adaptation Fund (AF)**, which was also established under the Kyoto Protocol to finance adaptation projects in developing countries, has committed over \$300 million towards such efforts to date (86).

At the same time, there is concern that climate finance

institutions fail to address the needs of both women and men in their funding decisions.¹ In particular, there are concerns that finance institutions are not doing enough to ensure that gender mainstreaming activities are incorporated in the projects that they fund (87, 88). In 2008, GEF outlined gender mainstreaming steps that its projects should take, which include (89):



- Conducting gender analysis and social assessment during project design
- Consulting with women as project stakeholders
- Including gender in the statement of the project's intended objective
- Developing project components with gender targets
- Collecting sex-disaggregated data
- Creating a budget item for gender-related activities

Within the past several years, however, most major climate financing mechanisms have adopted specific gender policies and action plans that are designed to change institutional norms towards gender, encouraging the adoption of some of the practices listed above. Specifically:

- **GCF adopted a Gender Policy and Gender Action Plan in 2015** (90). However, some have criticized the policy for allowing too much flexibility to individual governments, potentially undermining its effectiveness (91).
- **CIF underwent a Gender Review in 2012** (92), which was followed up with Gender Action Plans in 2014 (93) and 2016 (94) with concrete steps to further mainstream gender throughout CIF activities.
- **GEF enacted a gender mainstreaming policy in 2011** (95), as

¹ A more detailed discussion about the role of gender in climate finance institutions can be found in Chapter 6 of Roots for the Future (87).

well as a Gender Equality Action Plan in 2014, which provides additional guidance for implementing gender mainstreaming throughout GEF activities (96). GEF has undertaken reviews to ensure that its member entities are in compliance with the policy, with the bulk of the evidence suggesting that member entities are making progress in incorporating gender into project development (97).

- CDM projects in general do not have a strong focus on gender mainstreaming (87), although a 2010 review suggests that despite the lack of focus in many projects on designing and planning around gender concerns, many CDM projects are likely to impact issues that have gendered dimensions (98).
- AF has a Gender Policy and Gender Action Plan as of March 2016 (99).

The creation of these policies serves as an important step towards reforming climate finance processes with a goal of achieving stronger outcomes for women and men.

2.3 IMPACTS OF GENDER MAINSTREAMING

The efforts described above to create gender parity in policymaking activities, increase the use of gendered language in environmental treaties, and ensure that climate financing schemes include gender as a central focus seek to reduce gendered differences in vulnerability and adaptation capacity. However, there is an important missing link in this literature. There are currently very few academic articles or NGO reports detailing how these efforts resulted in impacts on women and men benefitting from climate policies and financing. Does increasing women's representation in governing bodies and increasing the use of gender mainstreaming practices lead to policies and programming that are more likely to produce, or which have produced more gender-responsive outcomes? Many in the advocacy community strongly believe that gender mainstreaming improves outcomes for women and men, yet there is a strong need to document whether and how this is true.

There are a handful of academic articles illustrating how increased representation of women in climate policymaking leads to improved environmental outcomes, which are likely to benefit women and men, providing some evidence for the importance of the role of gender in policy activities. As more women enter positions of authority that have been traditionally dominated by men, systematically different choices are often made. For instance, having more women in positions of political authority is associated with lower national carbon footprints (100, 101), or more protected land (102). Additionally, countries with a greater proportion of female parliamentarians are more likely to ratify

environmental treaties (103). When women represent a greater share of a corporate board, the firm is more likely to disclose information on carbon emissions (104).

The impacts of gender mainstreaming efforts to transform policies are now being documented, although the evidence base continues to be small.

- Early reviews of GEF projects indicate that gender mainstreaming activities did not occur in most projects (89). However, an IUCN analysis notes that after the adoption of the GEF's Gender Mainstreaming Policy in 2011, substantially more projects adopted gender mainstreaming practices (55).
- CIF has also recently documented similar results. For instance, up to June 2014, only 26% of CIF projects undertook gender analysis during project design, compared to 68% of projects approved in 2015, following the adoption of CIF's Gender Action Plan (94).
- In Cameroon, IUCN worked closely with government officials to develop a gender and REDD+ roadmap in order to ensure that gender considerations are addressed in REDD+ programming activities. In turn, these efforts have helped reform land tenure laws in order to make it easier for women to access land—an important asset for climate resilience (59).
- In contrast, despite a prevalence of policies and best practices around gender mainstreaming in the sustainable energy sector, a recent analysis of 192 renewable energy project proposals by the Wuppertal Institute for Climate, Environment and Energy suggests that relatively few proposals sought to incorporate aspects of gender mainstreaming into their project planning, indicating that more work needs to be done to encourage practitioners to address gender issues in project planning (105).



Chapter 3: Climate Change and Gendered Livelihoods Impacts and Adaptation Strategies

Climate change is affecting the ability of women and men around the world to earn a living, particularly in developing countries, and particularly among individuals who rely on the use and/or sale of natural resources as a primary livelihood strategy (106). This chapter discusses existing literature that provides examples of gendered vulnerability to the effects of climate change on livelihoods, as well as gendered

capacity to adapt to these impacts. As is true with other findings in this review, gendered climate change experiences in livelihoods vary within and between communities, with women experiencing greater vulnerability and/or difficulties adapting in some locations, and men in others. The following discussion centers on examples in several livelihoods areas—agriculture, forests, fisheries, water resources, energy, urban livelihoods, and migration.

3.1 LIVELIHOODS IMPACTS AND ADAPTATION STRATEGIES: AGRICULTURE

Agricultural vulnerability to climate change depends on cropping practices and access to land, as well as the use of farming inputs and tools. Individuals who have access to land, water, fertilizer, and other inputs, as well as who adopt sustainable agricultural practices are more likely to adapt to the impacts of climate change, yet access to and knowledge of these tools and practices is gendered. In many settings, women are less likely to possess the knowledge and financial capital needed to improve their farms (107, 108). Moreover, new technologies that are intended to improve adaptive capacity may not have gender-equalizing outcomes (109). This section addresses the relationships between gender, climate change, and agriculture, examining aspects of vulnerability and adaptation separately.

Cropping and Livestock Practices

Men and women often plant different types of crops and have different access to livestock. Depending on local contexts, this can make women or men more or less vulnerable to the effects of climate shocks. In general, planting a diversity of crops (both intraspecies and interspecies variation) is associated with resilience to climate change-related shocks (110). Some evidence suggests that men's crop production is more likely to be vulnerable to the effects of climate change. For example:

- In northern Ethiopia, households with a greater share of female members are more likely to plant a diversity of crop varieties (111).
- In Mexico, women who have access to irrigation plant a greater diversity of crops than comparable men (112).
- A nuanced case study from Ghana notes that men tend to grow crops to sell at markets, making their crops vulnerable to fluctuations in market prices, while some of the crops that women grow are more affected by precipitation fluctuations. However, women's and men's vulnerability to

the effects of climate change varies considerably between households, even within the same community (113).

In contrast, evidence from other settings suggests that some women may be especially vulnerable to climate shocks. For example:

- Evidence from Nepal notes that female-headed households grow fewer crop types than male-headed households (114, 115).
- In The Gambia, men tend to plant more species of crops and fruit trees, whereas women tend to focus primarily on rice production (although women often plant several varieties of rice, reducing susceptibility to diseases and pests) (116).

A key area of gendered climate adaptation research, particularly in Latin America, is the important role that women play as agents of agrobiodiversity conservation and household resilience through gardens or small household plots (117). As migration flows reduce male involvement in farming in many parts of rural Latin America, women are playing increasingly important roles in maintaining knowledge about different plant varieties, as well as deciding which crops to plant, as illustrated by case studies from Mexico (118, 119) and Bolivia (120). Given that women typically have dual roles as farmers and food preparers, women's selection of traditional crop varieties in this region is often influenced by cooking preferences (121, 122). There is also a growing body of research highlighting the unique role of women in maintaining crop diversity in countries such as Nepal (123), and Bangladesh (124, 125), often through saving and exchanging seeds and maintaining home gardens, serving as a source of household food security.

Research suggests that possession of livestock is also heavily gendered. Globally, women tend to be more likely to own small animals, such as chickens, whereas men are more likely to own larger animals, such as cows, as well as improved varieties of livestock, although women are often involved in animal care for large livestock (126, 127). Chickens can be kept at home and are often less expensive than larger livestock, making them advantageous for women who have to balance agricultural and domestic tasks and who often lack financial capital (128). These gendered livestock livelihood patterns are broadly confirmed by case studies from the developing world:

- In Nepal, women are more likely than men to participate in goat and poultry farming, often through community agricultural groups, but are less likely to farm more expensive livestock such as cattle or buffalo (129).



- In Benin, chicken production is predominately carried out by women and serves as an important source of household income (130).
- Among pastoralists in Kenya, while women have traditionally had less access to cattle than men, they have played important roles in producing and selling livestock products. However, changes in market conditions along with the effects of climate change are leading men to take over women's traditional role in livestock product production, harming women's livelihoods (131).

Cattle are particularly vulnerable to the effects of climate change, which may disproportionately affect the lives of men (132, 133). However, there is a tension between efforts to improve cattle production with the need to improve women's livelihoods. Conventional cattle production often requires capital and inputs that are increasingly scarce due to the effects of climate change, resources that could instead be used to provide other household members, including women, with greater livelihood opportunities (134). Livestock projects that require fewer inputs, as is generally the case with smaller animals such as pigs or chickens or locally-adapted breeds of cattle (135) may benefit women (134). Additional research is needed on livestock programs that seek to address the development needs of both women and men.

Gendered Access to Land

Male-dominated land tenure structures throughout much of the world often make it hard for women to own land—increasing women's vulnerability to climate shocks. As of 2010, only 15% of land in sub-Saharan Africa is managed by women (136). Rates are generally worse in Asia—only 13% of landholders in India are women, dropping to 11% in the Philippines and 9% in Indonesia (137). In Latin America, the situation is slightly better—more than 25% of land managers are women in some Latin American countries (136), although some studies note continued disparities in access to land in parts of the region (138). Other cross-national studies show

that women generally lack the ability to own or inherit land, particularly in sub-Saharan Africa (139, 140). Although the current evidence is limited, there are also growing concerns that large-scale deals for land, where tracts are purchased by investors, make women disproportionately vulnerable to the effects of climate change as they lack access to land and become more reliant on markets for food (141). A variety of research, conducted primarily in sub-Saharan Africa, notes the burdens that gender-biased land tenure regimes place on women in particular, making it more challenging to adapt women's agricultural practices to the effects of climate change. For example:

- In Tanzania, although the land tenure system legally facilitates access to land by women, in practice, men still make many of the decisions about land ownership, making it harder for women to expand or diversify their farming activities (142).
- In northern Mali, communication about land tenure laws is poor, and many marginalized women are unaware that they have equal access to land under the law. Despite persistent water scarcity throughout the region, many women have not sought to move from their current dry land to irrigated land due to exclusion by male farmers (143).
- In KwaZulu-Natal, South Africa women are less likely than men to own land, and among women, female spouses are less likely to own land than female household heads (144).
- In northern China, female-headed pastoral households tend to have less land and are consequently able to graze fewer livestock than male-headed households (145).
- In Mexico, the migration of men to the United States has spurred many women to transfer ownership of land to themselves from their husbands in order to protect land from expropriation. While this can reduce women's vulnerability to climate change by increasing tenure security, these transfers also cause intrahousehold conflict in cases where husbands return and become upset that titles have been transferred from their name (146).

- In contrast, research from Malawi notes that certain villages practice patrilineal land tenure, and others matrilineal. In both instances, researchers note that while members of the gender unable to inherit land can use family land for farming, this may be challenged in the future, given growing pressures on land in Malawi, disproportionately threatening men or women depending on local contexts (147).

Gendered Access to Resources

Cropping decisions are also impacted by the ability of women and men to secure access to capital and agricultural resources. Around the world, women tend to have less access than men to cash and credit (148). Women are also less likely to have access to tools, seeds, and fertilizer, as well as high quality water supplies, all of which increase women's vulnerability to the effects of climate change (107).

Surveys conducted in several African countries suggest that male-headed households have greater access to cash, which is necessary for agricultural input and household purchases in increasingly market-oriented economies in the continent (139). While evidence shows that male and female-headed households in this setting have similar access to credit (45, 139), research from Uganda notes that wives within male-headed households appear to have greater difficulty using credit (45). Women's access to credit is adversely affected by their ability to secure land tenure, which is often used as collateral (148, 149).

Lack of access to cash and credit is in turn reflected in gendered disparities in the ability to access tools, seeds, and fertilizer to help adapt to climate disruptions. For example:

- A cross-national study examining India, Ghana, Uganda, and Ecuador notes that women farmers are less likely than men to have access to small agricultural tools (140).
- Baseline data from a series of asset-building projects in sub-Saharan Africa and Asia suggest that while men tend to claim sole ownership of more agricultural assets than women, many household assets are jointly owned by women and men (150).
- In South Africa, female and male household heads own assets at similar rates, while women who are not household heads are substantially less likely to own assets than male or female heads (144).
- In Senegal and Benin, men largely control the use of household productive resources (such as donkey carts and labor). As a result, women's fields are planted last, such that their crops are often not harvested until well into the rainy season, when they are more susceptible to failure from dry spells (151, 152).

- In Ghana, women are less likely to have access to important resources, such as fertilizer or insecticides, to adapt to rainfall variability (153).
- In Kenya, female farmers are substantially more likely to manually till fields, rather than use animals or tractors (154).

Additionally, women tend to have less access to sufficient supplies of water for irrigation, increasing their vulnerability to shocks. For example:

- In Ghana and Zambia, female-headed households are more likely to use less efficient and more labor intensive methods for collecting water, such as buckets, whereas male-headed households are more likely to have access to more capital-intensive but efficient methods, such as electric pumps (155).

Myths vs. Facts

Myth: Men and boys will not be as affected by climate change as much as women and girls are.

Fact: As the evidence outlined indicates, males and females are affected by climate change in different ways, and the effects that each gender faces depend largely on local contexts. In some cases, males may be more vulnerable to harm from events related to climate change, as evidenced by higher rates of suicide among men (511), as well as higher fatalities from flooding (428). While some evidence suggests that men tend to have particular advantages in coping with climate shocks (107), much of the adaptation literature suggests that women and men are both able to adapt, but do so in different ways, such as men tending to migrate (373) while women often use home gardens/small-scale agriculture (120) or forest product collection (224).

- In Vietnam, female-headed households are disadvantaged in securing sufficient water for agricultural needs. Female-headed households report 20% lower rice yields compared to male-headed households due to limited water supplies (156).
- In Jordan, persistent water scarcity disproportionately affects women who maintain home gardens (157).
- In Turkey, greater water availability created by an irrigation system increased household dependence on irrigated monocrops for income (controlled by men), which in turn shifted intrahousehold power over

household decisions to men (158). However, these changes not only reduced crop diversity, but also reduced the diversity of other livelihood activities, as women were spending more time in the fields, and were less engaged with traditional livelihood activities such as animal husbandry (159).

Gendered Access to Information

Finally, there is some evidence that information on climate adaptation strategies is not well-distributed to farmers, especially women, in turn hampering adaptation efforts. Globally, agricultural extension programs often fail to target women farmers and lack female professional staff (160). Recent research suggests that women are more likely to take adaptation steps to climate change when provided information by female extension officers (161). Various studies from the developing world suggest that poor access to information on climate-smart agriculture (CSA) practices tends to make women disproportionately vulnerable to the impacts of climate change². For example:

- In Senegal and Uganda, men are generally more knowledgeable than women about CSA practices, though this finding was not replicated in Kenya (where men and women had similar knowledge overall, with men more likely to know about certain practices and women others) (163, 164).
- Men in Senegal and Uganda tend to have access to better weather information than women that can be used to modify production practices (163).
- In Gujarat, India, agricultural extension systems designed to provide information about adaptation strategies are heavily gendered, and such systems often fail to adequately target women and provide them with appropriate information (165).
- In Nepal, NGOs often target information on adapting agricultural activities to climate change to men, reflecting established gender roles (166). In addition, gendered social norms in Nepal often inhibit women from contributing to community discussions on climate adaptation, making it less likely that women's needs will be met in adaptation planning, and in turn, making women more vulnerable to the effects of climate change (167).

Gendered Changes in Farming Practices & Inputs

One key strategy for adapting to the effects of climate change is to change farming practices and/or the inputs used. A

² CSA practices include use of improved crop varieties, crop mulching, crop rotation, cover cropping, and water harvesting (162).

wide body of research examines the effects of this strategy, particularly in sub-Saharan Africa, and impacts appear to depend heavily on local contexts. In general, women appear to be less likely to change crop varieties grown or inputs used in order to adapt to climate change. Because women and men have unequal access to farming knowledge and assets, the ability to adapt farming activities is highly gendered.

Various studies examine gendered crop and livestock adaptation choices in response to climate change. For example:

- In Uganda, female-headed households and wives of male farmers are significantly less likely to adopt drought-tolerant maize than male farmers, which researchers attribute in part to lack of access to resources as well as less knowledge about drought-tolerant crops among women (45).
- In Ethiopia, male-headed households are significantly more likely than female-headed households to adopt new crop varieties in response to weather changes, though the reasons why in this context are unclear (168, 169).
- In Mali, women are increasingly responsible for herding small livestock, traditionally men's responsibility, as men migrate to seek work elsewhere (170).
- Research examining seven countries in South America finds that women farm heads are no more likely than men to change their crop mixture to adapt to climate change (171), but are more likely to adopt beef and dairy cattle, as well as sheep (172).

Other studies examine gendered farming practices and input choices in response to climate change. For example:

- In Ethiopia, male-headed households are significantly more likely to conserve soils, and plant trees in response to weather changes (168, 169).
- Male farmers in Ethiopia and Cameroon are more likely than women to use fertilizer to adapt to rainfall variability as women often lack sufficient capital (173, 174).
- In Kenya, women are more likely to intercrop or rotate crops, whereas men are more likely to use manure and practice minimum tillage (175).
- Other research from Kenya suggests women farmers who are aware of CSA practices are more likely to adopt them than men, though this was less true when comparable questions were asked to farmers in Uganda and Senegal (163).
- In South Africa, female-headed households are more likely to take agricultural adaptation measures such as water conservation or planting different crop varieties (176).
- In Anhui and Jiangsu, China, information on adaptation options is poorly distributed to farmers of both genders, which is cited as a likely reason that male farmers in these

regions are no more likely to take farm adaptation measures than female farmers (177).

- Recent evidence from Tanzania also highlights the particular vulnerabilities that women who are divorced or widowed face. Such women are less likely to access better farmlands or irrigate their crops than male-headed households, making them more susceptible to climate change-related impacts (178).
- In contrast to the above, three studies from Kenya suggest that male-headed households are no more likely than female-headed households to take certain farm adaptation steps, such as changing farm inputs or cover cropping, though researchers are largely unsure as to why minimal gender differences were found in this setting (164, 179, 180).

There is some evidence to suggest that because of women's important role in planting crops in many places around the world, the amount of time women spend planting is likely to grow due to crop losses related to climate change. For example:

- In Nepal, men, who largely have control over cropping choices, are choosing to plant more buckwheat in response to climate disruptions, yet because of the labor-intensive nature of the crop and gendered expectations about women's roles, women are performing much more work than men in order to produce it, reducing time available for other livelihood activities (181).
- In Vietnam, climate change is reducing crop yields, increasing women's workload as they replant rice crops more often to replace lost production (182).
- In Tanzania, women report that they are replanting certain crops that they are responsible for (such as groundnuts) more often because of changes in weather patterns that are destroying seeds (183).
- In Iran, pressures related to drought are increasing women's farm responsibilities, even in relatively well-off households (184).
- In contrast, in the Philippines, the farm roles of female household heads are changing as farms struggle to adapt to floods. Women's farming experience and relatively greater education levels compared to men in this setting are enabling them to take on greater managerial responsibilities, challenging traditional gender roles (185).

Gendered Patterns of Off-Farm Labor & Livelihood Diversification

Women and men may also adapt to climate change by working off the farm, either in jobs that require permanent migration (discussed in Section 3.7 below), or as day laborers. Evidence from Uganda (186), Tanzania (178, 187), and Kenya

(187) suggests that women may be less flexible than men in their ability to work off-farm in response to crop losses due to drought. This is largely due to women's often considerable household and reproductive responsibilities, as well as limitations in jobs that are available for women outside of the home (186). Two studies from Malawi present mixed evidence on off-farm work as a climate adaptation strategy for women. One study finds that in part because of traditional gender divisions in labor, there are more opportunities for men to work off the farm as a response to climate stress (188). However, other evidence suggests that female-headed households are more likely to engage in off-farm work, due to the fact that female-headed households are poorer, and thus have less capital to invest in their own farms (189).

Other examples of gendered livelihood diversification patterns in response to climate change, including engagement in off-farm work, include:

- In response to a 2002 drought in Mozambique, women were more likely than men to engage in livelihood diversification activities that were less profitable but allowed them to spend most of their time at home, such as selling vegetables locally (190).
- In Malawi women have relatively few adaptation options available to them in part because of the large time constraints associated with farmwork. Research suggests that women are half as likely as men to use charcoal production as an adaptation strategy, though slightly more likely to start a small business in response to climate shocks (191).
- Female farmers in Tanzania are less likely to work off farm in response to climate shocks than males, which researchers attribute to women's reproductive responsibilities and lower levels of education relative to men (178).
- In contrast, a case study from Namibia suggests that women tend to diversify how they earn income more quickly than men do in response to poor crop yields (192).

Off-farm work also plays a crucial role in gendered adaptation strategies in the Global North, as women seek employment in order to supplement family incomes and maintain farming activities, a practice documented in Australia (193) and Canada (194). This work is upending traditional gender roles in some farming households, although research suggests that many male farmers are resistant to these changes, creating tension in marital relationships (195).

Other research cites the importance of social networks in shaping gendered adaptation to climate change.

In parts of rural Mexico, social networks, particularly among women, rely on the reciprocal exchange of fruit and vegetable products. As climate variability and water scarcity adversely impact crop yields, the safety nets that women have developed with one another to assist in times of scarcity are fraying, weakening the ability of women to share tasks or engage in community development (196). Moreover, by affecting production of food used as gifts, these shocks disrupt transboundary ties that women have with family and friends in the United States (197). Additionally, case study evidence from Nicaragua notes that men are more likely to be involved in community organizations and have stronger social ties than women, which they rely upon following drought events (198).

Farm adaptation is also shaped by migration and remittance patterns. In general, males are more likely to migrate, resulting in a transfer of remittances from men in cities to women on farms. Research from Africa (199–201), Asia (166, 202, 203), and Latin America (166, 204, 205) notes the importance of remittances from migrants in allowing households facing climate change to diversify their livelihood activities, improve farm production, and reduce women’s workloads on the farm by providing much-needed capital. However, as discussed further in Section 3.7, long-term migration may adversely affect women’s quality of life and workload on the farm, depending on the local context.

3.2 LIVELIHOODS IMPACTS AND ADAPTATION STRATEGIES: FORESTS

Forest ecosystems serve as a key livelihood source for women and men around the world, through the harvesting of timber and non-timber forest products, as well as through the role that forests play in regulating climate and cycling nutrients (204). Throughout the developing world, men tend to be more involved in forest governance, influencing the relative vulnerability of women and men to climate shocks. Women and men also rely on forests in different ways, which shapes their adaptation responses to climate change. Efforts to mitigate the effects of climate change and improve forest livelihoods, most notably a carbon credit scheme known as Reducing Emissions for Deforestation and Forest Degradation (REDD+), are largely failing to incorporate women as full partners in forest management.

Gender and Forest Governance

Forestry is critiqued as a sector that is heavily male-dominated around the world, and this has historically resulted in the exclusion of women from forest governance, limiting their influence over forest rule-making, monitoring, access to forest resources, and ultimately their ability to use forests

to adapt to climate change (207). A recent review of gender and forests literature from the Amazon suggests that women are systematically underrepresented in forest management activities in that region, despite the important role that women play in advocacy and NGO activities that aim to democratize forest governance and resource access (208). Evidence from Africa (209) and Asia (210, 211) also notes that women tend to be underrepresented in forest management groups.

Evidence from India (212, 213) and Nepal (213) illustrates that women’s involvement forest conservation results in improved forest health, though a recent review notes that research on these effects outside of South Asia is scant (214). One example outside South Asia is a case study from Senegal, which notes that it is often women who initiate local community reforestation activities in that setting (48). Cross-national evidence from Bolivia, Kenya, Mexico, and Uganda suggests that women’s involvement in forest conservation also results in reduced conflict between forest users (215).

Gender and Forest Use as a Climate Change Adaptation Strategy

Many individuals rely on forests as important resources for coping with and adapting to climate change, although current studies do not show significant gender gaps in overall forest use in response to climate change-related shocks. A major cross-national study examining forest use in response to household shocks such as crop failure or illness finds that female-headed households are no more likely to use forest resources than male-headed households (216). National-level studies from sub-Saharan Africa appear to support this conclusion. In Zambia, male-headed households are no more likely than female-headed households to use forests in response to crop failure (217). In Malawi, female-headed households are no more likely than male-headed households to rely on forests for sustenance in response to climate events (218). As researchers note in the context of Mali, gendered differences in forest use as a result of shocks result in part from gendered time demands associated with domestic tasks that restrict the ability of women to access more distant markets for certain forest products (170).

A related literature explores the specific role that non-timber forest products (NTFPs), such as fruits, medicinal plants, and animals, play in gendered adaptation to climate change.³ Around the world, women are frequently involved in the collection and trade of NTFPs, often as a coping strategy or safety net when other household income generation activities are unavailable, including as a result of climate shocks (220). However, the ability of women and

³For greater nuance on how NTFPs are defined, see (219).

men to use NTFPs as a coping strategy varies by context.

- Extensive research on the role of NTFPs has been conducted in South Africa, with the available evidence suggesting that NTFP collection plays a critical safety net role for marginalized populations after climate shocks, particularly women (221). Female-headed households in South Africa are slightly more likely than male-headed households (not statistically significant) to use NTFP collection as a coping strategy in response to shocks (222).
- In Zimbabwe, NTFP collection by women serves as an important source of fuel, food, and income in response to crop loss driven by climate change (223).
- In Mozambique, a case study notes that women respond to crop loss by harvesting fruit in forests (224).
- In Tanzania, an increasing number of men are collecting NTFPs such as firewood and wild mushrooms due to climate-induced stresses in men’s traditional livelihood activities (225).
- In northern India, climate-induced scarcity of forest resources is leading women to spend more time collecting NTFPs, reducing the time they have available for other livelihood activities and making NTFP collection a less viable strategy for coping with climate change (226).
- In Nepal, the collection of NTFPs, such as grasses and medicinal plants, is being hampered by the effects of climate change, reducing the income that women receive from the sale of these products (227, 228).

Gender and REDD+

One policy approach for managing forests in response to climate change is a program that ties together forest conservation and carbon offset credits, REDD+. In exchange for a promise to manage forests sustainably to preserve carbon stored in trees, community and individual forest owners can receive cash payments (229).

The limited evidence that exists thus far suggests that REDD+ programs often fail to rigorously address issues of gender in their programming, sometimes incorporating gender in planning documents, but typically failing to reach out to women and provide them with sufficient information about the program (230), or involve them in decision-making (229, 231, 232). For instance, in a Nepal REDD+ program, despite comprising half of the population, women made up only 15% of those in REDD+-related leadership roles (233). In 2013 and 2014, WOCAN conducted gender and REDD+ scoping studies in Cambodia (234), the Philippines (235), and Sri Lanka (236), finding that in each location,

women faced numerous barriers to participation in REDD+, including lack of access to non-forest livelihood activities, limited and overly technical information provided to women about REDD+, and a failure to integrate gender into REDD+ policymaking activities. Some gender advocates are making efforts to improve REDD+ policies, such as IUCN’s work to develop gender and REDD+ roadmaps (59). However, given that scholars have identified a broad array of gender-related problems with REDD+ projects, it is imperative that stronger policies are developed to effectively incorporate the voices and needs of both women and men into REDD+ planning and management.

3.3 LIVELIHOODS IMPACTS AND ADAPTATION STRATEGIES: FISHERIES



Climate change is also affecting fisheries and aquaculture, directly, through mechanisms such as changes in fish population distributions, which is resulting in fewer fish available to catch in some settings (237–238), and indirectly, as households adjust fishing activity based on the attractiveness of other livelihood activities, such as farming, which is also impacted by climate shocks (239). Climate change is one of many stressors on fisheries globally, which include other pressures such as overfishing (often by large international fleets), invasive species, and pollution (240). Women are a critical component of fisheries around the world. Although gender roles in the fisheries sector vary, around the world, men tend to serve as fishermen, while women are often responsible for fish processing and trading, generally a less financially lucrative activity (241, 242).⁴ However, in some contexts, particularly in gleaning (shore-based) fisheries

⁴An interesting exception comes from Zanzibar, where women are entering the fish trading profession, which is traditionally male-dominated in this setting, due to a lack of other available livelihood opportunities (243).

and aquaculture activities, women also play critical roles in collecting fish (244, 245).

Gendered Fishery Practices

Gendered fisheries practices differ around the world, and may involve restrictions on access to fishing grounds, unequal control over fisheries governance, or unequal access to resources needed to engage in fishing, barriers which can result in fewer benefits from fisheries accruing to women, particularly in the context of climate change where fish populations are becoming more scarce (246, 247).

Women's high levels of participation in aquaculture and gleaning fisheries is attributed in part to the relatively low capital and skill requirements of these activities, enabling women to enter these fields even in settings where they lack equal access to human and financial capital (246). Additionally, women engage in these activities closer to home than non-gleaning fishing (on boats), which allows women to take part in fishing while also managing domestic responsibilities and other livelihood activities (245, 246). In contrast, where men are culturally expected to fish, women may only engage in boat-based fishing when household food security requires their assistance, as is true in Tonga (248). Examples from Nicaragua and Tanzania (249), Spain (250), and Uruguay (251) illustrate the importance of gleaning fisheries to women's income and household food security. However, while these fisheries are a valuable livelihood activity for many women, they are also especially vulnerable to the effects of climate change. In particular, ocean acidification is harming many shellfish species, with profound economic costs for producers, who are often female (252).

Women are generally underrepresented on fisheries management committees, a phenomenon documented particularly in sub-Saharan Africa. The lack of women in fisheries governance makes it difficult to ensure women have equal access to fisheries and that the impacts of fishing activities promote the health and welfare of all community members (253). Along Lake Victoria, where catches of several important fish species have declined in recent years (254), in part as a result of climate change (255), highly gendered labor and power distributions largely keep control of the fishery in the hands of men, even though women's roles in fish trading and processing are affected by fishery conditions (256). Despite quotas for women in local fisheries management committees, women tend to be underrepresented in the most important leadership roles, and are less likely than men to participate in fisheries management activities (257). Gender differentials in power and privilege in this fishery have resulted in malnutrition among women and children (258).

In Malawi, women are also underrepresented on fisheries management committees, and must manage their fishing activities with the support of males, effectively limiting their benefits from fishing (259). In Mozambique and Tanzania, climate change has reduced fish populations, while fisheries managers have simultaneously restricted access to fishing grounds to reduce overfishing, which has disproportionately burdened women who face significant social and financial constraints in adapting their livelihood strategies away from fisheries activities (260).

Gendered Adaptation Measures to Climate Change in Fisheries

Community adaptation measures designed to protect fish stocks, such as quotas or fishery closures, may disproportionately impact women or men if they are not designed in a gender-sensitive manner, particularly with services to support fishermen and their families coping with economic distress and to promote alternative livelihood strategies for household members most reliant on fishing (260, 261). Instituting fishery co-management programs, where a fishery is managed collaboratively between resource users and other parties, may change established decision-making practices in such a way that empowers women, increasing their participation in governance while also improving conservation outcomes (250, 251). However, such measures must be carefully designed to assess the barriers that women face in participating in governance activities, in order to ensure that women are genuinely able to participate in these processes and are not simply participants in order to meet membership quotas (262).

Among households, some evidence suggests that males are more reluctant to leave fishing than women. The income earned by women engaging in other livelihood activities may subsidize the continued fishing efforts of their husbands as fisheries decline (263), though this varies depending on local contexts. Evidence from Peru suggests that males involved in fishing often have trouble shifting to new livelihood tasks, particularly when there is a dearth of unskilled employment opportunities in a community, placing the burden of supporting local households on women (264). In contrast, in Peninsular Malaysia, fishing has become prohibitively expensive due to reduced fish populations, leading the husband-wife teams which previously engaged in fishing to drop out of the industry. In this setting, women are retreating to domestic duties, whereas men struggle to transition to new work (265).

One climate adaptation strategy that women in fish trading are adopting is exchanging sex with male fishermen for preferential access to fish supplies. Although the

phenomenon is most associated with African fisheries, it exists in many fishery economies around the world in various forms (266). Due to increasingly intense competition within the processing and retail segments of the fishing industry, as well as declining fish populations and increased fishing effort (267, 268), forming relationships and providing sexual favors to fishermen is viewed by many women as essential for success (269, 270). The fish-for-sex trade, particularly around Lake Victoria (271, 272) and Lake Malawi (273–275), is linked to the spread of HIV, primarily among females. As the fishing economy around these lakes involves seasonal migration (272, 276), women often have multiple partners throughout the year, increasing their risk of infection (270, 277).

3.4 LIVELIHOODS IMPACTS AND ADAPTATION STRATEGIES: WATER RESOURCES MANAGEMENT

Climate change is reducing the quantity and quality of safe water available around the world, forcing primarily women and girls to walk longer distances to access water, and in turn limiting the time available for other activities, including education and income generation (106). The following discussion examines the gendered vulnerabilities of water scarcity, how women and men adapt to water scarcity, as well as the gendered impacts of projects designed to reduce water scarcity.⁵

Gendered Water Collection and Governance Practices

In 7 out of 10 developing countries, women or girls are primarily responsible for collecting water (278). Survey evidence suggests that this is particularly true in sub-Saharan Africa and Asia, whereas water collection responsibilities tend to be borne in a more gender-equitable manner in Latin America (279).⁶ Moreover, access to improved sources of water at home is often limited or nonexistent for families throughout the developing world, particularly in sub-Saharan Africa (279).

Water rights are often linked to land rights, which as noted above, generally favor males over females in many developing countries, resulting in men being more formally involved in water management regimes (281–283). When women are involved in water governance, outcomes typically improve for both women and men (284). However, gendered power relations often prevent women from taking part in water management activities. For example, in rural Kenya, researchers note that governance arrangements exist which effectively exclude women from community water management groups, in part because women typically do not own land, and as a consequence decisions about water management (which almost always affect nearby properties) are routed through men (285, 286). Despite this, women

continue to be involved in water management informally, raising funds and enforcing rules around local water systems (285). Cases from India (287–289) and Bangladesh (290, 291) present other examples of women's marginalization in water management activities, often as a result of strong gender norms in South Asia that limit women's ability to participate in water management institutions and influence decision-making.⁷

Gendered Adaptation to Water Scarcity

Evidence from rural areas in the developing world suggests that because women and girls are generally tasked with collecting water, they are also typically burdened by the effects of water scarcity.

- In rural Mali, water scarcity is a growing problem, especially for women who are predominately responsible for collecting water. Recent research notes that the cost of water during the dry season in rural areas is 20-40 times more expensive than water in Mali's major cities, leading to intrahousehold rationing of water supplies (293).
- Survey evidence from rural Ethiopia finds that in a 30 day period, more than 40% of women did not collect water due to long lines and/or insufficient supplies, and 18% kept a daughter home from school in order to help collect water (294).
- In rural South Africa, women report walking increasing distances to collect water, as much as 15 km in some cases (295).
- Evidence from India echoes many of the challenges faced in Africa, with climate-induced water scarcity increasing the burdens that women and girls face, and that these burdens are felt among women of different ethnic groups (226).
- In Bangladesh, water scarcity results not only from the effects of climate change, but also from widespread arsenic contamination of wells, effects that can lead to unexpected empowering effects for women. As a result of water scarcity, some women lobby their husbands for personal tubewells, noting the stigma in Bangladesh associated with women venturing too far

⁵ Given the limited material available on gender, water governance, and the Global North, that region is not covered here.

⁶ Although see (280) for an interesting exception regarding Mongolia, where water collection is done largely by men.

⁷ Although this section only provides a summary of published literature, readers with further interests in gender, water, and linkages to climate change in South Asia are encouraged to consult an extensive series of case studies in (292).

from homesteads to collect water, whereas other women appreciate the fact that water scarcity provides them with freedom to spend additional time away from the family homestead, which they find confining (296).

In urban areas, women also tend to be disproportionately burdened by water scarcity. Research from one of Nairobi's largest slums, Kibera, where water scarcity has led to rationing of water and high costs, details the gendered challenges in securing access to water supplies. Women in Kibera often purchase water from vendors, which can consume up to 1/3 of a household's monthly income, and takes at least one hour to collect per day (and much more time when supplies are scarce) (297, 298). Many women report that because of high financial and time costs, they reduce their income-earning activities and change how they use limited water supplies, restricting use to drinking and occasional bathing (297), problems also documented elsewhere in Kenya (256). In urban India, researchers note that women face similar pressures as a result of scarcity, and many women report keeping daughters out of school in order to serve as lookouts for infrequent water tanker trucks (299). Similar problems are also noted in research from water-scarce Cochabamba, Bolivia, where women are substantially more likely than men to spend time searching for available water vendors (300).

A unifying element found in research from all three developing regions is that as water supplies become more scarce, gender roles change. In particular, in places where women are traditionally responsible for collecting water, men spend more time collecting water during periods of scarcity in order to ensure that the household secures sufficient supplies (295, 301, 302). Similarly, some evidence suggests that as supplies become scarcer, women's involvement in water management activities increases (302).

Effects of Water Scarcity Reduction Projects

Considerable research from the developing world (largely from South Asia) details how irrigation and household water supply projects intended to reduce water scarcity can result in gendered outcomes.

- A project to increase water supplies in Bangladesh through new wells resulted in males having access to water year-round (as they used motorized pumps for irrigation), whereas women continued to use handpumps for domestic activities, which did not function during periods of low water availability, effectively increasing the distance that women had to travel to access water (303).
- Research from India notes the heterogeneous effects a water supply project had on women. Upper class women

experienced greater ease of access and time savings, while poorer women were more burdened by the new system (304).

- Conversely, a project in Kenya providing piped household water supplies reduced the time women spent collecting water (up to 50% decrease), while men spent more time on income-generating activities facilitated by added supplies, as well as on system maintenance (305).
- Evidence from Pakistan suggests that improved water infrastructure reduces the time women spend collecting water (306).

Projects designed to reduce water scarcity that challenge gendered norms in water governance by involving women in management activities can reduce women's time spent collecting water, while also ensuring that water is distributed fairly to women and men, as illustrated by a case study from Sri Lanka (307). In northeast Brazil, water scarcity serves as



an opportunity for some women, where a program designed to reduce water scarcity through the construction of cisterns is carried out largely by women, helping to improve their social status and incomes, as well as shift attitudes regarding acceptable roles for women in resource management (308, 309).

3.5 LIVELIHOODS IMPACTS AND ADAPTATION STRATEGIES: ENERGY

The global transition of energy systems to more sustainable forms of production as a means of mitigating the effects of climate change has gendered implications. Several reviews document that energy access projects have differential impacts on women and men (310–312). While the literature on sustainable energy development and climate change is

growing rapidly, including in terms of women's participation in renewable energy fields and the relationship between women and technology, it cannot be treated in detail here. The discussion below centers on two specific energy topics that directly affect gendered vulnerability to and adaptive capacity associated with climate change: electricity access and liquid biofuels development.

Electricity

Women and men face gendered barriers to electricity access, particularly in developing countries. World Bank survey data of 22 developing countries suggest that female-headed households are more likely to have access to electricity in 14 of these countries, though the gaps between male- and female-headed households are relatively small (<5%) in most countries (313). Other gendered barriers include challenges in securing electricity connections. For instance, data from five countries in sub-Saharan Africa suggests that female-owned businesses are more likely than male-owned businesses to pay bribes and experience delays in securing electricity connections (314).

Women's access to electricity is enhanced when electrification projects incorporate gender mainstreaming principles into their functioning. Gender mainstreaming in electrification involves examining health and livelihood impacts related to construction, hiring practices, decision-making and energy needs (315). For instance, an electrification project in Laos that adopted gender mainstreaming practices increased the number of female-headed households electrified by 43%, nearly twice the rate of increase as compared to other households (316). Other examples of successful gender mainstreaming in electrification include projects in the Philippines (317), Botswana (318) and Uganda (319).

Although a detailed examination is beyond the scope of this paper, there is a wide literature that addresses the effects of electricity on women's access to education, employment, and time poverty, with electricity access generally associated with improvements in women's quality of life (320). Case studies note that electricity access enables women to complete more household tasks and enjoy leisure time (321–323). Additionally, electricity access allows women to adopt new livelihood activities, such as agricultural processing, sewing, or managing cell phone charging stations, diversifying household income generation and in turn reducing vulnerability to the effects of climate change on farming income (321–323).

Liquid Biofuels

Liquid biofuels are touted as a key strategy for addressing

climate change and development challenges by providing a sustainable source of fuel and income for farmers in developing countries (324). However, critics of this development worry that these activities have the potential to harm women, and reviews of biofuels literature note several areas of concern, including land rights, food security, and health impacts (325, 326). These effects are mediated by the type of biofuels strategy undertaken (plantation vs. smallholder development) (327). Several discussion papers outline these gendered effects in greater detail and propose strategies for ameliorating the adverse gendered impacts of biofuels production (324, 327, 328).

Biofuels projects often use marginal lands, which may be less suitable for food crop farming. These lands are generally allocated to women, and converting production of these lands to energy crops may reduce the ability of women to meet household food needs as well as make decisions about land use (329). Because women's access to land in many contexts is precarious, some advocates worry that rising demand from biofuels projects may push women onto more marginal lands or deprive them of land access altogether (330). Various case studies note that biofuels development projects have reduced the control that women have over land rights. For instance, in Mindanao, the Philippines, the use of collective land titles for biofuel plantations effectively undermines women's participation in biofuels activities, as women are poorly represented in biofuels cooperatives that manage the land (331). In Brazil, fears about the effects associated with biofuels development, namely growth of land tenure conflicts, have prompted many women with existing livelihoods strategies that rely on small-scale palm seed and oil harvesting to advocate against the expansion of biofuels activities (332).

In Indonesia, an extensive case study on gender and biofuel development notes that although many women had customary land tenure prior to the development of biofuels plantations, households are required to register land under a household head (culturally regarded as the male head of household) in order to join biofuels schemes. As owners, men in turn may control the income earned from biofuels production.⁸ Moreover, transferring land titles to husbands also results in women losing access to credit, as they no longer have collateral in their name (334). Because customary land rights are often lost when biofuels concessions are granted in Indonesia, individuals who rely on land backed by customary

⁸ Although recent research from Indonesia suggests that this may vary by location, and in some places, women serve as treasurers of household income on smallholder plantations, with responsibility for many spending decisions (333).

rights for food and forest product collection, generally women, lose access to these resources (333, 334).

The development of biofuels may also affect household food security. The International Food Policy Research Institute estimates that demand for biofuels contributed to 30% of the rise in food prices between 2000 and 2007, making food less affordable (335). Case studies suggest that women often struggle to ensure household food security as biofuels projects develop. In Papua New Guinea, men tend to control income earned from biofuels activities. However, a shift to biofuels production is reducing the amount of land available for women to cultivate home gardens, effectively reducing their income and household access to food (336). In Mozambique, women who work on *jatropha* plantations continue to be responsible for household farming duties, though the time available to spend on these tasks is reduced due to the demands of biofuel production tasks. This creates a tradeoff, as households produce less food, but earn more income that can be used to purchase food (337, 338). Simulation models examining the effect of women's participation in biofuels production in Mozambique suggest that increased participation of women in biofuels activities is likely to improve women's incomes, but at the expense of some increase in food prices due to higher labor costs for individuals working in food crop agriculture (339).

Additionally, some evidence shows that biofuels production presents a health risk for workers, particularly women. Research on biofuel plantations notes that women are typically asked to apply pesticides or conduct other dangerous tasks, as this work is often considered "easier" for women, despite the harmful health effects of pesticide exposure, including adverse pregnancy outcomes (333, 334, 340). Women typically lack adequate training to apply these chemicals safely, and are also generally not provided with proper safety equipment (334, 340). Moreover, monitoring of pesticide exposure and access to medical care is typically not provided for plantation workers (341).

However, biofuels development may create particular benefits for women. A survey of small-scale biofuels projects from Africa and Asia suggests that when developed in a participatory fashion, such projects have the potential to greatly improve women's lives. Researchers note that women are often more interested than men in developing biofuels industries, because biofuels can serve as an important income diversification strategy, particularly for smallholders, as well as an energy source to reduce the burdens of manual labor (342).

3.6 LIVELIHOODS IMPACTS AND ADAPTATION STRATEGIES: URBAN LIVELIHOODS

Although the research base is smaller, there is a growing body of work exploring the linkages between gender, climate change, and cities. This literature largely centers on the role of gender in affecting disaster-related impacts and recovery strategies, as well as urban agricultural practices often adopted in response to household food insecurity.

Disaster Recovery and Livelihoods

There is a growing body of research illustrating the adverse impacts of storms and related flooding on women living in urban settings in both developing and developed countries.

- In the Philippines, post-typhoon vulnerability assessments found that female-headed households were more likely to be vulnerable to flooding and other storm-related impacts (343). After Typhoon Ondoy struck Manila, female-headed households experienced greater damage costs, while male-headed households experienced greater temporary loss of income, likely due to a reliance on manufacturing employment among men, which took longer to resume after the floods (344).
- In Gorakhpur, India, men often work as wage laborers (in occupations such as pulling rickshaws or construction), and report being unable to work due to extreme weather, reducing household incomes. In contrast, women report that they work more during disasters, taking care of family members and looking after possessions. Women also report taking out loans in order to cope with the effects of lost income due to climate change-related events, which they bear the brunt of repaying (345).
- In Lagos, Nigeria, research suggests that women have been disproportionately impacted by flooding. In 2011, heavy flooding after a major storm destroyed the informal businesses that many women relied upon, whereas many husbands had migrated for work and were not directly affected (346). Many women lost assets and struggled to rebuild. In part because of prejudices against women who live in low-lying and poor communities in the city, women in these areas often lack the social capital to diversify their livelihood strategies to more effectively respond to floods (347).

Evidence from developed countries also illustrates the gendered livelihood impacts of storms in urban areas, much of which has focused on the impacts of Hurricane Katrina in the United States. During Hurricane Katrina, many low income women were hampered in evacuating due to lack of access to adequate transport (348). Women also faced additional burdens because they are typically regarded as primary caregivers for children and elderly parents, and these responsibilities became more challenging to manage in

the face of addressing other aspects of rebuilding after the storm, particularly as many childcare facilities were no longer available (348, 349). There is also some evidence that after Katrina, girls were more likely than boys to adopt caregiving roles within families (350).

Women's caregiving roles also created work-related challenges after Katrina. Partly as a result of these responsibilities, women were more likely than men to drop out of the labor force after the storm (348). After Hurricane Katrina, women were substantially less likely than men to maintain their pre-hurricane employment (or a job of similar status) (351). Moreover, women in New Orleans experienced an average loss of earnings of 7% in the year after the storm (14% loss for African American women), while males experienced a 23% gain, thanks largely to the importance of (male-dominated) construction and sales fields in the labor market following the storm (348). In addition, as disasters like Katrina often result in population shifts, many women in care-related professional roles, such as childcare or eldercare were adversely affected after the storm as many of their clients were displaced (31). Women who lacked partners were at a particular disadvantage, as they were responsible for securing childcare and employment, which was extremely difficult given the resources available after Katrina (352).

Urban Agriculture

An increasingly researched resilience mechanism for coping with climate change in urban areas is the development of urban farming and gardens to provide secure food supplies (353, 354). In urban areas around the world, between 10% and 70% of households earn income from agricultural activities, though often in small amounts (355). In general, women are more likely to participate in urban agriculture when they are expected to provide for household food security and when they possess lower levels of education (and thus have fewer job opportunities). In contrast, when gendered barriers to accessing agricultural resources exist, such as gendered land tenure regimes or differences in access to capital, men are more likely to participate (356). Around the world, poorer households are more likely than wealthier households to engage in urban agriculture (355), although in some instances, lack of access to land titles may make urban agriculture inaccessible for the poorest households (357).

Scholars note that a wide variety of urban farming activities take place, with women's involvement typically centering on ensuring household food security. Wealthier households, typically led by men, tend to have more land and resources, and as a result, men involved in urban farming often have more diversified farming operations, which serve as a stand-

alone business or as a complement other household livelihood activities (358, 359). In contrast, poorer households, often led by females, tend to rely on urban agriculture as a household survival strategy (358, 360, 361). For instance, in urban Malawi, agriculture is a primary livelihood activity for 55% of female-headed households, compared to only 4% of male-headed households, most of which rely on informal employment in other industries that women have less access to. As a consequence, female-headed households earn more income from urban agriculture in Malawi than male-headed households (358).

Gender roles and responsibilities in urban agriculture also differ depending on the local context of production. Sometimes, women conduct agricultural activities by themselves, while in other cases, their partners are heavily involved, in which case a gendered division of labor develops. For instance, in urban Senegal, Sierra Leone and Ghana, while the rate of participation of women and men in urban agricultural activities is relatively equal, the division of labor is not. Women are primarily responsible for marketing agricultural products, whereas men do much of the production (362–364). In contrast, in urban Kenya (365, 366), South Africa (367), and Peru (361) women are more heavily involved than men in the planting and tending of crops. In these places, decision-making about crop choices and inputs may be left up to the woman producing the crops (361), shared between partners (365), or largely left up to the male partner that owns the land (366), depending on the setting.

3.7 LIVELIHOODS IMPACTS AND ADAPTATION STRATEGIES: MIGRATION

There is a growing body of research detailing the importance of migration as an adaptation strategy for individuals experiencing climate change-related impacts (368). Within the past several years, research on gender and climate migration has grown substantially, yet few clear patterns emerge in terms of how migration is used as a response to climate disturbances. In general, migration appears to be an adaptive response to climate change more frequently carried out by males (369). However, migration is a complex process and decisions to migrate are determined by more than simply effects resulting from climate change. The gendered use of migration as a climate adaptation strategy varies from place to place depending on contextual factors such as household access to assets, livelihood strategies, distance to urban areas, gender roles, and marriage customs (370–372).

Much of the research on climate change and migration addresses patterns in sub-Saharan Africa, with the quantitative literature largely showing that climate shocks

reduce mobility for women, but increase it for men.

- In Ethiopia, more severe droughts tend to increase migration by men, but reduce it for women, particularly for the purpose of marriage. This may be due to the unwillingness of families to absorb the high costs of marriage (dowry) during droughts (373).
- Drought, disease, and flood shocks in Nigeria reduce migration by women, likely due to shortages of off-farm employment opportunities and the lower cost of bride prices, making it less desirable for households to send females elsewhere (374).
- In Burkina Faso, rainfall variability is significantly associated with migration, particularly for men, who are likely to move from areas with poor rainfall to other rural areas that are wetter (375).
- A multi-country study of environmental determinants of migration in Africa notes several significant differences in how temperature and precipitation predicts migration behavior for men and women, such as high temperatures significantly predicting the migration among women in Uganda, but reducing it among men in Kenya (376).

Qualitative studies from sub-Saharan Africa largely find similar patterns to quantitative studies. A case study from Ghana highlights some of the key motivations for migrating by men, namely the ability to diversify incomes away from increasingly uncertain farming, as well as the ability to improve their social status relative to that in their home villages (377). In rural Mozambique, migration among men to South Africa is high as a result of drought and environmental degradation, with the result that in some villages, over half of household heads are female (224).

In other regions of the world that are heavily impacted by climate change, such as South Asia, migration is also used as an adaptation strategy, but in contrast to sub-Saharan Africa, women often move in response to climate shocks. In Bangladesh, crop failure and flooding disproportionately increase the rate of migration by women (378, 379). In Pakistan, extreme heat increases the likelihood of migrating for both men and women, but women are less likely than men to move long distances (380). In Nepal, men's likelihood of migrating is affected by firewood availability (which men tend to collect), and women's likelihood of migrating is affected by the availability of fodder (which women tend to collect), suggesting that the impacts of climate shocks on specific gendered livelihood activities influences the propensity to migrate (381). Recent evidence from Bangladesh suggests that parents are marrying off girls soon after they reach menarche, who in turn go to live with their husband's family, partly as a coping mechanism to address

household financial challenges associated with climate change (382).

The migration of men may adversely impact the ability of women who stay behind to adapt to climate change. As one study focusing on the gendered impacts of male migration in South Asia notes, "While women have greater labor responsibilities following male outmigration they do not necessarily have improved access to finances, social networks and knowledge" (266, p. 267). Women often face increased workloads at home to make up for the loss of labor provided by departed male relatives (143, 201, 384). Moreover, the lack of capital presents even greater burden if land is degraded due to climate change-related impacts, making it challenging for women to earn income, as is the case in Niger (385). Thus, in at least some settings, the absence of men, who often have greater access to resources and can provide assistance, may present another impediment to climate change adaptation for women.

Conversely, in other contexts, male migration serves as a means of empowering women. For example, in rural Mexico, households that send migrants to the United States (who are disproportionately male) experience higher land productivity than households that do not send migrants (386). After men migrate in Mexico, women are also more likely to decide what crops to plant and to have control over land rights (146), and irrigation practices (204), which is very unusual among women with husbands present. However, this newfound empowerment may not last. Some evidence suggests that once men return, gender roles often revert to pre-migration norms (205).

Chapter 4. Climate Change and Gendered Health Impacts

In addition to its impacts on livelihoods, climate change also has gendered effects on health outcomes. Climate change impacts mortality and morbidity through the effects of high temperatures and heat waves, as well as through the effects of natural disasters, such as more severe storms or floods (387).⁹ Many of these health impacts of climate change vary by gender (24).¹⁰ This chapter examines the literature on gender differences in health impacts that result from climate change, with discussions of mortality, food security, infectious disease, mental health, maternal and reproductive health, and personal safety during disasters.

4.1 HEALTH IMPACTS: MORTALITY

Overall Effects

One of the most comprehensive and widely cited articles exploring the gendered impacts of natural disasters suggests that females are more likely to be killed by natural disasters and/or are systematically killed at younger ages than males (388).¹¹ The gender gap in mortality grows as the magnitude of the disaster increases, implying that as climate change breeds stronger droughts and storms, women and girls will be disproportionately affected. This disparity is reduced, however, when women have improved social status (388). Other recent cross-national evidence from developing countries suggests that women are more likely to be affected by disasters in countries where their economic status is poorer (389). The status of women is an important determinant of the gendered effects of disasters, yet other factors matter as well. As illustrated below, gendered social, economic, political, and cultural practices shape vulnerability to health impacts from disasters, and in some contexts, particularly in the developed world, men and boys are more vulnerable to health impacts from climate change-related disasters than women and girls.

Mortality in Extreme Heat

Heat waves are projected to become more severe as a result of climate change (387, 390). These effects are likely to worsen as urban areas continue to grow worldwide, generating heat island effects that are associated with deaths due to extreme heat (391). There is a great deal of academic literature exploring the health-related impacts of heat waves, generally using historical data on temperature and mortality and comparing mortality during periods of extreme heat to periods of more typical weather. Heat waves often disproportionately affect older populations, regardless of sex, particularly in developed countries, as these individuals tend to be more sedentary and are less likely to leave hot living spaces during a heat wave (392, 393).

Much of the literature examining gendered disparities in mortality from heat waves in the Global South indicates no significant gendered differences between women and men in mortality or increases in the risk of mortality due to extreme heat. Such studies include research from three cities in Latin America (394), Shanghai, China (395), Nairobi, Kenya (396), and northern Ghana (397). In contrast, other research has found disproportionate impacts of heat waves on female mortality. For example, in Ahmedabad, India, the rate of deaths among females likely associated with heat was significantly higher than for males during a 2010 heat wave (398).



Some studies from the developed world, particularly the United States and Australia, suggest that males are generally more susceptible to dying during extreme heat events.

- In the United States, the death rate from extreme heat (which includes deaths from heat waves, as well as isolated days that are abnormally hot) is 2.6 times greater for men than for women (399).¹²

⁹ The events used in this section to make claims about gendered health effects of climate change, such as heat waves, tropical cyclones, and floods, are representative of the types of events that are likely to become stronger and/or more frequent with climate change. This report should not be read as attributing any particular event mentioned to climate change.

¹⁰ Many of these same gendered effects of disasters on physical and mental health discussed here can also be found in research on disasters not linked to climate change, such as earthquakes, tsunamis, or terrorism. Although there is an extensive literature on the gendered linkages between disasters (of all types) and health problems (see, for instance, (30)), only literature on disasters likely to result from climate change was reviewed for this report.

¹¹ The Neumayer and Plumper (2007) study is one of the most comprehensive to date, but it is not without its limitations. This study makes an important point that women tend to be disproportionately affected by disasters. However, advocates are encouraged to use caution in using this study when making claims about the impacts of disasters on women and girls because the study pools mortality impacts from a variety of different types of disasters (including those not directly related to climate change), obscuring important heterogeneity in gendered disaster impacts between contexts.

¹² For this and all additional claims about risk in this report, adjusted relative risk or odds ratios (accounting for factors such as race, income, or self-reported health status that may systematically differ between males and females) are presented here, if provided by the study.

- A study exploring 167 years of data from Australia also concludes that men are more likely than women to die from heat-related deaths during periods of extreme heat, although the ratio of male to female deaths has declined in recent decades (400).
- In contrast, other research from three major cities in Australia, which examines all causes of mortality (rather than mortality attributed to heat), finds that females are roughly 10% more likely than men to die during heat waves between 1988 and 2009 (401).
- Related to extreme heat is the risk of bushfires. Detailed data from Australia show that males are disproportionately more likely to be killed by bushfires, as they tend to stay and defend their properties, although in recent decades, there has been growing gender parity in death rates (402).

In contrast, other studies from the developed world, largely from recent European heat waves, suggest that females are more vulnerable to heat-related mortality.

- French research from the 2003 and 2006 European heat waves suggests that females were at greater risk than males (403–405). Research on earlier heat waves in France suggests that women made up between 53–60% of all deaths attributable to heat waves before 2003 (406).
- Heat wave research examining nine Mediterranean cities shows that women age 75–84, were significantly more likely than similarly-aged men to die in heat waves between 1990 and 2004 (407).
- Research from Korea suggest that women were at a significantly greater risk (16%) of mortality during heat waves between 2000 and 2007, whereas men’s increased risk of mortality was statistically indistinguishable from zero (408).

In the United States, the vulnerability of males to heat wave deaths is attributed in part to the social isolation that many elderly men experience. As Eric Klinenberg notes in his study of the 1995 Chicago heat wave, while elderly women were more likely than elderly men to live alone, they were much more likely than men to have active social connections, which were likely protective during the heat event (409). In Europe, the high number of elderly women living alone (410), as well as social isolation among these individuals (411), have been cited as contributors to the high rate of deaths among elderly women. Some literature speculates that physiological differences between males and females in their capacity to regulate high temperatures are at least partially responsible for gender differences in heat-related mortality (412), though the reported geographic variability of heat-related mortality trends suggests that gendered living and livelihood patterns, access to medical treatment, and local climatic factors likely matter more than innate sex differences.

Mortality in Storms and Flood Events

Climate change is increasing the risk of health impacts associated with storms and flood events (387). As with heat-related health impacts, the gendered effects of storms and flood events vary in different contexts. Storms (including tropical storms such as hurricanes and cyclones, as well as thunderstorms) and floods are associated with mortality (413, 414).

Despite many claims concerning gendered disparities in mortality during major storms in the developing world, few robust studies have been conducted to examine these differences. Evidence from the 1991 cyclone in Bangladesh suggests that mortality among women over age 10 was triple that of comparably-aged males (415). Evidence examining 26 years of cyclones from Bangladesh suggests that women were 58% more likely than comparably-aged men to die during these events (416). Preliminary evidence from Tacloban City after Typhoon Haiyan struck the Philippines suggests that among adults, roughly 50% more females died than males (417). However, popular claims, such as that women are 14 times more likely than men to die during disasters, are not likely credible.

Evidence from developed country settings is more conclusive, suggesting that storm-related mortality does not disproportionately impact women and in some cases, disproportionately impacts men. Studies examining mortality from Hurricane Katrina note that gender did not significantly predict risk of death (418, 419). Based on data from Texas, 70% of deaths from Hurricane Ike were males (420). Including deaths from the United States as well as the Caribbean, researchers found that males were nearly twice as likely to die than females during Hurricane Sandy (421).

Vulnerability to flood mortality varies between developing and developed country settings due to differences in gendered livelihood patterns and resources to mitigate flood impacts (422, 423). Evidence from 1993 floods in Nepal finds that females were 1.4 times more likely to die than males (424), but evidence from 1999 floods in Hunan, China suggests that men were more likely to die prematurely, which the authors attribute to the greater involvement of men in rescue efforts (425). Studies examining flood mortality in developed regions, including the United States, Europe, and Australia, find that men are substantially more likely to be killed by flood events than women, often as a result of being trapped in vehicles in floodwaters (426–429). A study examining mortality in major flood events between 1989 and 2003 in Europe and the United States found that 76% of

¹³ There is some uncertainty with the US figure in this study, as 26% of flood fatalities lacked gender information.

Europeans who died were male, while in the US, nearly two men died for every woman (428).¹³

Relatively little research examines gendered practices that directly increase vulnerability to harm during storms and floods in the developing world. A notable exception is research from Bangladesh, which notes several cultural practices that increase the vulnerability of women and girls during storms and floods. Cultural expectations about appropriate dress for women may limit women’s ability to survive floods. The use of the sari, a long dress that can become easily waterlogged during a flood, hampers the ability of women to survive dangerous floodwaters (430). As noted in a case study regarding a 1998 flood event, the cultural practice of purdah, which restricts women’s ability to visit places outside the home, led women to restrict their movement in the aftermath of the event, making it more difficult to access toilets and health facilities (431). Another dimension of vulnerability is that women are often not involved in designing the spaces around them—construction is often seen as men’s work, and this may lead to the use of designs (such as the use of ladders that are less accessible for pregnant women) which can make women disproportionately vulnerable to harm during storms and floods (432). Women also experience increased vulnerability due to the fact that disaster planning policymaking in Bangladesh does not routinely take into account the needs and concerns of women (48, 433).

4.2 HEALTH IMPACTS: HUNGER AND FOOD SECURITY

Climate change is also likely to increase the risk of food insecurity worldwide, particularly for individuals in the Global South (49, 50). There is a growing body of evidence suggesting that this food security is, in many settings, likely to disproportionately burden women and girls.

Food insecurity for women and girls is a pervasive fact of life in much of Asia, and particularly in India and Bangladesh (434–436), where more than one in three adolescent girls are stunted (437). There is some evidence that women and girls in this region are more likely to go hungry following disasters related to climate change. In Andhra Pradesh, India, twice as many women as men reported eating less in response to drought (35). A recent study of communities affected by climate change in Bangladesh suggests that women and girls are typically the first to skip meals if there is a shortage of food, as often occurs during droughts, floods or storms (5).¹⁴ After natural disasters in India, young girls were more likely to be stunted and underweight than boys (439).

Elsewhere in Asia, the effects of climate change-induced food insecurity on women and girls have been documented.

For example:

- In the Philippines, infant mortality increased after typhoons among girls but not among boys, which researchers attribute to competition for scarce resources within families (440).
- During drought in Iran, women and girls are more likely to go hungry (184).
- In Vietnam, women are more likely to skip meals than men during periods of food scarcity due to cultural norms regarding the importance of men’s physical labor (182).

In sub-Saharan Africa and Latin America, food insecurity associated with climate change is, in general, also experienced disproportionately by women and girls.

- In South Africa, female-headed households with an unmarried head (who are less likely to receive income support from a migrant partner), are more vulnerable to food shortages than households where the head is married (441).
- In Malawi, female-headed households are more than twice as likely as male-headed households to report reducing the number of meals they eat as an adaptation strategy in response to climate shocks (191).
- In Niger, where drought and flooding are having major impacts on crop yields, female-headed households are significantly more likely to be considered food insecure than male-headed households (442).
- In Ghana, men, who typically have control over how food is distributed in some rural areas, have been observed distributing food unequally as scarcity reduces available supplies, leading to food insecurity for women and children (384).
- In Nicaragua, women are more likely than men to reduce their food consumption in response to drought (198).
- In contrast, some evidence from East Africa suggests that female-headed households are no more likely (443), or even less likely (444) to suffer from food insecurity, despite drought that is gripping the region. Researchers speculate that the female-headed households they observe prioritize food and other essential needs in household spending decisions more effectively than male-headed households in order to ensure adequate household welfare (444).

Climate change is also having profound impacts on food security in the Arctic. Less hunting is taking place due to fewer available prey (partly as a result of climate change),

¹⁴ However, evidence collected after Cyclone Sidr suggests that women of reproductive age were at no greater risk of food insecurity after a devastating cyclone as compared to women nationwide, suggesting that disaster did not worsen existing difficulties in securing food supplies (438).



as well as higher hunting costs, which are the result of increased time and effort required to hunt due to scarcer wildlife populations (445, 446). These changes have gendered implications for food security. In Greenland, research suggests that because of poor hunting conditions, husbands are becoming increasingly dependent on their wives to economically support the family with income in order to pay for food (446). Recent evidence suggests that other sources of food, such as berries, often collected by women, are of lower quality, which is attributed to climate change-related disturbances in some Inuit communities (447). These changes are forcing many Inuit families to rely more heavily on food shipped in from elsewhere, which generally costs much more than in less isolated settings (448). Qualitative evidence from Greenland suggests that Inuit women are more vulnerable to food insecurity than men, as women are more reliant on food sharing networks, which depend on steady supplies of traditional food (449). When food is scarce, women are often the first to sacrifice in Inuit communities, skipping meals and selling assets in order to ensure that there is enough food to go around (445).¹⁵ Certain subgroups of Inuit women, such as those who are single or those with lower educational attainment, are especially vulnerable to food insecurity (452).

4.3 HEALTH IMPACTS: INFECTIOUS DISEASE

Climate change is increasing the spread of water- and vector-borne diseases around the world (387, 453), such as cholera (454, 455), dengue fever (456), malaria (457), and schistosomiasis (458, 459), which tend to disproportionately burden poor populations globally in developing countries.¹⁶ Gendered behavior patterns and access to care affect the gendered burden of these diseases, discussed below.¹⁷

In many settings, men and women are roughly equally affected by cholera, with some studies showing slightly higher burdens of the disease among men, and others among women (461–463). Gendered behavior patterns that affect time spent near water or infected individuals (due to the caring roles that women often have) as well as water use behaviors

(such as for drinking, bathing, or religious purposes) affect the gendered burden of the disease (464). Regarding dengue fever, a multicountry analysis from Asia suggests that males are at greater risk of the disease, with 57–62% of dengue cases affecting males among adult cases in the countries surveyed (465). This may be because dengue is often regarded as a disease that disproportionately impacts urban areas (466), and as illustrated in Section 3.7 on migration, it is disproportionately men moving to cities in many developing countries.

There are also substantial gender differences related to malaria susceptibility as women often cook in the early morning or late evening when mosquitoes are prevalent, while men often work in industries such as forest product harvesting that may make them more susceptible to receiving mosquito bites (467). Most studies examining the issue find that women are substantially more likely to have malaria (468–470). For instance, research from Kisumu, Kenya suggests that the odds of women having malaria are 1.4 times greater than those of men (468).¹⁸ In contrast, there is some evidence that males are at greater risk of schistosomiasis infection than females (472–474), particularly at younger ages as boys tend to spend more time playing near water where the disease is transmitted. For instance, a study

¹⁵ Gendered disparities in food insecurity may be less pronounced in more urban settings in the Arctic, such as Iqaluit, where studies show that gender is not a significant predictor of food insecurity (450, 451).

¹⁶ The challenges associated with integrating weather and ecological changes in disease modeling continue to produce considerable uncertainty in estimates of changes in disease risk resulting from climate change. While it is beyond the scope of this paper, readers should note that there is important complexity and nuance in these models which may result in greater or lesser impacts of climate change on disease burden. These difficulties are discussed in (460).

¹⁷ A separate discussion about the impact of these diseases on pregnancy-related outcomes is included in Section 4.5.

from Tanzania notes that 28% of boys reported having schistosomiasis, compared to only 21% of girls (474). One of the most common symptoms of infectious disease, particularly among children, is diarrhea, which is closely linked with temperature changes and flooding (475).

Exposure to contaminated floodwaters is also associated with skin conditions, often as a result of bacterial or viral infections (476). After Hurricane Katrina, the proportion of (predominately male) firefighters and construction workers with skin rashes was very high as a result of being exposed to dirty floodwaters (49.1% among firefighters; 42.6% among construction workers) (477, 478). In contrast, there is evidence from Bangladesh suggesting that females may be disproportionately exposed to skin problems related to floodwater exposure (5).

4.4 HEALTH IMPACTS: MENTAL HEALTH

Climate change also has gendered impacts on mental health. In particular, climate related disasters lead to additional stress, depression, and in extreme cases, suicide (422, 479). While both men and women tend to experience higher rates of mental health challenges after disasters, women are generally more susceptible to developing stress-related disorders and depression (480, 481), whereas men are disproportionately more likely to commit suicide (482).

Stress-Related Disorders

Studies examining the aftermath of a variety of climate change-related disasters illustrate that women tend to disproportionately suffer stress-related disorders after such events.

- A large study after flooding in Hunan, China found that females had slightly greater odds (1.1 times greater) of developing post-traumatic stress disorder (PTSD) than males (483). A separate study examining the effects of the event among children found that the odds of girls developing PTSD were also slightly greater than those of boys (484).
- After Cyclone Nargis in Myanmar, the odds of women developing PTSD were 2.6 times greater than those of

¹⁸ It is important for advocates using studies where odds are mentioned to remember that odds differ from probabilities in their interpretation and how they should be presented to audiences. In technical terms, women having 1.4 times greater odds for having malaria than men means is that for every woman without malaria, 1.4 times as many women will have malaria than the number of men with malaria for every man without malaria. Statistically speaking, this is not the same as saying that 1.4 times as many women get malaria as men. A helpful article for understanding the differences in interpretation between odds and probabilities is (471).

men, while women's odds of developing acute stress disorder were 3.2 times greater than men's odds (485).

- After Hurricane Katrina, the odds of women suffering from acute stress disorder were 4.1 times those of men (486). Pregnant women who were most exposed to the storm had odds of suffering from PTSD 3.7 times greater than similar women not exposed to the storm (487).
- Studies conducted in the UK find that women are more susceptible to stress-related disorders after flood events than men (488–490). For instance, after 2007 floods, the odds of women suffering from PTSD were 1.5 times greater than those of men (489).
- After the Black Saturday bushfires in Australia, the odds of women developing fire-related PTSD were 1.7 times greater than those of men, whereas men's odds of drinking heavily as a response to the event were 1.7 times greater than those of women (491).
- After Cyclone Larry struck Australia, the odds of girls developing PTSD were 8.7 times greater than those of boys within three months of the storm (492), although a follow-up study 18 months after the event found no significant differences by sex, suggesting that gender differences in the effects of the disaster on PTSD were short-lived (493).
- A notable exception to the patterns found in other events is Hurricane Sandy. After that event, women were statistically no more likely than men to suffer from PTSD (494, 495)

Depression and Anxiety

Women are also disproportionately at risk for developing anxiety and depression following climate change-related disasters.

- Studies conducted after Hurricane Katrina suggest a link between stronger exposure to the disaster's impacts and postpartum depression (487, 496). Pregnant women who were most exposed to the storm were 1.8 times as likely as similar women to suffer from depression (487).
- After 2007 floods in the UK, the odds of women experiencing depression were 1.7 times greater than those of men (489).
- While depression tends to affect females in post-disaster contexts, it also is prevalent among certain predominately male groups, such as emergency responders. A post-Katrina survey found that 27% of firefighters in New Orleans reported depressive symptoms (477).
- As with other health impacts, the gendered effects of climate change-related events on depression appear to

depend heavily on the context of the event. Women were statistically no more likely to suffer from depression after the Black Saturday bushfires (491) or Hurricane Sandy (494, 495).

Moreover, other vulnerabilities associated with climate change, such as food insecurity, are linked to a greater risk of depression with much of the existing evidence centering on the impacts on women. In Tanzania, food insecure women are more likely to suffer from depression and anxiety (497), particularly during periods of most acute food scarcity (498). Research from Ethiopia on women and food security from Ethiopia corroborates these links (498). Evidence from Uganda among individuals living with HIV finds that food insecurity is significantly associated with depression among women, but not men (499).

Less evidence exists regarding the links between water scarcity and depressive disorders, with a handful of exceptions. In Cochabamba, Bolivia, water scarcity is significantly associated with emotional distress, particularly among female household heads, who tend to experience greater burdens of collecting water (300, 500). In rural Ethiopia, repeated surveys note a strong association between household water scarcity and psychosocial distress among women (294, 501).

Suicide

Despite a growing body of research on the relationship between natural disasters and suicide risk, there are few clear patterns concerning how suicide rates change after such events (502). However, there is a more conclusive set of work around the relationship between weather and suicide, and in particular, the relationship between increased temperatures and suicide rates. Studies from the United States and Canada (503), Germany (504), the United Kingdom (505), and Korea (506) link higher temperatures with increased suicide risk.¹⁹ For instance, data from the UK suggest that above 18°C, every 1°C increase in temperature is associated with a 3.8% increase in the rate of suicide (505). During periods of higher temperatures, suicide risks among males and females increase at similar rates (505, 506).

Suicide risks are also connected with livelihood choices, and in particular, farming (509). In India, climate change is increasing risks to farmers on small plots on marginal lands (largely men), who are more vulnerable to crop failures due to the limited ability to diversify crop holdings, which in turn is associated with elevated suicide rates (510). Research from Australia

¹⁹ While much research supports a positive association between temperature and suicide risk, not all does. See, for instance (507, 508).

links rural suicide with drought and deteriorating economic conditions for (predominately male) farmers (46, 47, 511). Data from Australia show that a moderate increase in the drought index is associated with a 15% increase in the rate of suicides among males, while such an increase is associated with a slight decrease in the suicide rate for females (511). In rural Australia, traditional masculinities, in particular a reluctance among men to seek help when having difficulties, serve as an important contributor to the risk of suicide (46, 47, 512, 513).

4.5 HEALTH IMPACTS: REPRODUCTIVE AND MATERNAL HEALTH

Women and girls face unique challenges associated with their reproductive roles as mothers. Disasters related to climate change often disrupt supplies of family planning commodities (514). Additionally, natural disasters and diseases associated with climate change have adverse impacts on pregnancy and maternal health outcomes (515).

Family Planning

Climate change threatens the ability of women to access family planning services, making it harder for women to choose if and/or when to have children. Climate-linked natural disasters are likely to hamper access to reproductive healthcare, as occurred after Typhoon Haiyan (516) and Hurricane Katrina (517). Additionally, the impacts of disasters may exacerbate the effects of preexisting barriers that women have to seeking reproductive health services, such as race and class, as documented after Hurricane Ike (518).

As the linkages between climate change and reproductive health are increasingly recognized, governments are adopting voluntary, rights-based family planning programs as a strategy for reducing vulnerability to climate disruptions. In particular, integrating family planning with other forms of development designed to promote resilience, such as through population, health, and environment initiatives, is an increasingly popular approach for jointly improving human health and environmental outcomes (519). Such initiatives are associated with improved reproductive health as well as environmental outcomes, helping to facilitate local resilience to environmental changes, including climate change impacts (520).

Providing women with greater control of their fertility empowers them to make choices that can improve their resilience to the effects of climate change. However, it is crucial to remember that environmental rationales should not be used as a justification for coercive or quota-based family planning initiatives nor should family planning be seen as the exclusive or primary solution for addressing climate change (521, 522).

Pregnancy-Related Outcomes: Infectious Disease

Climate change is also likely to impact pregnancy outcomes and care in part as a result of an increase in the infectious disease burden among pregnant women, which will affect those in the developing world the most (387, 515). Various reviews summarize the pregnancy-related health outcomes associated with these conditions, including cholera (523), dengue fever (524), malaria (525, 526), and schistosomiasis (527). While the quality and quantity of the literature examining the impact of these diseases on pregnancy outcomes varies between diseases, the majority of literature suggests that these conditions are associated with adverse pregnancy outcomes. In the cases of dengue (528) and malaria (529, 530) pregnant women are more susceptible to developing these conditions than non-pregnant women—an added dimension of vulnerability. This suggests that if climate change expands the range of these diseases, pregnant women are likely to be particularly vulnerable.

Adverse pregnancy and maternal health outcomes linked with cholera, dengue fever, malaria, and schistosomiasis include miscarriage (531–533), premature birth (534, 535), and anemia (536–538), among other consequences. For example, a study linking malaria and miscarriages notes that women without fevers (but with laboratory evidence of having malaria) have 2.7 times greater odds of miscarrying than women without the disease, while women with fevers have 4.0 times greater odds (532). Research from Tanzania suggests that women with severe schistosomiasis infections have 1.9 times greater odds of developing anemia as pregnant women without schistosomiasis (538).

Pregnancy-Related Outcomes: Temperature and Disaster Linkages

Climate change is also likely to impact pregnancy and maternal health outcomes directly through changes in weather patterns, as well as indirectly because of the stress associated with these weather pattern changes. There are several reviews of the literature linking weather and adverse pregnancy outcomes, centering on exposure to extreme temperatures (generally extreme heat) (539, 540), as well as stress during pregnancy, which is often induced by natural disasters (541–543). In general, exposure to natural disasters and stress during pregnancy increases the risk of poor outcomes, although researchers continue to debate the mechanisms that link climate events to adverse pregnancy and maternal health outcomes (544). Recent research has linked heat waves (545–547) and flood/storm events (548–550) to reduced birth weights. Other research has linked heat waves (551–555) and flood/storm events (549, 556, 557) to

an increased risk of preterm delivery and related pregnancy complications. Saltwater intrusion into groundwater, which is more likely with higher sea levels and associated flooding, may also increase rates of preeclampsia and hypertension during pregnancy (558, 559). Finally, exposure to extreme weather in utero may have lasting implications for a child beyond pregnancy, such as an increased risk of developing autistic disorder (560), or lower test scores and earnings (561).

Myths vs. Facts

Myth: High fertility rates among women in the developing world are a predominant cause of climate change.

Fact: Although women in developing countries tend to have higher fertility than those in developed countries, it is consumption driven by the Global North that has been the primary driver of climate change to date, not high fertility among poor women (521). Family planning and reproductive rights can serve as a resilience tool for women in all countries, ensuring that they are able to choose if and when to have children at a time that is appropriate for them and their partner.

4.6 HEALTH IMPACTS: PERSONAL SAFETY DURING DISASTERS

Climate change-related disasters often trigger displacement. However, systems designed to facilitate evacuation and safety during disasters are heavily gendered, and can disproportionately harm marginalized women in several ways. Decision-making regarding when and where to evacuate sometimes excludes women, decisions which have a direct bearing on women's safety during and after a disaster. Shelters may lack facilities for women and/or place them at risk for assault. Moreover, incidents of gender-based violence have been shown to increase after disasters.

Personal Safety

Much of the evidence regarding the role of gender in ensuring health and safety in climate change-related disasters comes from responses to cyclones and flooding in Bangladesh. There is a growing body of evidence illustrating that marginalized women in Bangladesh tend to be unable to make independent choices about whether or not to evacuate, as these decisions are often left up to the male head of household (5, 562, 563). This is in part because of the purdah system in

Bangladesh that restricts women's movement outside the home (430). Expectations that the male head of household should determine when to evacuate can delay evacuations in cases where the male head is not present at the time that evacuation warnings are received, threatening women's safety (562).

Additionally, information regarding hazards may not be provided in a way that is easily accessible for women. After Cyclone Sidr, for instance, women reported that warnings about the storm were provided only in local markets, and that efforts were not made to notify people door-to-door (563). This is problematic as women in rural Bangladesh tend to be responsible for domestic duties, and are less likely to be present in public spaces where warnings are provided. Recent evidence indicates that women and men in Bangladesh have different preferences regarding how to hear warnings as women often have less access than men to radios, televisions, and mobile phones (5).

Even if a family chooses to evacuate to a shelter, it may be inaccessible due to distance (563–565). A study of predominately male respondents in Bangladesh found that individuals who lived more than 1 km from a shelter were significantly less likely to evacuate to a shelter during Cyclone Sidr than those who lived within 1 km (566). Since evacuation decisions in Bangladesh for entire families are typically made by men, these results imply that women distant from shelters are less likely to evacuate during storm as well, even if they independently prefer to leave.

If a woman makes it to a shelter, she faces additional barriers, as shelters are often not designed to provide women sufficient space or privacy, which is particularly important in places such as Bangladesh where women's modesty is culturally significant. Research suggests that shelters in Bangladesh often lack separate or hygienic washing facilities for women, as well as private spaces for breastfeeding or changing menstrual pads, and that all too often, women are harassed or threatened in these settings (564). A recent study finds that among individuals who did not evacuate to a shelter during Cyclone Alia, 36% cited the lack of separate spaces for women in shelters as an important reason for not evacuating (567). Research also notes that adolescent girls are particularly at risk of sexual harassment and violence in shelters (568).

An assessment after 2012 flooding in Fiji encountered similar themes to those in Bangladesh. Although women in Fiji are less likely to work outside the home than men, which can sometimes constrain the information they receive on disasters, they were instrumental in communicating about advancing floodwaters to men during the 2012 flood, as many

women were awake preparing food the morning of the event (569, 570). Moreover, some women reported being coerced into having sex with their husbands in shelters after the flood, despite the lack of privacy in these settings (570).

Evidence from the developed world suggests that women tend to prefer evacuation during natural disasters. For example, in the United States, women are more likely to evacuate before hurricanes than men (571–573), which likely plays a protective role during storms (575). In the 2009 Black Saturday bushfires, men and women responded differently, with men tending to advocate for defending their property and women wanting to evacuate in order to protect the children (575). The delays in resolving these disagreements resulted in the late departure of many women and children from rural homes, and many of these individuals were killed as a result (576). Researchers note that messaging, policies, and training around bushfires are heavily gendered and often fail to reflect the preferences and needs of women, increasing their vulnerability to these events (577, 578).

Gender-Based Violence

Climate change-related disasters are also associated with increases in gender-based violence (579). Much of the evidence regarding gender-based violence in post-disaster settings in the developing world comes from studies examining disasters not directly related to climate change, such as earthquakes or the Indian Ocean Tsunami, evidence that is reviewed in (580). A notable exception is work done after flooding in Bangladesh, which found extremely high incidences of violence against women after 2007 flooding, particularly among disadvantaged groups such as sex workers and the disabled (581). Recent work from Bangladesh notes that violence against women has increased in response to the effects of climate change (5). Increases in violence against women after climate change-related disasters have also been documented in Vietnam (182).

In developed countries, there is more research examining increases in gender-based violence after disasters. Several studies indicate that gender-based violence increased after Hurricane Katrina (582–586). For example, in a study examining intimate partner violence, psychological victimization of women and men increased by 35% and 17% respectively in the six months after the storm and physical victimization of women increased by 98% (584).

Other evidence from developed countries broadly confirms the experiences faced during Katrina.²⁰ For example:

²⁰ Although see (587) for null findings.

Myths vs. Facts

Myth: Women are more likely to die during storms and floods because of an inability to swim.

Fact: Research suggests that women in countries that are vulnerable to storm surges and flooding, such as the Philippines and Bangladesh, are indeed less likely than men to know how to swim (596, 597). However, swimming skills have not been demonstrated to be linked to the odds of survival during major storm events. Instead, evidence from storms and flood events suggests the inability to access safe shelter facilities is a leading contributor to mortality (598, 599). In developed countries men are disproportionately more likely to die during floods, largely as a result of being trapped inside vehicles (implying that the lack of swimming skills is not problematic, rather the inability to escape a confined space) (426–429).

- A case study from the Red River floods in the United States notes that incidents of domestic violence increased sharply after the event, while volunteer time to help women who had been abused decreased as local residents worked to rebuild their lives after the disaster (588).
- Research from Australia links droughts (589, 590) and bushfires (591) with increases in violence against women, which is attributed in part to the burdens placed on men by traditional masculinities in the face of tremendous loss (589).
- After 2004 floods in New Zealand, domestic violence cases increased substantially (592).

Finally, it should be noted that after the wake of climate change-related events in both developing and developed countries, such as after cyclones in Bangladesh or hurricanes in the United States, reports have surfaced regarding an increase in human trafficking and sexual exploitation of vulnerable women and girls (5, 593). However, these reports are often anecdotal and in some post-disaster contexts, appear to be unsubstantiated (594, 595). As the threats of trafficking and sexual exploitation are a pressing concern after disasters, there is a tremendous need for additional research to contextualize the nature and quantify the scale of these problems.



Chapter 5. Concluding Remarks

The current literature on gender and climate change is clear. Climate change has gender-differentiated impacts, and men and women make different choices in their responses to climate change. As illustrated by the evidence outlined above, gendered experiences associated with climate change vary considerably within and between communities. Keeping this in mind, however, we draw several broad conclusions about the literature base around gender and climate change.

Despite recent gains, women continue to be underrepresented in climate policymaking and finance activities. Climate policies and financing strategies continue to inadequately incorporate gender-related concerns or address pressing needs for gender-disaggregated information on policy impacts. Nevertheless, a growing number of organizations are adopting gender mainstreaming strategies into their programs and policies, which is likely to improve their capacity to meet the needs of females and males in the years to come.

Women, particularly in many developing countries and low-income communities of developed countries, often lack access to assets and power, and this serves as a major source of vulnerability and barrier to adaptation. Women are less likely than men to manage farmland around the world, and are also less likely to be involved in forest and fishery governance. The lack of control that women have over these vital resources makes it harder for women to influence how resources are used in response to climate shocks, and ultimately, for women to access the livelihood opportunities necessary for their survival. Women also tend to lack access to capital and inputs that are necessary components of adaptation to climate change.

The caring roles that women inhabit adversely impact their capacity to adapt to climate change. Numerous examples throughout this document highlight the burdens that caring roles place on women seeking to adapt to climate change, particularly as they create time constraints for women. Many studies note that care-related activities, including childrearing and taking care of the sick, make it more challenging for women to adapt to the effects of climate change. Research after natural disasters notes the roles that women play in taking care of other household

members makes it harder to earn income and rebuild their lives.

Gendered livelihoods practices exist around the world, but climate change is changing established gender roles in some cases.

In many developing countries, women tend to be responsible for cooking, collecting water, managing kitchen gardens and small livestock, small business management, and collecting non-timber forest products, while men are often responsible for farm and livestock management, timber harvesting, fishing, forests and fisheries management, and are often the individuals who migrate in order to seek other livelihood opportunities in cities. However, scarcity induced by climate change events is changing men's established gender roles, such as men beginning to collect non-timber forest products due to a paucity of other livelihood opportunities, or men assisting women with water collection due to local shortages. Conversely, there is some, albeit limited, evidence that women are becoming more involved in natural resource management in response to scarcity.

Events related to climate change have substantial health impacts for women and men, though the gendered health effects of such events depend largely on social, economic, political, and cultural contexts, not biology.

With the exception of pregnancy and reproductive health-related outcomes, health impacts related to climate change are determined primarily as a result of gendered livelihood and cultural practices, as well as responses to risk associated with natural disasters. Current evidence suggests that in developed countries, men tend to be more susceptible to mortality as a result of climate change-related events, but there is some evidence that the opposite is largely true in the developing world, though with many exceptions in both settings. Gendered susceptibility to other health-related impacts varies across contexts, though some impacts, such as increases in gender-based violence, disproportionately impact women in virtually all settings.

RECOMMENDATIONS FOR ADDITIONAL RESEARCH

Despite the rapid growth in the gender and climate change literature, there is still much that we do not know about the linkages between these two important topics. Increasing the gender and climate change knowledge base is an essential task in order to strengthen adaptation and mitigation responses to climate change. We hope that readers of this document will contribute to this research. Although there are still many gaps in the literature to be filled, we briefly highlight five gaps that we hope researchers will explore in the coming years.

Geographic scope: Much of the academic research on climate change and gender focuses on parts of the world that are currently the most impacted by climate change and/or have the least capacity to cope. This includes sub-Saharan Africa, South Asia, and Australia. Less is known about gendered climate change impacts in the Americas, Europe, the Middle East, North Africa, East and Southeast Asia, and the Pacific. Additional research that addresses the experiences of women and men living in a wide variety of settings is important for developing climate policies that effectively account for local contexts. More research is also needed to distinguish between the needs of individuals in urban versus rural areas, as rural dwellers often have different experiences with climate change than individuals in urban settings.

Larger-scale, quantitative studies: Much of the literature on gender and climate change centers around largely qualitative case studies, generally focusing on a community or region. This is important research that provides insights on localized impacts of and responses to climate disruption. However, additional comparative and longitudinal national or multi-country studies would provide greater breadth as to how climate change responses vary in different settings, as well as allow for comparisons of vulnerability and adaptive capacity within and between regions. In addition, incorporating more quantitative data into gender and climate change research would potentially improve its generalizability, as case studies are often based on small samples that may be less representative of larger populations.

Gender and climate change institutions: Recent research notes that gender mainstreaming practices are becoming more important in transnational governance institutions, including climate finance entities, although in most cases, these institutions have yet to reach gender parity in most leadership roles. As gender mainstreaming practices become more widely adopted, research is needed to understand their effects on women and men and highlight areas where policies are failing to achieve their goals in order to ensure that gender mainstreaming achieves its desired impacts.

Gender and mitigation: Our review centers on the impacts and adaptation literature in part because it is more developed than the literature around mitigation. There are growing efforts to document the work being done by women to develop sustainable energy and transport solutions in response to climate change, although more work is needed, particularly from the academic community. Highlighting how gender is an important lens through which to understand mitigation, as well as adaptation efforts, will help to ensure that solutions to climate change reflect the needs of females and males.

Longer-term health impacts: Much of the research on the impacts of climate change on health centers on observational studies of particular disasters and their immediate aftermath. More studies examining the long-term outcomes of heat waves, storms, and floods are needed to better understand the relative resilience capacity of men and women in different settings. In addition, more research is needed to explore strategies that can be used to reduce vulnerability to the impacts of climate disasters, and whether such approaches equally impact females and males.

Further action is needed to mitigate the effects of climate change and empower women, men, boys, and girls to cope with its impacts. We hope that by addressing these gaps within the gender and climate literature base, that additional knowledge which contributes to the development of more appropriate policies is adopted. Research that shines new light on challenges of climate vulnerability and adaptation is essential in order to ensure that additional progress is made towards yielding more gender-equitable outcomes to climate change.

For Further Reading: Feminist Critiques of the Gender and Climate Literature

GGCA strongly supports the efforts of researchers to engage and challenge climate change scholarship with feminist critiques. This body of literature is not the focus of the discussion above, which prioritized literature with primary data. Nevertheless, as research and data collection can itself be gendered, GGCA strongly encourages readers to review the burgeoning body of feminist scholarship addressing gender and climate linkages, including overviews of this literature and the field (600, 601), critiques of climate mitigation policies and policy discourses (7, 602–606), critiques of proposed solutions to climate change (9, 607), how responsibility for climate change and its solutions is assigned (climate justice) (10, 608–610), human rights and climate change (611, 612), the portrayal of women and gender in climate literature (613, 614), works that engage critically with climate literature in a geographic context, such as Australia (615) or South Asia (616), and calls for additional scholarship to strengthen discourse and analysis of these important issues (8, 617, 618).

Toolkits

The evidence in this document is designed to help inform advocates and policymakers regarding the linkages between gender and climate change. However, addressing gendered vulnerabilities or gendered disparities in climate adaptation capacity requires more than evidence; it also requires the implementation of gender mainstreaming processes. Various organizations have developed guides or toolkits that clearly describe steps to incorporate gender considerations into practices, policies, and research related to climate change. We encourage readers to use the resources below and inform us of other resources that would be appropriate for this list.

GENERAL TOOLKITS:

- USAID Adapt Asia-Pacific (Periodically Updated) Integrating Gender in Climate Change Adaptation Proposals
- ADB (2013) Tool Kit on Gender Equality Results and Indicators
- Centre for Global Change (2013) Gender and Climate Change Adaptation: A Toolkit for Practitioners
- UNDP (2009) Resource Guide on Gender and Climate Change
- UNDP (2007) Gender Mainstreaming in Practice
- UNDP (2007) Gender Mainstreaming: A Key Driver of Development in Environment and Energy

FOOD AND AGRICULTURE TOOLKITS:



- FAO (2013) Understanding and Integrating Gender Issues into Livestock Projects and Programmes
- FAO (2011) Social Analysis for Agriculture and Rural Development Projects
- ADB (2006) Gender and Agriculture Checklist

FORESTS TOOLKITS:



- UN-REDD (2013): Guidance Note on Gender Sensitive REDD+

FISHERIES & AQUACULTURE TOOLKITS:

- USAID/Ghana Sustainable Fisheries Management Project (2016) Gender Mainstreaming in



Fisheries Management: A Training Manual

- FAO (2011) *Mainstreaming Gender into Project Cycle Management in the Fisheries Sector*



WATER TOOLKITS

- Cap-Net UNDP & Gender and Water Alliance (2014) *Why Gender Matters in IWRM: A Tutorial for Water Managers*
- FAO (2012) *Passport to Mainstreaming Gender in Water Programmes*
- Water and Sanitation Program (2010) *Gender in Water and Sanitation*
- UN HABITAT (2007) *Gender Mainstreaming Toolkit for Water and Sanitation Actors*
- Gender and Water Alliance (2006) *Resource Guide: Mainstreaming Gender in Water Management*
- Swiss Agency for Development and Cooperation (2005) *Gender & Water*



ENERGY TOOLKITS:

- USAID (2015) *Building a Safer World: Toolkit for Integrating GBV Prevention and Response into USAID Energy and Infrastructure Projects*
- World Bank ESMAP (2013) *Integrating Gender Considerations into Energy Operations*
- ADB (2012) *Gender Tool Kit: Energy Going Beyond the Meter*
- ENERGIA (2011) *Mainstreaming Gender in Energy Projects: A Practical Handbook*

DISASTER-RELATED TOOLKITS:



- Oxfam GB (2011): *Gender and Disaster Risk Reduction: A Training Pack*
- International Federation of Red Cross and Red Crescent Societies (2010): *A Practical Guide to Gender-Sensitive Approaches for Disaster Management*
- United Nations International Strategy for Disaster Reduction (2009): *Making Disaster Risk Reduction Gender-Sensitive: Policy and Practical Guidelines*
- Oxfam America and NANBAN Trust (2008): *Gender Sensitive Disaster Management: A Toolkit for Practitioners*

REGIONALLY-FOCUSED TOOLKITS:



- Secretariat of the Pacific Community (2015) *Pacific Gender and Climate Change Toolkit*

- Centre for Global Change (2012) *Climate Change and Gender: With a Special Reference to Bangladesh*
- UNDP, GGCA (2012 & 2013) *Africa and Asia-Pacific Gender and Climate Change Capacity Development Series*: GGCA released a series of toolkits focusing on gender mainstreaming in particular sectors in the Africa and Asia-Pacific regions. These toolkits cover an overview of gender and climate linkages, gender and climate adaptation, gender and energy, gender and food security (Africa only), gender and disaster risk reduction (Asia-Pacific only), and gender and climate finance.

TOOLKITS FOR RESEARCHERS:

- World Agroforestry Centre (2015) *A Guide for Gender Mainstreaming in Agroforestry Research and Development*
- CGIAR (2014) *Gender and Inclusion Toolbox: Participatory Research in Climate Change and Agriculture*
- CGIAR (2013) *Gender and Climate Change Research in Agriculture and Food Security for Rural Development*
- CIFOR (2012) *Integrating Gender into Forestry Research: A Guide for CIFOR Scientists and Programme Administrators*



Appendix

Glossary:

AF: Adaptation Fund

CDM: Clean Development Mechanism

CIF: Climate Investment Funds

COP: Conference of the Parties

CSA: Climate-smart agriculture

GCF: Green Climate Fund

GEF: Global Environment Facility

GGCA: Global Gender and Climate Alliance

IUCN: International Union for Conservation of Nature

NGO: Non-governmental organization

NTFP: Non-timber forest product

PTSD: Post-traumatic stress disorder

REDD+: Reducing Emissions from Deforestation and Forest Degradation

UNFCCC: United Nations Framework Convention on Climate Change

WEDO: Women's Environment & Development Organization

WOCAN: Women Organizing for Change in Agriculture and Natural Resource Management

Methodology/Approach

This report started with a search of the recent gender and climate literature to prepare this review. The author used two databases, Web of Science and Google Scholar, to locate suitable materials. The Web of Science database primarily includes literature that has been reviewed by other scholars prior to publication (peer-reviewed). Google Scholar is not limited to these sources, and searches using this tool found other sources such as NGO reports and related literature. A call for suggested literature also was sent to GGCA members, and these resources were incorporated as appropriate. Although peer-reviewed literature is generally considered by academics to be the “gold standard” for ensuring the information is valid, publishing in an academic journal takes time and money that many researchers lack. Research published outside of academic journals often offers important insights, and is incorporated here when the author deemed it reliable.

A variety of terms were combined in the search in order to locate suitable literature (Table 1). These terms were entered to allow for the inclusion of articles that listed the word jointly with another term. For instance, the terms “gender” or “women” includes results that mention “gender equality” or “women’s rights” respectively. The search was limited to materials published in 2005 or later in order to limit the scope of this search to only the most recent literature.²¹ Although the search was restricted to material published during or after 2005, data for cited studies may have been collected prior to then. In addition to the terms cited below, reference lists for the papers located were also searched to locate additional sources.

Table 1: List of search terms used to find literature for this review. Results must have contained an entry from Term 1 AND Term 2 in order to be located. Asterisks indicate the use of a wild-card term, which can represent any ending to the query. For example, the search term Forest* will include results that have the terms “forest”, “forests”, or “forested”. Terms in italics were used in searches with a third term, either “climate change” or “global warming”.

TERM 1	TERM 2
Gender*	Climate change Sustain* cit*
Sex	Global Warming Climate polic*
Women*	Water Action
Female	Forest* Activit*
	Land use* Adapt*
	Tenure Mitig*
	Natural resource* Vulnerb*
	Marine resource IPCC
	Sustain* deve* UNFCCC
	biodivers* REDD*
	Climate finac* <i>Physical health</i>
	Climate justice <i>Mental health</i>
	Ocean <i>Mortality</i>
	Fisher* <i>Morbidity</i>
	Hurricane <i>Injur*</i>
	Flood <i>Pregnan*</i>
	Storm <i>Malaria</i>
	Drought <i>Denfue</i>
	Energy* <i>Cholera</i>
	Resource use* <i>Schistosomiasis</i>
	Consum* <i>Gender-based violence</i>
	Urbaniz* <i>Safety</i>

²¹ In a small number of cases, references published before this date which are especially important/influential in particular subfields were added to the review.

Works Cited

- Björnberg KE, Hansson SO (2013) Gendering local climate adaptation. *Local Environ* 18(2):217–232.
- Rohr U (2007) *Gender, climate change and adaptation. Introduction to the gender dimensions* (genanet).
- Pettengell C (2010) *Climate change adaptation: enabling people living in poverty to adapt* (Oxfam GB).
- Alston M (2013) Introducing gender and climate change: research, policy and action. *Research, Action and Policy: Addressing the Gendered Impacts of Climate Change*, eds Alston M, Whittenbury K (Springer Netherlands, Dordrecht), pp 3–14.
- Alston M (2015) *Women and Climate Change in Bangladesh* (Routledge, New York).
- Nelson V (2010) *Climate change and gender: what role for agricultural research among smallholder farmers in Africa?* (Natural Resources Institute University of Greenwich, Greenwich, UK).
- Alston M (2014) Gender mainstreaming and climate change. *Womens Stud Int Forum* 47:287–294.
- Kaijser A, Kronsell A (2014) Climate change through the lens of intersectionality. *Environ Polit* 23(3):417–433.
- Nagel J (2012) Intersecting identities and global climate change. *Identities* 19(4):467–476.
- Terry G (2009) No climate justice without gender justice: an overview of the issues. *Gend Dev* 17(1):5–18.
- Alber G (2011) *Gender, cities and climate change*.
- Räty R, Carlsson-Kanyama A (2010) Energy consumption by gender in some European countries. *Energy Policy* 38(1):646–649.
- Lambrou Y, Piana G (2006) *Gender: the missing component of the response to climate change* (Food and Agriculture Organization, Rome, Italy).
- Tirado C, Zanev C, Mahy L (2011) *Enhancing women's leadership to address the challenges of climate change on nutrition security and health* (Public Health Institute, World Food Program, UN Standing Committee on Nutrition, and Action Against Hunger).
- Enarson E, Fothergill A, Peek L (2007) Gender and disaster: foundations and directions. *Handbook of Disaster Research*, eds Rodríguez H, Quarantelli EL, Dynes RR (Springer New York, New York, NY), pp 130–146.
- Bradshaw S, Fordham M (2015) Double disaster: disaster through a gender lens. *Hazards, Risks and Disasters in Society*, eds Collins AE, Jones S, Manyena B, Jayawickrama J (Academic Press, Boston), pp 233–251.
- Bäthge S (2010) *Climate change and gender: economic empowerment of women through climate mitigation and adaptation?* (GTZ).
- Brody A, Demetriades J, Esplen E (2008) *Gender and climate change: mapping the linkages* (Institute of Development Studies).
- Goh AHX (2012) *A literature review of the gender-differentiated impacts of climate change on women's and men's assets and well-being in developing countries* (CAPRI).
- Otzelberger A (2011) *Gender-responsive strategies on climate change: recent progress and ways forward for donors* (Institute of Development Studies).
- Schipper L, Langston L (2014) *Gender equality and climate compatible development drivers and challenges to people's empowerment* (Climate and Development Knowledge Network).
- Skinner E (2011) *Gender and climate change overview report* (Institute of Development Studies).
- Nelson V (2011) *Gender, generations, social protection & climate change: a thematic review* (Overseas Development Institute, London).
- World Health Organization (2014) *Gender, Climate Change and Health* (Geneva, Switzerland).
- Nagel J (2016) *Gender and Climate Change: Impacts, Science, Policy* (Routledge, New York).
- Dunn L ed. (2013) *Working paper series number 7: gender, climate change and disaster risk management* (Institute of Gender and Development Studies and Friedrich Ebert Stiftung, Kingston, Jamaica).
- Alston M, Whittenbury K eds. (2013) *Research, Action and Policy: Addressing the Gendered Impacts of Climate Change* (Springer, New York).
- Dankelman I (2010) *Gender and Climate Change: An Introduction* (Earthscan, Washington D.C.).
- Terry G ed. (2009) *Climate Change and Gender Justice* (Practical Action Publishing, Oxford, UK).
- Enarson E, Chakrabarti PGD (2009) *Women, Gender and Disaster: Global Issues and Initiatives* (SAGE Publications, Thousand Oaks, CA).
- Enarson E (2012) *Women Confronting Natural Disaster: From Vulnerability to Resilience* (Lynne Rienner Publishers, Boulder, CO).
- David E, Enarson E eds. (2012) *The Women of Katrina: How Gender, Race, and Class Matter in an American Disaster* (Vanderbilt University Press, Nashville, TN).
- Buechler S, Hanson AMS eds. (2015) *A Political Ecology of Women, Water and Global Environmental Change* (Routledge, New York).
- Williams M (2016) *Gender and Climate Change Financing: Coming Out of the Margin* (Routledge, New York).
- Lambrou Y, Nelson S (2010) *Farmers in a changing climate does gender matter?* (Food and Agriculture Organization, Rome, Italy).
- Nelson V, Morton J, Forsythe L, Martin A, Hartog M (2015) *Achieving dryland women's empowerment: environmental resilience and social transformation imperatives* (Natural Resources Institute University of Greenwich).
- Pearl-Martinez R (2014) *Women at the forefront of the clean energy future* (IUCN-USAID, Washington D.C.).
- Shardul A, Carraro M (2010) *Assessing the role of microfinance in fostering adaptation to climate change* (OECD).
- Mitchell T, Tanner T, Lussier K (2007) *We know what we need: South Asian women speak out on climate change adaptation* (Institute of Development Studies University of Sussex).
- Rodenberg B (2009) *Climate change adaptation from a gender perspective* (German Development Institute, Bonn, Germany).
- Aguilar L, Granat M, Owren C (2015) *Roots for the Future* (IUCN and GGCA, Washington D.C.).
- Bunce A, Ford J (2015) How is adaptation, resilience, and vulnerability research engaging with gender? *Environ Res Lett* 10(12):123003.
- Rohr U, Hemmati M, Lambrou Y (2009) Towards gender equality in climate change policy: challenges and perspectives for the future. *Women Gender and Disaster: Global Issues and Initiatives*, eds Enarson E, Chakrabarti PGD (Sage Publications), pp 289–303.
- IUCN (2015) Women's Participation in Global Environmental Decision Making. Available at: <http://genderandenvironment.org/2015/09/new-egi-data-on-womens-participation-in-global-environmental-decision-making/> [Accessed May 8, 2016].
- Fisher M, Carr ER (2015) The influence of gendered roles and responsibilities on the adoption of technologies that mitigate drought risk: the case of drought-tolerant maize seed in eastern Uganda. *Glob Environ Change-Hum Policy Dimens* 35:82–92.
- Alston M (2012) Rural male suicide in Australia. *Soc Sci Med* 74(4):515–522.
- Bryant L, Garnham B (2015) The fallen hero: masculinity, shame and farmer suicide in Australia. *Gend Place Cult* 22(1):67–82.
- Dankelman I, et al. (2008) *Gender, climate change and human security: Lessons from Bangladesh, Ghana and Senegal* (Women's Environment and Development Association and ABANTU).
- Porter JR, et al. (2014) Food security and food production systems. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change*, eds Field CB, et al. (Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA), pp 485–533.
- Wheeler T, von Braun J (2013) Climate change impacts on global food security. *Science* 341(6145):508.
- Mary Robinson Foundation - Climate Justice (2015) *Women's participation: an enabler of climate justice* (Dublin).
- European Institute for Gender Equality (2012) *Review of the Implementation in the EU of area K of the Beijing Platform for Action: Women and the Environment*.
- Aguilar L, Owren C (2015) From Global Standards to Local Action. *Roots for the Future*, pp 81–127.
- Kruse J (2014) Women's representation in the UN climate change negotiations: a quantitative analysis of state delegations, 1995–2011. *Int Environ Agreem-Polit Law Econ* 14(4):349–370.
- IUCN (2013) *The Environment and Gender Index* (EGI) 2013 Pilot (IUCN, Washington D.C.).
- GIZ (2013) *Gender and rural development: aspects, approaches and good practices* (Bonn).
- IFAD (2012) *Gender equality and women's empowerment policy* (Rome).
- Government of Ghana (2010) *Agriculture gender strategy* (Accra).
- USAID, IUCN (2015) *Cameroon, Ghana & Uganda's Gender & REDD+ roadmaps* (USAID and IUCN, Washington D.C.).
- FAO (2007) *Gender mainstreaming in forestry in Africa* (Rome, Italy).
- FAO, RECOFTC (2015) *Mainstreaming gender into forest policies in Asia and the Pacific* (Bangkok).
- Lentisco A (2012) *Gender mainstreaming strategy for the Regional Fisheries Livelihoods Programme for South and Southeast Asia* (FAO, Rome, Italy).
- Lentisco A, Alonso E (2012) On gender mainstreaming strategies and tools in fisheries development projects: RFLP gender strategy and lessons from the Asia-Pacific Region. *Asian Fish Sci* 25:105–117.
- FAO (2007) *Gender policies for responsible fisheries* (Rome, Italy).
- Okyere Nyako A, Owusu A, Torell E (2015) *Gender mainstreaming strategy the USAID/Ghana Sustainable Fisheries Management Project* (SFMP) (University of Rhode Island Coastal Resources Center, Narragansett, RI).
- ECOWAS (2015) *Draft ECOWAS policy for gender mainstreaming in energy access*.
- United Nations Industrial Development Organization, UN Women (2013) *Sustainable energy for all: the gender dimensions*.
- Energy Sector Management Assistance Program (2013) *Integrating gender considerations into energy operations* (World Bank, Washington D.C.).
- Southern African Development Community (2015) *Mainstreaming gender in the SADC energy sector* (SADC, Gaborone).
- World Bank Water and Sanitation Program (2010) *Gender in water and sanitation* (Nairobi).
- Gender and Water Alliance and UNDP (2006) *Mainstreaming gender in water management*.
- Government of Uganda (2010) *Water and sanitation sub-sector gender strategy (2010-15)* (Kampala).
- WHO (2009) *Strategy for integrating gender analysis and actions into the work of WHO* (Geneva).
- Southern African Development Community (2011) *Gender mainstreaming guidelines for HIV and AIDS, tuberculosis and malaria* (Gaborone).
- Pendleton J, Mellish M, Sapuwa H, Irani L (2015) *Gender and reproductive health policy in Malawi* (USAID and Health Policy Project).
- UNISDR (2009) *UNISDR policy on gender mainstreaming in disaster risk reduction*.
- Huyer S (2016) *Gender and international climate policy* (CGIAR Research Program on Climate Change, Agriculture and Food Security).
- Bastian L, Gilligan M, Clabots B (2016) *Gender and protected areas: exploring national reporting to the Ramsar Convention and the World Heritage Convention* (IUCN, Washington D.C.).
- Acosta M, Ampaire E, Okolo W, Twyman J (2015) *Gender and climate change in Uganda: effects of policy and institutional frameworks* (CGIAR Research Program on Climate Change, Agriculture and Food Security).
- Hepworth N (2010) *Climate change vulnerability and adaptation preparedness in Uganda* (Heinrich Böll Stiftung East & Horn of Africa, Nairobi).
- Green Climate Fund (2015) *Green Climate Fund project briefs 2015* (Songdo).
- Heinrich Boll Stiftung North America (2016) *Green Climate Fund: the basics*.
- Climate Investment Funds (2015) *Empowering a greener future: annual report 2015*.
- Global Environment Facility (2014) *GEF-6 programming directions*.
- Fenhann J, Hinostroza M (2011) *CDM information and guidebook* (United Nations Environmental Programme).
- TANGO International, Overseas Development Institute (2015) *Independent evaluation of the Adaptation Fund* (World Bank, Washington D.C.).
- Schalatek L, Aguilar L, Garant M (2015) Unlocking the door to action:

- gender-responsive climate finance. *Roots for the Future*, pp 328–381.
88. Schalatek L (2009) *Gender and climate finance: double mainstreaming for sustainable development* (Heinrich Böll Foundation North America, Washington D.C.).
89. Global Environment Facility (2008) *Mainstreaming gender at the GEF* (Washington D.C.).
90. Green Climate Fund (2015) *Gender policy and action plan* (Songdo).
91. Schalatek L (2015) *From innovative mandate to meaningful implementation: ensuring gender-responsive Green Climate Fund (GCF) projects and programs* (Heinrich Böll Foundation North America).
92. Aguilar L, et al. (2012) Gender Review of the CIF.
93. Climate Investment Funds (2014) CIF Gender Action Plan.
94. Climate Investment Funds (2016) *CIF Gender Action Plan - Phase 2*.
95. Global Environment Facility (2011) *Policy on gender mainstreaming*.
96. Global Environment Facility (2014) Gender Equality Action Plan.
97. Global Environment Facility (2013) *Review of GEF agencies on environmental and social safeguards and gender mainstreaming* (Washington D.C.).
98. Ministry for Foreign Affairs of Finland (2010) *Gender and the Clean Development Mechanism*.
99. Adaptation Fund (2016) *Gender Policy of the Adaptation Fund*.
100. Ergas C, York R (2012) Women's status and carbon dioxide emissions: a quantitative cross-national analysis. *Soc Sci Res* 41(4):965–976.
101. McKinney LA, Fulkerson GM (2015) Gender equality and climate justice: a cross-national analysis. *Soc Justice Res* 28(3):293–317.
102. Nugent C, Shandra JM (2009) State environmental protection efforts, women's status, and world polity: a cross-national analysis. *Organ Environ* 22(2):208–229.
103. Norgaard K, York R (2005) Gender equality and state environmentalism. *Gen Soc* 19(4):506–522.
104. Liao L, Luo L, Tang Q (2012) Gender diversity, board independence, environmental committee and greenhouse gas disclosure. *Br Account Rev* 47(4):409–424.
105. Terrapon-Pfaff J, Dienst C, Ortiz W (2015) The role of gender concerns in the planning of small-scale energy projects in developing countries. *Decentralized Solutions for Developing Economies: Addressing Energy Poverty Through Innovation*, eds Groh S, et al. (Springer International Publishing, Cham), pp 285–294.
106. Olsson L, et al. (2014) Livelihoods and poverty. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change*, eds Field CB, et al. (Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA), pp 793–832.
107. Peterman A, Behrman JA, Quisumbing AR (2014) A review of empirical evidence on gender differences in nonland agricultural inputs, technology, and services in developing countries. *Gender in Agriculture: Closing the Knowledge Gap*, eds Quisumbing RA, et al. (Springer Netherlands, Dordrecht), pp 145–186.
108. Ragasa C (2012) *Gender and institutional dimensions of agricultural technology adoption: a review of literature and synthesis of 35 case studies* Available at: <http://ageconsearch.umn.edu/bitstream/126747/2/IAAE.2012.gender.pdf>.
109. Beuchelt TD, Badstue L (2013) Gender, nutrition- and climate-smart food production: opportunities and trade-offs. *Food Secur* 5(5):709–721.
110. Altieri MA, Nicholls CI, Henao A, Lana MA (2015) Agroecology and the design of climate change-resilient farming systems. *Agron Sustain Dev* 35(3):869–890.
111. Benin S, Smale M, Pender J (2006) Explaining the diversity of cereal crops and varieties grown on household farms in the highlands of northern Ethiopia. *Valuing Crop Biodiversity*, ed Smale M (CABI Publishing, Washington D.C.).
112. Bee B (2013) Who reaps what is sown? A feminist inquiry into climate change adaptation in two Mexican ejidos. *ACME Int E-J Crit Geogr* 12(1):131–154.
113. Carr ER (2008) Men's crops and women's crops: the importance of gender to the understanding of agricultural and development outcomes in Ghana's Central Region. *World Dev* 36(5):900–915.
114. Gentle P, Thwaites R, Race D, Alexander K (2014) Differential impacts of climate change on communities in the middle hills region of Nepal. *Nat Hazards* 74(2):815–836.
115. Rana RB, Garforth C, Sthapit B, Jarvis D (2007) Influence of socio-economic and cultural factors in rice varietal diversity management on-farm in Nepal. *Agric Hum Values* 24(4):461–472.
116. Nuijten E (2010) Gender and management of crop diversity in The Gambia. *J Polit Ecol* 17:42–58.
117. Howard PL (2006) Gender and social dynamics in swidden and homegardens in Latin America. *Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry*, eds Kumar BM, Nair PKR (Springer Netherlands), pp 159–182.
118. Chambers KJ, Momsen JH (2007) From the kitchen and the field: gender and maize diversity in the Bajío region of Mexico. *Singap J Trop Geogr* 28(1):39–56.
119. Aguilar-Støen M, Moe SR, Camargo-Ricalde SL (2009) Home gardens sustain crop diversity and improve farm resilience in Candelaria Loxicha, Oaxaca, Mexico. *Hum Ecol* 37(1):55–77.
120. Zimmerer KS (2011) The landscape technology of spate irrigation amid development changes: Assembling the links to resources, livelihoods, and agrobiodiversity-food in the Bolivian Andes. *Glob Environ Change* 21(3):917–934.
121. Keleman A, Hellin J, Bellon MR (2009) Maize diversity, rural development policy, and farmers' practices: lessons from Chiapas, Mexico. *Geogr J* 175(1):52–70.
122. Hellin J, Keleman A, Bellon M (2010) Maize diversity and gender: research from Mexico. *Gen Dev* 18(3):427–437.
123. Gautam R, et al. (2009) Home gardens management of key species in Nepal: a way to maximize the use of useful diversity for the well-being of poor farmers. *Plant Genet Resour* 7(2):142–153.
124. Oakley E, Momsen J (2005) Gender and agrobiodiversity: a case study from Bangladesh. *Geogr J* 171(3):195–208.
125. Ali AMS (2005) Homegardens in smallholder farming systems: examples From Bangladesh. *Hum Ecol* 33(2):245–270.
126. Köhler-Rollefson I (2012) *Invisible guardians - women manage livestock diversity* (Food and Agriculture Organization, Rome).
127. Kristjanson P, et al. (2010) *Livestock and women's livelihoods: a review of the recent evidence* (International Livestock Research Institute).
128. Kryger KN, Thomsen KA, Whyte MA, Dissing M (2010) *Smallholder poultry production-livelihoods, food security and sociocultural significance* (Food and Agriculture Organization, Rome).
129. Paudel LN, ter Meulen U, Wollny C, Dahal H, Gaully M (2009) Gender aspects in livestock farming: pertinent issues for sustainable livestock development in Nepal. 21(3).
130. Thomsen K, Chrysostome C, Houndonougbo F (2005) Strategies for income generation and marketing within the local context—the case of smallholder poultry production and micro credits in Benin (Copenhagen).
131. Kipuri N, Ridgewell A (2008) *A double bind: the exclusion of pastoralist women in the east and horn of Africa* (Minority Rights Group International).
132. Nardone A, Ronchi B, Lacetera N, Ranieri MS, Bernabucci U (2010) Effects of climate changes on animal production and sustainability of livestock systems. *Livest Sci* 130(1–3):57–69.
133. Calvosa C, Chuluunbaatar D, Fara K (2009) *Livestock and climate change* (International Fund for Agricultural Development, Rome).
134. Chanamoto NJC, Hall SJG (2015) Gender equality, resilience to climate change, and the design of livestock projects for rural livelihoods. *Gen Dev* 23(3):515–530.
135. Hoffmann I (2013) Adaptation to climate change – exploring the potential of locally adapted breeds. *animal* 7(s2):346–362.
136. FAO (2011) *The state of food and agriculture: women in agriculture closing the gender gap for development* (Food and Agriculture Organization, Rome, Italy).
137. FAO (2010) *FAO gender and land rights database* (Food and Agriculture Organization, Rome, Italy) Available at: <http://www.fao.org/gender-landrights-database/en/>.
138. Brumer A (2008) Gender relations in family-farm agriculture and rural-urban migration in Brazil. *Lat Am Perspect* 35(6):11–28.
139. Perez C, et al. (2015) How resilient are farming households and communities to a changing climate in Africa? A gender-based perspective. *Glob Environ Change-Hum Policy Dimens* 34:95–107.
140. Doss C, Deere CD, Oduro AD, Suchitra JY (2012) *The rural gender asset and wealth gaps: evidence from Ghana, Ecuador, Uganda and Karnataka, India* (Indian Institute of Management, Bangalore).
141. Behrman J, Meinzen-Dick R, Quisumbing A (2012) The gender implications of large-scale land deals. *J Peasant Stud* 39(1):49–79.
142. Paavola J (2008) Livelihoods, vulnerability and adaptation to climate change in Morogoro, Tanzania. *Environ Sci Policy* 11(7):642–654.
143. Djoudi H, Brockhaus M, Locatelli B (2013) Once there was a lake: vulnerability to environmental changes in northern Mali. *Reg Environ Change* 13(3):493–508.
144. Jacobs K, Namy S, Kes A, Bob U, Moodley V (2011) *Gender differences in asset rights in KwaZulu-Natal, South Africa* (International Center for Research on Women, Washington D.C.).
145. Ding WQ, et al. (2014) Evaluation of the livelihood vulnerability of pastoral households in Northern China to natural disasters and climate change. *Rangel J* 36(6):535–543.
146. Radel C, Schmook B, McEvoy J, Mendez C, Petrzela P (2012) Labour migration and gendered agricultural relations: the feminization of agriculture in the Ejidal sector of Calakmul, Mexico. *J Agrar Change* 12(1):98–119.
147. Berge E, Kambewa D, Munthali A, Wiig H (2014) Lineage and land reforms in Malawi: Do matrilineal and patrilineal landholding systems represent a problem for land reforms in Malawi? *Land Use Policy* 41:61–69.
148. Flutschner D, Kenney L (2014) Rural women's access to financial services: credit, savings, and insurance. *Gender in Agriculture: Closing the Knowledge Gap*, eds Quisumbing RA, et al. (Springer Netherlands, Dordrecht), pp 187–208.
149. Antwi-Agyei P, Dougill AJ, Stringer LC (2015) Impacts of land tenure arrangements on the adaptive capacity of marginalized groups: The case of Ghana's Ejura Sekyedumase and Bongo districts. *Land Use Policy* 49:203–212.
150. Johnson NL, Kovarik C, Meinzen-Dick R, Njuki J, Quisumbing AR (2015) *Gender, assets, and agricultural development: lessons from eight projects* (International Food Policy Research Institute, Washington D.C.).
151. Tall A, Kristjanson P, Chaudhury M, McKune S, Zougmore R (2014) *Who gets the information? gender, power and equity considerations in the design of climate services for farmers* (CGIAR Research Program on Climate Change, Agriculture and Food Security).
152. Kinkingninhoum-Médagbé FM, Diagne A, Simtowe F, Agboh-Noameshie AR, Adégbola PY (2010) Gender discrimination and its impact on income, productivity, and technical efficiency: evidence from Benin. *Agric Hum Values* 27(1):57–69.
153. Glazebrook T (2011) Women and climate change: a case-study from Northeast Ghana. *Hypatia - J Fem Philos* 26(4):762–782.
154. Wanjiku J, Manyengo JU, Oluoch-Kosura W, Karugia JT (2007) *Gender differentiation in the analysis of alternative farm mechanization choices on small farms in Kenya* (United Nations University).
155. van Koppen B, Hope L, Colenbrander W (2012) *Gender aspects of small-scale private irrigation in Africa* (International Water Management Institute, Colombo).
156. Huynh PTA, Resurreccion BP (2014) Women's differentiated vulnerability and adaptations to climate-related agricultural water scarcity in rural Central Vietnam. *Clim Dev* 6(3):226–237.
157. DFID (2006) *Water demand management in areas of groundwater over-exploitation: water demand management - strategy formulation final report (Annex B - case studies)* (DFID, London, UK).
158. Harris LM (2006) Irrigation, gender, and social geographies of the changing waterscapes of southeastern Anatolia. *Environ Plan Soc Space* 24(2):187–213.
159. Harris LM (2008) Water rich, resource poor: intersections of gender, poverty, and vulnerability in newly irrigated areas of southeastern Turkey. *World Dev* 36(12):2643–2662.
160. Gallina A (2010) *Gender aware approaches in agricultural programmes – international literature review* (Sida).
161. Kondylis F, Mueller V, Sheriff G, Zhu S (2014) *Policy experiment in Mozambique highlights importance of gender in dissemination of sustainable land management techniques* (International Food Policy Research Institute, Washington D.C.).
162. FAO (2010) *“Climate-smart” agriculture policies, practices and financing for food security, adaptation and mitigation* (Food and Agriculture Organization, Rome).
163. Twyman J, et al. (2014) *Adaptation actions in Africa: evidence that gender matters* (CGIAR Research Program on Climate Change, Agriculture and Food Security).
164. Mungai C, et al. (2017) Uptake of climate-smart agriculture through a gendered intersectionality lens: experiences from Western Kenya.

- Climate Change Adaptation in Africa: Fostering African Resilience and Capacity to Adapt*, eds Filho WL, et al. (Springer, Berlin).
165. Ahmed S, Fajber E (2009) Engendering adaptation to climate variability in Gujarat, India. *Gend Dev* 17(1):33–50.
166. Bhattarai B, Beilin R, Ford R (2015) Gender, agrobiodiversity, and climate change: a study of adaptation practices in the Nepal Himalayas. *World Dev* 70:122–132.
167. Jones L, Boyd E (2011) Exploring social barriers to adaptation: insights from Western Nepal. *Glob Environ Change* 21(4):1262–1274.
168. Deressa TT, Hassan RM, Ringler C, Alemu T, Yesuf M (2009) Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Glob Environ Change-Hum Policy Dimens* 19(2):248–255.
169. Gebrehiwot T, van der Veen A (2013) Farm level adaptation to climate change: the case of farmer's in the Ethiopian Highlands. *Environ Manage* 52(1):29–44.
170. Djoudi H, Brockhaus M (2011) Is adaptation to climate change gender neutral? Lessons from communities dependent on livestock and forests in northern Mali. *Int For Rev* 13(2):123–135.
171. Seo SN, Mendelsohn R (2008) An analysis of crop choice: adapting to climate change in South American farms. *Ecol Econ* 67(1):109–116.
172. Seo SN, McCarl BA, Mendelsohn R (2010) From beef cattle to sheep under global warming? An analysis of adaptation by livestock species choice in South America. *Ecol Econ* 69(12):2486–2494.
173. Alem Y, Bezabih M, Kassie M, Zikhali P (2010) Does fertilizer use respond to rainfall variability? Panel data evidence from Ethiopia. *Agric Econ* 41(2):165–175.
174. Molua EL (2011) Farm income, gender differentials and climate risk in Cameroon: typology of male and female adaptation options across agroecologies. *Sustain Sci* 6(1):21–35.
175. Ndiritu SW, Kassie M, Shiferaw B (2014) Are there systematic gender differences in the adoption of sustainable agricultural intensification practices? Evidence from Kenya. *Food Policy* 49, Part 1:117–127.
176. Nhemachena C, Hassan R (2007) *Micro-level analysis of farmers' adaptation to climate change in southern Africa* (International Food Policy Research Institute, Washington D.C.).
177. Kibue GW, et al. (2016) Farmers' perceptions of climate variability and factors influencing adaptation: evidence from Anhui and Jiangsu, China. *Environ Manage*:1–11.
178. Van Aelst K, Holvoet N (2016) Intersections of gender and marital status in accessing climate change adaptation: evidence from rural Tanzania. *World Dev* 79:40–50.
179. Silvestri S, Bryan E, Ringler C, Herrero M, Okoba B (2012) Climate change perception and adaptation of agro-pastoral communities in Kenya. *Reg Environ Change* 12(4):791–802.
180. Bryan E, et al. (2013) Adapting agriculture to climate change in Kenya: household strategies and determinants. *J Environ Manage* 114:26–35.
181. Onta N, Resurreccion BP (2011) The role of gender and caste in climate adaptation strategies in Nepal. *Mt Res Dev* 31(4):351–356.
182. United Nations, Oxfam International (2009) *Responding to climate change in Viet Nam: opportunities for improving gender equality*.
183. Nelson V, Stathers T (2009) Resilience, power, culture, and climate: a case study from semi-arid Tanzania, and new research directions. *Gend Dev* 17(1):81–94.
184. Keshavarz M, Karami E, Vanclay F (2013) The social experience of drought in rural Iran. *Land Use Policy* 30(1):120–129.
185. Tatlonghari GT, Paris TR (2013) Gendered adaptations to climate change: a case study from the Philippines. *Research, Action and Policy: Addressing the Gendered Impacts of Climate Change*, eds Alston M, Whittenbury K (Springer, New York), pp 237–250.
186. Hisali E, Birungi P, Buyinza F (2011) Adaptation to climate change in Uganda: evidence from micro level data. *Glob Environ Change* 21(4):1245–1261.
187. Eriksen SH, Brown K, Kelly PM (2005) The dynamics of vulnerability: locating coping strategies in Kenya and Tanzania. *Geogr J* 171(4):287–305.
188. Coulibaly JY, Gbetibouo GA, Kundhlande G, Sileshi GW, Beedy TL (2015) Responding to crop failure: understanding farmers' coping strategies in Southern Malawi. *Sustainability* 7(2):1620–1636.
189. Simtowe FP (2010) Livelihoods diversification and gender in Malawi. *Afr J Agric Res* 5(3):204–216.
190. Eriksen S, Silva JA (2009) The vulnerability context of a savanna area in Mozambique: household drought coping strategies and responses to economic change. *Environ Sci Policy* 12(1):33–52.
191. Kakota T, Nyariki D, Mkwambisi D, Kogi-Makau W (2011) Gender vulnerability to climate variability and household food insecurity. *Clim Dev* 3(4):298–309.
192. Angula M (2010) *Gender and Climate Change: Namibia Case Study* (Heinrich Böll Foundation Southern Africa, Cape Town, South Africa).
193. Alston M (2006) The gendered impact of drought. *Rural Gender Relations*, eds Bock B, Shortall S (CAB International, Cambridge, MA), pp 165–180.
194. Fletcher AJ, Knuttila E (2016) Gendering change: Canadian farm women respond to drought. *Vulnerability and Adaptation to Drought: The Canadian Prairies and South America*, eds Diaz H, Hurlbert M, Warren J (University of Calgary Press, Calgary, Alberta), pp 159–177.
195. Alston M, Whittenbury K (2013) Does climatic crisis in Australia's food bowl create a basis for change in agricultural gender relations? *Agric Hum Values* 30(1):115–128.
196. Buechler S (2009) Gender, water, and climate change in Sonora, Mexico: implications for policies and programmes on agricultural income-generation. *Gend Dev* 17(1):51–66.
197. Buechler S (2012) Gendered fruit and vegetable home processing near the US-Mexico border. *Gender and Sustainability: Lessons from Asia and Latin America* (University of Arizona Press, Tucson, AZ).
198. Segnestam L (2009) Division of capitals—what role does it play for gender-differentiated vulnerability to drought in Nicaragua? *Community Dev* 40(2):154–176.
199. Antwi-Agyei P, Dougill AJ, Fraser EDG, Stringer LC (2013) Characterising the nature of household vulnerability to climate variability: empirical evidence from two regions of Ghana. *Environ Dev Sustain* 15(4):903–926.
200. Brockhaus M, Djoudi H, Locatelli B (2013) Envisioning the future and learning from the past: adapting to a changing environment in northern Mali. *Environ Sci Policy* 25:94–106.
201. Ibnouf FO (2011) Challenges and possibilities for achieving household food security in the Western Sudan region: the role of female farmers. *Food Secur* 3(2):215–231.
202. Maharjan A, Bauer S, Knerr B (2012) Do rural women who stay behind benefit from male out-migration? A case study in the hills of Nepal. *Gend Technol Dev* 16(1):95–123.
203. Desai S, Banerji M (2008) Negotiated identities: Male migration and left-behind wives in India. *J Popul Res* 25(3):337–355.
204. Buechler S (2005) Women at the helm of irrigated agriculture in Mexico: the other side of male migration. *Opposing Currents: The Politics of Water and Gender in Latin America*, eds Bennett V, Davila-Poblete S, Nieves Rico M (University of Pittsburgh Press, Pittsburgh, PA), pp 170–189.
205. Taylor MJ, Moran-Taylor MJ, Rodman Ruiz D (2006) Land, ethnic, and gender change: Transnational migration and its effects on Guatemalan lives and landscapes. *Geoforum* 37(1):41–61.
206. Seppälä R, Buck A, Katila P (2009) *Adaptation of forests and people to climate change: a global assessment report* (International Union of Forest Research Organizations).
207. Gurung J (2011) Women's exclusion from forestry. *Forests and Gender*, eds Aguilar L, Shaw D, Quesada-Aguilar A (IUCN, Gland, Switzerland), pp 19–23.
208. Schmink M, Gómez-García MA (2015) *Under the canopy: gender and forests in Amazonia* (Centre for International Forestry Research, Bogor, Indonesia).
209. Blomley T (2013) *Lessons learned from community forestry in Africa and their relevance for REDD+* (USAID-supported Forest Carbon, Markets and Communities (FCMC) Program, Washington D.C.).
210. Agarwal B (2010) *Gender and green governance: the political economy of women's presence* (Oxford University Press, Oxford) Available at: <http://dx.doi.org/10.1093/acprof:oso/9780199569687.001.0001>.
211. Benjamin AE (2010) Women in community forestry organizations: an empirical study in Thailand. *Scand J For Res* 25(sup9):62–68.
212. Agrawal A, Chhatre A (2006) Explaining success on the commons: community forest governance in the Indian Himalaya. *World Dev* 34(1):149–166.
213. Agarwal B (2009) Gender and forest conservation: the impact of women's participation in community forest governance. *Ecol Econ* 68(11):2785–2799.
214. Leisher C, et al. (2015) Does the gender composition of forest and fishery management groups affect resource governance and conservation outcomes: a systematic map protocol. *Environ Evid* 4(1):1–7.
215. Coleman EA, Mwangi E (2013) Women's participation in forest management: a cross-country analysis. *Glob Environ Change* 23. doi:10.1016/j.gloenvcha.2012.10.005.
216. Wunder S, Börner J, Shively G, Wyman M (2014) Safety nets, gap filling and forests: a global-comparative perspective. *World Dev* 64, Supplement 1:S29–S42.
217. Kalaba FK, Quinn CH, Dougill AJ (2013) The role of forest provisioning ecosystem services in coping with household stresses and shocks in Miombo woodlands, Zambia. *Ecosyst Serv* 5:143–148.
218. Fisher M, Chaudhury M, McCusker B (2010) Do forests help rural households adapt to climate variability? Evidence from Southern Malawi. *World Dev* 38(9):1241–1250.
219. Shackleton C, Delang CO, Shackleton S, Shanley P (2011) Non-timber forest products: concept and definitions. *Non-Timber Forest Products in the Global Context*, eds Shackleton S, Shackleton C, Shanley P (Springer Berlin Heidelberg, Berlin, Heidelberg), pp 3–21.
220. Shackleton S, Delang CO, Angelsen A (2011) From subsistence to safety nets and cash income: exploring the diverse values of non-timber forest products for livelihoods and poverty alleviation. *Non-Timber Forest Products in the Global Context*, eds Shackleton S, Shackleton C, Shanley P (Springer Berlin Heidelberg, Berlin, Heidelberg), pp 55–81.
221. Shackleton C, Shackleton S (2004) The importance of non-timber forest products in rural livelihood security and as safety nets: a review of evidence from South Africa. *South Afr J Sci* 100(11/12):658–664.
222. Paumgarten F, Shackleton CM (2011) The role of non-timber forest products in household coping strategies in South Africa: the influence of household wealth and gender. *Popul Environ* 33(1):108–131.
223. Woittiez LS, Rufino MC, Giller KE, Mapfumo P (2013) The use of woodland products to cope with climate variability in communal areas in Zimbabwe. *Ecol Soc* 18(4):24.
224. Ribeiro N, Chauque A (2010) *Gender and climate change: Mozambique case study* (Heinrich Böll Foundation Southern Africa, Cape Town, South Africa).
225. Balama C, Augustino S, Eriksen S, Makonda FBS (2016) Forest adjacent households' voices on their perceptions and adaptation strategies to climate change in Kilombero District, Tanzania. *SpringerPlus* 5(1):1–21.
226. Ogra MV, Badola R (2015) Gender and climate change in the Indian Himalayas: global threats, local vulnerabilities, and livelihood diversification at the Nanda Devi Biosphere Reserve. *Earth Syst Dyn* 6(2):505–523.
227. Gurung DD, Bisht S (2014) *Women's empowerment at the frontline of adaptation: emerging issues, adaptive practices, and priorities in Nepal* (International Centre for Integrated Mountain Development, Kathmandu, Nepal).
228. Gentle P, Maraseni TN (2012) Climate change, poverty and livelihoods: adaptation practices by rural mountain communities in Nepal. *Environ Sci Policy* 21:24–34.
229. Gurung J, Giri K, Setyowati A, Lebow E (2011) *Getting REDD+ right for women: an analysis of the barriers and opportunities for women's participation in the REDD+ sector in Asia* (USAID, Washington D.C.).
230. Krause T, Collen W, Nicholas KA (2013) Evaluating safeguards in a conservation incentive program: participation, consent, and benefit sharing in indigenous communities of the Ecuadorian Amazon. *Ecol Soc* 18(4):1.
231. Peach Brown HC (2011) Gender, climate change and REDD+ in the Congo Basin forests of Central Africa. *Int For Rev* 13(2):163–176.
232. Larson AM, et al. (2015) The role of women in early REDD plus implementation: lessons for future engagement. *Int For Rev* 17(1):43–65.
233. Khadka M, Karki S, Karki BS, Kotru R, Darjee KB (2014) Gender equality challenges to the REDD+ initiative in Nepal. *Mt Res Dev* 34(3):197–207.
234. Gurung J, Kono A, Ganz D (2013) *Women's inclusion in REDD+ in Cambodia: lessons from good practices in forest, agriculture and other natural resources management sectors* (WOCAN).
235. Gurung J, Kono A, Ganz D (2014) *Women's inclusion in REDD+ in the Philippines: lessons from good practices in forest, and other natural resources management sectors* (WOCAN).
236. Gurung J, Kono A, Ganz D (2013) *Women's inclusion in REDD+ in Sri Lanka: lessons from good practices in forest, agriculture and other natural resources management sectors* (WOCAN).

237. Sumaila UR, Cheung WWL, Lam VWY, Pauly D, Herrick S (2011) Climate change impacts on the biophysics and economics of world fisheries. *Nat Clim Change* 1(9):449–456.
238. Cheung WWL, et al. (2009) Projecting global marine biodiversity impacts under climate change scenarios. *Fish Fish* 10(3):235–251.
239. Béné C, Friend RM (2011) Poverty in small-scale fisheries old issue, new analysis. *Prog Dev Stud* 11(2):119–144.
240. The Prince's Charities' International Sustainability Unit (2012) *Towards global sustainable fisheries*.
241. Harper S, Zeller D, Hauzer M, Pauly D, Sumaila UR (2013) Women and fisheries: contribution to food security and local economies. *Mar Policy* 39:56–63.
242. Monfort MC (2015) *The role of women in the seafood industry* (Food and Agriculture Organization, Rome, Italy).
243. Fröcklin S, de la Torre-Castro M, Lindström L, Jiddawi NS (2013) Fish traders as key actors in fisheries: gender and adaptive management. *AMBIO* 42(8):951–962.
244. Lentisco A, Lee RU (2015) *A review of women's access to fish in small-scale fisheries* (Food and Agriculture Organization, Rome, Italy).
245. Weeratunge N, Snyder KA, Sze CP (2010) Gleaner, fisher, trader, processor: understanding gendered employment in fisheries and aquaculture. *Fish Fish* 11(4):405–420.
246. Kleiber D, Harris LM, Vincent ACJ (2015) Gender and small-scale fisheries: a case for counting women and beyond. *Fish Fish* 16(4):547–562.
247. Matthews E, Bechtel J, Britton E, Morrison K, McClennen C (2012) *A Gender Perspective on Securing Livelihoods and Nutrition in Fish-dependent Coastal Communities* (Report to The Rockefeller Foundation from Wildlife Conservation Society, Bronx, NY).
248. Kronen M, Bender A (2007) Assessing marine resource exploitation in Lofanga, Tonga: one case study—two approaches. *Hum Ecol* 35(2):195–207.
249. Crawford B, et al. (2010) Small scale fisheries management: lessons from cockle harvesters in Nicaragua and Tanzania. *Coast Manag* 38(3):195–215.
250. Frangoudes K, Marugán-Pintos B, Pascual-Fernández JJ (2008) From open access to co-governance and conservation: the case of women shellfish collectors in Galicia (Spain). *Mar Policy* 32(2):223–232.
251. Gianelli I, Martínez G, Defeo O (2015) An ecosystem approach to small-scale co-managed fisheries: the yellow clam fishery in Uruguay. *Mar Policy* 62:196–202.
252. Narita D, Rehdanz K, Tol RSJ (2012) Economic costs of ocean acidification: a look into the impacts on global shellfish production. *Clim Change* 113(3):1049–1063.
253. Nunan F (2014) Wealth and welfare? Can fisheries management succeed in achieving multiple objectives? A case study of Lake Victoria, East Africa. *Fish Fish* 15(1):134–150.
254. Njiru M, et al. (2014) Management of Lake Victoria fishery: are we looking for easy solutions? *Aquat Ecosyst Health Manag* 17(1):70–79.
255. Hecky RE, Mugidde R, Ramlal PS, Talbot MR, Kling GW (2010) Multiple stressors cause rapid ecosystem change in Lake Victoria. *Freshw Biol* 55:19–42.
256. Nyukuri E (2016) *Gender approaches in climate compatible development: lessons from Kenya* (Climate Development Knowledge Network).
257. Lwenya C, Mbilingi B, Luombo J, Yongo E (2009) Gender integration in the management of the Lake Victoria fisheries. *Afr J Trop Hydrobiol Fish* 12(1):59–66.
258. Geheb K, et al. (2008) Nile perch and the hungry of Lake Victoria: gender, status and food in an East African fishery. *Food Policy* 33(1):85–98.
259. Nunan F, Hara M, Onyango P (2015) Institutions and co-management in East African inland and Malawi fisheries: a critical perspective. *World Dev* 70:203–214.
260. Bunce M, Rosendo S, Brown K (2010) Perceptions of climate change, multiple stressors and livelihoods on marginal African coasts. *Environ Dev Sustain* 12(3):407–440.
261. Gerrard S (2008) Quota policy and local fishing: gendered practices and perplexities. *MAST* 6(2):53–75.
262. Ajroud B, Westerman K, Edmond J (2015) Men and women as conservation partners in conflict settings. *Peace Rev* 27(2):175–180.
263. Pauly D (2006) Major trends in small-scale marine fisheries, with emphasis on developing countries and some implications for the social sciences. *MAST* 4(2):7–22.
264. Godden N (2013) Gender and declining fisheries in Lobitos, Peru: beyond pescador and ama de casa. *Research, Action and Policy: Addressing the Gendered Impacts of Climate Change*, eds Alston M, Whittenbury K (Springer, New York), pp 251–263.
265. Nowak BS (2008) Environmental degradation and its gendered impact on coastal livelihoods options among Btisi households of peninsular Malaysia. *Development* 51(2):186–192.
266. Béné C, Merten S (2008) Women and fish-for-sex: transactional sex, HIV/AIDS and gender in African fisheries. *World Dev* 36(5):875–899.
267. Njiru M, Kazungu J, Ngugi CC, Gichuki J, Muhoozi L (2008) An overview of the current status of Lake Victoria fishery: opportunities, challenges and management strategies. *Lakes Reserv Res Manag* 13(1):1–12.
268. Weyl OLF, Ribbink AJ, Tweddle D (2010) Lake Malawi: fishes, fisheries, biodiversity, health and habitat. *Aquat Ecosyst Health Manag* 13(3):241–254.
269. Lwenya C, Yongo E (2012) The fisherman's wife: vulnerabilities and strategies in the local economy: the case of Lake Victoria, Kenya. *Signs J Women Cult Soc* 37(3):566–573.
270. Camlin CS, Kwena ZA, Dworkin SL (2013) Jaboya vs. jakambi: status, negotiation, and HIV risks among female migrants in the “sex for fish” economy in Nyanza Province, Kenya. *AIDS Educ Prev* 25(3):216–231.
271. Mojola SA (2011) Fishing in dangerous waters: ecology, gender and economy in HIV risk. *Soc Sci Med* 72(2):149–156.
272. Nunan F (2010) Mobility and fisherfolk livelihoods on Lake Victoria: implications for vulnerability and risk. *Geoforum* 41(5):776–785.
273. MacPherson E, et al. (2012) Transactional sex and HIV: understanding the gendered structural drivers of HIV in fishing communities in southern Malawi. *J Int Aids Soc* 15. doi:10.7448/ias.15.3.17364.
274. Kathewera-Banda M, et al. (2005) Sexual violence and women's vulnerability to HIV transmission in Malawi: a rights issue. *Int Soc Sci J* 57(4):649–660.
275. Nagoli J, Holvoet K, Remme M (2010) HIV and AIDS vulnerability in fishing communities in Mangochi district, Malawi. *Ajar-Afr J Aids Res* 9(1):71–80.
276. Njaya F (2007) Governance challenges of the implementation of fisheries co-management: Experiences from Malawi. *Int J Commons* 1(1):137–153.
277. Seeley J, et al. (2012) High HIV incidence and socio-behavioral risk patterns in fishing communities on the shores of Lake Victoria, Uganda. *Sex Transm Dis* 39(6).
278. World Health Organization, United Nations Children's Fund (2010) *Progress on sanitation and drinking water: 2010 update* (Geneva).
279. Sorenson SB, Morssink C, Campos PA (2011) Safe access to safe water in low income countries: water fetching in current times. *Soc Sci Med* 72(9):1522–1526.
280. Hawkins R, Seager J (2010) Gender and water in Mongolia. *Prof Geogr* 62(1):16–31.
281. Meinzen-Dick R, Kovarik C, Quisumbing AR (2014) Gender and sustainability. *Annu Rev Environ Resour* 39:29–55.
282. Wahaj R, Hartl M (2007) *Gender and water: securing water for improved rural livelihoods: The multiple-uses system approach* (International Fund for Agricultural Development, Rome, Italy).
283. Roberts T (2010) *Water Sector Governance in Africa: Volume 1 Theory and Practice* (African Development Bank).
284. Water Supply and Sanitation Collaborative Council, Water, Engineering and Development Centre (2006) *For her it's the big issue: putting women at the centre of water supply, sanitation and hygiene* (Water Supply and Sanitation Collaborative Council, Geneva, Switzerland).
285. Were E, Roy J, Swallow B (2008) Local organisation and gender in water management: a case study from the Kenya Highlands. *J Int Dev* 20(1):69–81.
286. Onyango L, Swallow B, Roy J, Meinzen-Dick R (2007) Coping with history and hydrology: how Kenya's settlement and land tenure patterns shape contemporary water rights and gender relations in water. *Community-Based Water Law and Water Resource Management Reform in Developing Countries* (CAB International), pp 173–195.
287. O'Reilly K (2006) Women fieldworkers and the politics of participation. *Signs* 31(4):1075–1098.
288. O'Reilly K (2006) “Traditional” women, “modern” water: linking gender and commodification in Rajasthan, India. *Geoforum* 37(6):958–972.
289. Das P (2014) Women's participation in community-level water governance in urban India: the gap between motivation and ability. *World Dev* 64:206–218.
290. Sultana F, Mohanty CT, Miraglia S (2013) *Gender justice and public water for all: Insights from Dhaka, Bangladesh* (Municipal Services Project).
291. Sultana F (2009) Community and participation in water resources management: gendering and naturing development debates from Bangladesh. *Trans Inst Br Geogr* 34(3):346–363.
292. Zwartveen M, Ahmed S, Gautam SR (2014) *Diverting the Flow: Gender Equity and Water in South Asia* (Zubaan Books).
293. Becerra S, Saqalli M, Gangneron F, Dia AH (2016) Everyday vulnerabilities and “social dispositions” in the Malian Sahel, an indication for evaluating future adaptability to water crises? *Reg Environ Change* 16(5):1253–1265.
294. Stevenson EGJ, et al. (2012) Water insecurity in 3 dimensions: an anthropological perspective on water and women's psychosocial distress in Ethiopia. *Soc Sci Med* 75(2):392–400.
295. Babugura A (2010) *Gender and climate change: South Africa case study* (Heinrich Böll Foundation Southern Africa, Cape Town, South Africa).
296. Sultana F (2009) Fluid lives: subjectivities, gender and water in rural Bangladesh. *Gen Place Cult* 16(4):427–444.
297. Crow B, Odaba E (2010) Access to water in a Nairobi slum: women's work and institutional learning. *Water Int* 35(6):733–747.
298. Crow B, Davies J, Paterson S, Miles J (2013) Using GPS and recall to understand water collection in Kenyan informal settlements. *Water Int* 38(1):43–60.
299. Truelove Y (2011) (Re-)Conceptualizing water inequality in Delhi, India through a feminist political ecology framework. *Themed Issue New Fem Polit Ecol* 42(2):143–152.
300. Wutich A (2009) Intrahousehold disparities in women and men's experiences of water insecurity and emotional distress in urban Bolivia. *Med Anthropol Q* 23(4):436–454.
301. Singh N, Singh OP (2015) Climate change, water and gender: impact and adaptation in North-Eastern hills of India. *Int Soc Work* 58(3):375–384.
302. Wutich A (2012) Gender, water scarcity, and sustainability tradeoffs. *Gender and Sustainability: Lessons from Asia and Latin America*, eds Cruz-Torres ML, McElwee P (University of Arizona Press, Tucson, AZ), pp 97–120.
303. Karim KMR, Emmelin M, Resurreccion BP, Wamala S (2012) Water development projects and marital violence: experiences from rural Bangladesh. *Health Care Women Int* 33(3):200–216.
304. Birkenholtz T (2013) “On the network, off the map”: developing intervillage and intragender differentiation in rural water supply. *Environ Plan Soc Space* 31(2):354–371.
305. Crow B, Swallow B, Asamba I (2012) Community organized household water increases not only rural incomes, but also men's work. *World Dev* 40(3):528–541
306. Ilahi N, Grimard F (2000) Public infrastructure and private costs: water supply and time allocation of women in rural Pakistan. *Econ Dev Cult Change* 49(1):45–75.
307. Aladuwaka S, Momsen J (2010) Sustainable development, water resources management and women's empowerment: the Wanaraniya Water Project in Sri Lanka. *Gen Dev* 18(1):43–58.
308. de Moraes AFJ (2015) Advances and setbacks in women's participation in water management in Brazil. *A Political Ecology of Women, Water and Global Environmental Change*, eds Buechler S, Hanson AMS (Routledge, New York), pp 77–96.
309. de Moraes AFJ, Rocha C (2013) Gendered waters: the participation of women in the “One Million Cisterns” rainwater harvesting program in the Brazilian semi-arid region. *J Clean Prod* 60:163–169.
310. Cecelski E (2006) *From the Millennium Development Goals towards a gender-sensitive energy policy research and practice: empirical evidence and case studies synthesis report* (ENERGIA/DFID Collaborative Research Group on Gender and Energy, Leudsen, the Netherlands).
311. Haves E (2012) *Does energy access help women? Beyond anecdotes: a review of the evidence* (Ashden, London, UK).
312. O'Dell K, Peters S, Wharton K (2014) *Women, energy, and economic empowerment: applying a gender lens to amplify the impact of energy*

- access (Deloitte University Press).
313. World Bank and International Energy Agency (2015) *Progress toward sustainable energy 2015: global tracking framework report* (World Bank and International Energy Agency).
314. Alstone P, Niethammer C, Mendonca B, Eftimie A (2011) *Expanding women's role in Africa's modern off-grid lighting market* (Lighting Africa).
315. ENERGIA (2012) *Transmission line projects building capacity for gender mainstreaming of energy sector co-operation in Uganda: baseline study. Report to Ministry of Energy and Mineral Development and the Norwegian Embassy*.
316. World Bank Asia Sustainable and, Alternative Energy Program (2012) *Lao PDR power to the people: twenty years of national electrification* (World Bank Asia Sustainable and, Washington D.C.).
317. SIBAT (2011) *Gender mainstreaming to strengthen community based renewable energy systems in the Philippines*.
318. Omari K (2011) *Gender mainstreaming in the Botswana Power Corporation* (ENERGIA).
319. African Development Bank (2015) *Uganda Rural Electricity Access Project*.
320. Kohlin G, Sills EO, Pattanayak SK, Wilfong C (2011) *Energy, gender and development What are the linkages? Where is the evidence?* (World Bank).
321. ENERGIA (2014) *Creating conditions for gender equity in rural energy projects: experience in productive uses of renewable energy in Guatemala*.
322. ENERGIA (2014) *Creating conditions for gender equity in rural electrification projects experiences from the Nicaraguan Electrification Project (PELNICA)*.
323. Sovacool BK, et al. (2013) The energy-enterprise-gender nexus: lessons from the Multifunctional Platform (MFP) in Mali. *Renew Energy* 50:115–125.
324. Rossi A, Lambrou Y (2008) *Gender and equity issues in liquid biofuels production: minimizing the risks to maximize the opportunities* (Food and Agriculture Organization, Rome, Italy).
325. Schott C (2009) *Socio-economic dynamics of biofuel development in Asia Pacific* (Friedrich Ebert Stiftung).
326. van Eijck J, Romijn H, Balkema A, Faaij A (2014) Global experience with jatropha cultivation for bioenergy: an assessment of socio-economic and environmental aspects. *Renew Sustain Energy Rev* 32:869–889.
327. Nelson V, Lambrou Y (2011) *Scoping the gender issues in liquid biofuel value chains* (Natural Resources Institute University of Greenwich, Greenwich).
328. Rossi A, Lambrou Y (2009) *Making sustainable biofuels work for smallholder farmers and rural households* (Food and Agriculture Organization, Rome).
329. Amigun B, Musango JK, Stafford W (2011) Biofuels and sustainability in Africa. *Renew Sustain Energy Rev* 15(2):1360–1372.
330. Cotula L, Dyer N, Vermeulen S (2008) *Fuelling exclusion?: The biofuels boom and poor people's access to land* (IIED).
331. Villanueva J (2011) Oil palm expansion in the Philippines: analysis of land rights, environment and food security issues. eds Colchester M, Chao S (Forest Peoples Programme, Moreton-in-Marsh).
332. Clancy J (2013) *Biofuels and Rural Poverty* (Routledge).
333. Li TM (2015) *Social impacts of oil palm in Indonesia: a gendered perspective from West Kalimantan* (Centre for International Forestry Research, Bogor, Indonesia).
334. Julia, White B (2012) Gendered experiences of dispossession: oil palm expansion in a Dayak Hibun community in West Kalimantan. *J Peasant Stud* 39(3–4):995–1016.
335. von Braun J, et al. (2008) *High food prices: the what, who, and how of proposed policy actions* (International Food Policy Research Institute, Washington D.C.).
336. Friends of the Earth International (2009) *Women raise their voices against tree plantations: the role of the European Union in disempowering women in the South*.
337. Mota M (2009) *Potential changes in Mozambican farming systems due to Jatropha introduction for biodiesel* (Netherlands Ministry of Foreign Affairs).
338. Peters F (2009) *Socio-economic impact study of biofuel plantation on farm households in Mozambique* (Netherlands Ministry of Foreign Affairs).
339. Arndt C, Benfca R, Thurlow J (2011) Gender implications of biofuels expansion in Africa: the case of Mozambique. *World Dev* 39(9):1649–1662.
340. Marti S (2008) *Losing ground: the human rights impacts of oil palm plantation expansion in Indonesia* (FoE, LifeMosaic and SawitWatch).
341. World Rainforest Movement (2006) *Oil palm: from cosmetics to biodiesel colonization lives on*.
342. Karlsson G, Banda K (2009) *Biofuels for sustainable rural development and empowerment of women: case studies from Africa and Asia* (ENERGIA).
343. Barth B (2010) Gender mainstreaming in the climate change response of Sorsogon City. *Gender and Climate Change: An Introduction*, ed Dankelman I (Earthscan, Sterling, VA), pp 100–104.
344. Porio E (2014) Climate change vulnerability and adaptation in Metro Manila. *Asian J Soc Sci* 42(1–2):75–102.
345. Sogani R (2016) *Gender approaches in climate compatible development: Lessons from India* (Climate and Development Knowledge Network).
346. Ajibade I, McBean G, Bezner-Kerr R (2013) Urban flooding in Lagos, Nigeria: patterns of vulnerability and resilience among women. *Glob Environ Change-Hum Policy Dimens* 23(6):1714–1725.
347. Ajibade I, McBean G (2014) Climate extremes and housing rights: a political ecology of impacts, early warning and adaptation constraints in Lagos slum communities. *Geoforum* 55:76–86.
348. Willinger B, Knight J (2012) Setting the stage for disaster: Women in New Orleans before and after Katrina. *The Women of Katrina: How Gender, Race, and Class Matter in an American Disaster*, eds David E, Enarson EP (Vanderbilt University Press, Nashville, TN), pp 55–75.
349. Lowe SR, Rhodes JE, Scoglio AAJ (2012) Changes in marital and partner relationships in the aftermath of Hurricane Katrina: an analysis with low-income women. *Psychol Women Q* 36(3):286–300.
350. Fothergill A, Peek L (2015) *Children of Katrina* (University of Texas Press).
351. Zottarelli LK (2008) Post-Hurricane Katrina employment recovery: the interaction of race and place. *Soc Sci Q* 89(3):592–607.
352. Peek L, Fothergill A (2008) Displacement, gender, and the challenges of parenting after Hurricane Katrina. *NWSA J* 20(3):69–105.
353. Poulsen MN, McNab PR, Clayton ML, Neff RA (2015) A systematic review of urban agriculture and food security impacts in low-income countries. *Food Policy* 55:131–146.
354. Hovorka A, de Zeeuw H, Njenga M (2009) *Women Feeding Cities: Mainstreaming Gender in Urban Agriculture and Food Security* (Practical Action Publishing).
355. Zezza A, Tasciotti L (2010) Urban agriculture, poverty, and food security: Empirical evidence from a sample of developing countries. *Food Policy* 35(4):265–273.
356. Hovorka A, de Zeeuw H, Njenga M (2009) Gender in urban agriculture: an introduction. *Women Feeding Cities: Mainstreaming Gender in Urban Agriculture and Food Security* (Practical Action Publishing), pp 1–32.
357. Floro MS, Bali Swain R (2013) Food security, gender, and occupational choice among urban low-income households. *World Dev* 42:89–99.
358. Mkwambisi DD, Fraser EDG, Dougill AJ (2011) Urban agriculture and poverty reduction: Evaluating how food production in cities contributes to food security, employment and income in Malawi. *J Int Dev* 23(2):181–203.
359. Hovorka AJ (2006) The No. 1 Ladies' Poultry Farm: A feminist political ecology of urban agriculture in Botswana. *Gend Place Cult* 13(3):207–225.
360. Hovorka AJ (2006) Urban agriculture: addressing practical and strategic gender needs. *Dev Pract* 16(1):51–61.
361. Soto N, Merzthel G, Ordonez M, Touzet M (2009) Urban agriculture, poverty alleviation, and gender in Villa Maria del Triunfo, Peru. *Women Feeding Cities: Mainstreaming Gender in Urban Agriculture and Food Security*, eds Hovorka A, de Zeeuw H, Njenga M (Practical Action Publishing), pp 123–139.
362. Gaye G, Toure N (2009) Gender and urban agriculture in Pikine, Senegal. *Women Feeding Cities: Mainstreaming Gender in Urban Agriculture and Food Security*, eds Hovorka A, de Zeeuw H, Njenga M (Practical Action Publishing), pp 219–233.
363. Maconachie R, Binns T, Tengbe P (2012) Urban farming associations, youth and food security in post-war Freetown, Sierra Leone. *Cities* 29(3):192–200.
364. Hope L, Cofie O, Keraita B, Drechsel P (2009) Gender and urban agriculture: the case of Accra, Ghana. *Women Feeding Cities: Mainstreaming Gender in Urban Agriculture and Food Security*, eds Hovorka A, de Zeeuw H, Njenga M (Practical Action Publishing), pp 65–78.
365. Foeken DWJ, Owuor SO (2008) Farming as a livelihood source for the urban poor of Nakuru, Kenya. *Placing Splintering Urban* 39(6):1978–1990.
366. Simiyu R, Foeken D (2014) Gendered divisions of labour in urban crop cultivation in a Kenyan town: implications for livelihood outcomes. *Gend Place Cult* 21(6):768–784.
367. Van Averbeke W (2007) Urban farming in the informal settlements of Atteridgeville, Pretoria, South Africa. *Water SA* 33(3):337–342.
368. Hunter LM, Luna JK, Norton RM (2015) Environmental dimensions of migration. *Annu Rev Sociol* 41:377–397.
369. Warner K, Afifi T (2014) Where the rain falls: evidence from 8 countries on how vulnerable households use migration to manage the risk of rainfall variability and food insecurity. *Clim Dev* 6(1):1–17.
370. Chindarkar N (2012) Gender and climate change-induced migration: proposing a framework for analysis. *Environ Res Lett* 7(2). doi:10.1088/1748-9326/7/2/025601.
371. Hunter L, David E (2011) Displacement, climate change and gender. *Migration and Climate Change*, eds Piguat E, Pecoud A, de Guchteneire P (Cambridge University Press, Cambridge), pp 306–330.
372. Warner K, et al. (2012) *Where the rain falls: climate change, food and livelihood security, and migration* (Global Policy Report of the Where the Rain Falls Project. Bonn: CARE France and UNU-EHS).
373. Gray CL, Mueller V (2012) Drought and population mobility in rural Ethiopia. *World Dev* 40(1):134–145.
374. Dillon A, Mueller V, Salau S (2011) Migratory responses to agricultural risk in northern Nigeria. *Am J Agric Econ* 93(4):1048–1061.
375. Henry S, Schoumaker B, Beauchemin C (2004) The impact of rainfall on the first out-migration: a multi-level event-history analysis in Burkina Faso. *Popul Environ* 25(5):423–460.
376. Gray C, Wise E (2016) Country-specific effects of climate variability on human migration. *Clim Change* 135(3):555–568.
377. Carr ER (2005) Placing the environment in migration: environment, economy, and power in Ghana's Central Region. *Environ Plan A* 37(5):925–946.
378. Joarder MAM, Miller PW (2013) Factors affecting whether environmental migration is temporary or permanent: evidence from Bangladesh. *Glob Environ Change* 23(6):1511–1524.
379. Gray CL, Mueller V (2012) Natural disasters and population mobility in Bangladesh. *Proc Natl Acad Sci U S A* 109(16):6000–6005.
380. Mueller V, Gray C, Kosec K (2014) Heat stress increases long-term human migration in rural Pakistan. *Nat Clim Change* 4(3):182–185.
381. Massey D, Axinn W, Ghimire D (2010) Environmental change and out-migration: evidence from Nepal. *Popul Environ* 32(2–3):109–136.
382. Alston M, Whittenbury K, Haynes A, Godden N (2014) Are climate challenges reinforcing child and forced marriage and dowry as adaptation strategies in the context of Bangladesh? *Womens Stud Int Forum* 47:137–144.
383. Sugden F, et al. (2014) Agrarian stress and climate change in the Eastern Gangetic Plains: gendered vulnerability in a stratified social formation. *Glob Environ Change-Hum Policy Dimens* 29:258–269.
384. Nyantakyi-Frimpong H, Bezner-Kerr R (2015) The relative importance of climate change in the context of multiple stressors in semi-arid Ghana. *Glob Environ Change-Hum Policy Dimens* 32:40–56.
385. Afifi T (2011) Economic or environmental migration? The push factors in Niger. *Int Migr* 49(s1):e95–e124.
386. Taylor JE, López-Feldman A (2010) Does migration make rural households more productive? Evidence from Mexico. *J Dev Stud* 46(1):68–90.
387. Smith KR, et al. (2014) Human health: impacts, adaptation, and co-benefits. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change*, eds Field CB, et al. (Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA), pp 709–754.
388. Neumayer E, Plümper T (2007) The gendered nature of natural disasters: the impact of catastrophic events on the gender gap in life expectancy, 1981–2002. *Ann Assoc Am Geogr* 97(3):551–566.
389. Austin KF, McKinney LA (2016) Disaster devastation in poor nations: the direct and indirect effects of gender equality, ecological

- losses, and development. *Soc Forces*. doi:10.1093/sf/sow056.
390. Kovats RS, Hajat S (2008) Heat stress and public health: a critical review. *Annu Rev Public Health* 29(1):41–55.
391. Wong KV, Paddon A, Jimenez A (2013) Review of world urban heat islands: many linked to increased mortality. *J Energy Resour Technol* 135(2):022101–022101.
392. Gamble JL, et al. (2013) Climate change and older Americans: state of the science. *Environ Health Perspect Online* 121(1):15.
393. Kuzuya M (2013) Heatstroke in older adults. *Jpn Med Assoc J* 56(3):193–198.
394. Bell ML, et al. (2008) Vulnerability to heat-related mortality in Latin America: a case-crossover study in São Paulo, Brazil, Santiago, Chile and Mexico City, Mexico. *Int J Epidemiol* 37(4):796–804.
395. Huang W, Kan H, Kovats S (2010) The impact of the 2003 heat wave on mortality in Shanghai, China. *Sci Total Environ* 408(11):2418–2420.
396. Egondi T, et al. (2012) Time-series analysis of weather and mortality patterns in Nairobi's informal settlements. *Glob Health Action* 5:23–32.
397. Azongo DK, Awine T, Wak G, Binka FN, Oduro AR (2012) A time series analysis of weather variability and all-cause mortality in the Kasena-Nankana Districts of Northern Ghana 1995–2010. *Glob Health Action* 5:10.3402/gha.v5i0.19073.
398. Azhar GS, et al. (2014) Heat-related mortality in India: excess all-cause mortality associated with the 2010 Ahmedabad heat wave. *PLoS ONE* 9(3):e91831.
399. Berko J, Ingram DD, Saha S, Parker JD (2014) *Deaths attributed to heat, cold, and other weather events in the United States, 2006–2010* (National Center for Health Statistics).
400. Coates L, Haynes K, O'Brien J, McAnaney J, de Oliveira FD (2014) Exploring 167 years of vulnerability: an examination of extreme heat events in Australia 1844–2010. *Environ Sci Policy* 42:33–44.
401. Tong S, Wang XY, Yu W, Chen D, Wang X (2014) The impact of heatwaves on mortality in Australia: a multicity study. *BMJ Open* 4(2):e003579.
402. Haynes K, Handmer J, McAnaney J, Tibbits A, Coates L (2010) Australian bushfire fatalities 1900–2008: exploring trends in relation to the “prepare, stay and defend or leave early” policy. *Environ Sci Policy* 13(3):185–194.
403. Toulemon L, Barbieri M (2008) The mortality impact of the August 2003 heat wave in France: Investigating the “harvesting” effect and other long-term consequences. *Popul Stud* 62(1):39–53.
404. Fouillet A, et al. (2006) Excess mortality related to the August 2003 heat wave in France. *Int Arch Occup Environ Health* 80(1):16–24.
405. Fouillet A, et al. (2008) Has the impact of heat waves on mortality changed in France since the European heat wave of summer 2003? A study of the 2006 heat wave. *Int J Epidemiol* 37(2):309–317.
406. Rey G, et al. (2007) The impact of major heat waves on all-cause and cause-specific mortality in France from 1971 to 2003. *Int Arch Occup Environ Health* 80(7):615–626.
407. D'ippoliti D, et al. (2010) The impact of heat waves on mortality in 9 European cities: results from the EuroHEAT project. *Environ Health* 9(1):1.
408. Son J-Y, Lee J-T, Anderson GB, Bell ML (2012) The impact of heat waves on mortality in seven major cities in Korea. *Environ Health Perspect* 120(4):566.
409. Klinenberg E (2015) *Heat Wave: A Social Autopsy of Disaster in Chicago* (University of Chicago Press, Chicago).
410. Borrell C, et al. (2006) Socioeconomic position and excess mortality during the heat wave of 2003 in Barcelona. *Eur J Epidemiol* 21(9):633–640.
411. Vandentorren S, et al. (2006) August 2003 heat wave in France: risk factors for death of elderly people living at home. *Eur J Public Health* 16(6):583–591.
412. Lundgren K, Kuklane K, Gao C, Holmer I (2013) Effects of heat stress on working populations when facing climate change. *Ind Health* 51(1):3–15.
413. Mitchell RD, Aitken P, Franklin RC (2014) The physical health impacts of tropical cyclones. *Ann ACTM Int J Trop Travel Med* 15(1):2.
414. Bourque LB, Siegel JM, Kano M, Wood MM (2006) Weathering the storm: the impact of hurricanes on physical and mental health. *Ann Am Acad Pol Soc Sci* 604(1):129–151.
415. Bern C, et al. (1993) Risk factors for mortality in the Bangladesh cyclone of 1991. *Bull World Health Organ* 71(1):73.
416. Lindeboom W, Alam N, Begum D, Streatfield PK (2012) The association of meteorological factors and mortality in rural Bangladesh, 1983–2009. *Glob Health Action* 5:61–73.
417. Ballera JE, et al. (2015) Management of the dead in Tacloban City after Typhoon Haiyan. *West Pac Surveill Response J* 6(Suppl 1):44–47.
418. Brunkard J, Namulanda G, Ratard R (2008) Hurricane Katrina deaths, Louisiana, 2005. *Disaster Med Public Health Prep* 2(4):215–223.
419. Jonkman SN, Maaskant B, Boyd E, Levitan ML (2009) Loss of life caused by the flooding of New Orleans after Hurricane Katrina: Analysis of the relationship between flood characteristics and mortality. *Risk Anal* 29(5):676–698.
420. Zane DF, et al. (2011) Tracking deaths related to Hurricane Ike, Texas, 2008. *Disaster Med Public Health Prep* 5(1):23–28.
421. Diakakis M, Deligiannakis G, Katsetsiadou K, Lekkas E (2015) Hurricane Sandy mortality in the Caribbean and continental North America. *Disaster Prev Manag* 24(1):132–148.
422. Alderman K, Turner LR, Tong S (2012) Floods and human health: a systematic review. *Environ Int* 47:37–47.
423. Rufat S, Tate E, Burton CG, Maroof AS (2015) Social vulnerability to floods: review of case studies and implications for measurement. *Int J Disaster Risk Reduct* 14, Part 4:470–486.
424. Pradhan EK, et al. (2007) Risk of flood-related mortality in Nepal. *Disasters* 31(1):57–70.
425. Li X, et al. (2007) Years of potential life lost in residents affected by floods in Hunan, China. *Trans R Soc Trop Med Hyg* 101(3):299–304.
426. Ashley ST, Ashley WS (2008) Flood fatalities in the United States. *J Appl Meteorol Climatol* 47(3):805–818.
427. FitzGerald G, Du W, Jamal A, Clark M, Hou X-Y (2010) Flood fatalities in contemporary Australia (1997–2008). *Emerg Med Australas* 22(2):180–186.
428. Jonkman SN, Kelman I (2005) An analysis of the causes and circumstances of flood disaster deaths. *Disasters* 29(1):75–97.
429. Diakakis M, Deligiannakis G (2015) Flood fatalities in Greece: 1970–2010. *J Flood Risk Manag*. doi:10.1111/jfr3.12166.
430. Juran L, Trivedi J (2015) Women, gender norms, and natural disasters in Bangladesh. *Geogr Rev* 105(4):601–611.
431. Rashid SF (2000) The urban poor in Dhaka City: their struggles and coping strategies during the floods of 1998. *Disasters* 24(3):240–253.
432. Jabeen H (2014) Adapting the built environment: The role of gender in shaping vulnerability and resilience to climate extremes in Dhaka. *Environ Urban*. doi:10.1177/0956247813517851.
433. Sultana F (2010) Living in hazardous waterscapes: Gendered vulnerabilities and experiences of floods and disasters. *Environ Hazards-Hum Policy Dimens* 9(1):43–53.
434. McIntyre L, et al. (2011) Food provisioning experiences of ultra poor female heads of household living in Bangladesh. *Soc Sci Med* 72(6):969–976.
435. Ali A, Niehof A (2007) Changing gender roles in household food security and rural livelihoods in Bangladesh. *Sustainable Poverty Reduction in Less-Favoured Areas*, eds Ruben R, Pender J, Kuyvenhoven A (CAB International, Cambridge), pp 228–247.
436. Deaton A, Drèze J (2009) Food and nutrition in India: facts and interpretations. *Econ Polit Wkly* 44(7):42–65.
437. Black RE, et al. (2013) Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet* 382(9890):427–451.
438. Paul SK, Paul BK, Routray JK (2012) Post-Cyclone Sidr nutritional status of women and children in coastal Bangladesh: an empirical study. *Nat Hazards* 64(1):19–36.
439. Datar A, Liu J, Linnemayr S, Stecher C (2013) The impact of natural disasters on child health and investments in rural India. *Soc Sci Med* 76:83–91.
440. Anttila-Hughes JK, Hsiang SM (2013) Destruction, disinvestment, and death: Economic and human losses following environmental disaster. *Environ Sci Policy* 37:10–19.
441. Tibesigwa B, Visser M, Hunter L, Collinson M, Twine W (2015) *Gender differences in climate change risk, food security, and adaptation: a study of rural households' reliance on agriculture and natural resources to sustain livelihoods*.
442. Zakari S, Ying L, Song B (2014) Factors influencing household food security in West Africa: The case of Southern Niger. *Sustainability* 6(3):1191–1202.
443. Silvestri S, et al. (2015) Households and food security: lessons from food secure households in East Africa. *Agric Food Secur* 4(1):1–15.
444. Amwata DA, Nyariki DM, Musimba NRK (2016) Factors influencing pastoral and agropastoral household vulnerability to food insecurity in the drylands of Kenya: a case study of Kajiado and Makueni Counties. *J Int Dev* 28(5):771–787.
445. Beaumier MC, Ford JD (2010) Food insecurity among Inuit women exacerbated by socio-economic stresses and climate change. *Can J Public Health-Rev Can Sante Publique* 101(3):196–201.
446. Van Voorst R (2009) “I work all the time-he just waits for the animals to come back” Social impacts of climate changes: a Greenlandic case study. *Jamba J Disaster Risk Stud* 2(3):235–254.
447. Bunce A, Ford J, Harper S, Edge V (2016) Vulnerability and adaptive capacity of Inuit women to climate change: a case study from Iqaluit, Nunavut. *Nat Hazards* 83(3):1419–1441.
448. Willows ND, Iserhoff R, Napash L, Leclerc L, Verrall T (2005) Anxiety about food supply in Cree women with infants in Quebec. *Int J Circumpolar Health* 64(1).
449. Goldhar C, Ford JD, Berrang-Ford L (2010) Prevalence of food insecurity in a Greenlandic community and the importance of social, economic and environmental stressors. *Int J Circumpolar Health* 69(3):285–303.
450. Ford J, Lardeau M-P, Vanderbilt W (2012) The characteristics and experience of community food program users in arctic Canada: a case study from Iqaluit, Nunavut. *BMC Public Health* 12(1):1.
451. Guo Y, et al. (2015) Seasonal prevalence and determinants of food insecurity in Iqaluit, Nunavut. *Int J Circumpolar Health* 74:27284.
452. Beaumier MC, Ford JD, Tagalik S (2015) The food security of Inuit women in Arviat, Nunavut: the role of socio-economic factors and climate change. *Polar Rec* 51(5):550–559.
453. Bennett CM, McMichael AJ (2010) Non-heat related impacts of climate change on working populations. *Glob Health Action* 3:5640.
454. Constantin de Magny G, et al. (2008) Environmental signatures associated with cholera epidemics. *Proc Natl Acad Sci* 105(46):17676–17681.
455. Baker-Austin C, et al. (2013) Emerging Vibrio risk at high latitudes in response to ocean warming. *Nat Clim Change* 3(1):73–77.
456. Morin CW, Comrie AC, Ernst K (2013) Climate and dengue transmission: Evidence and implications. *Environ Health Perspect Online* 121(11–12):1264.
457. Pascual M, Ahumada J, Chaves L, Rodo X, Bouma M (2006) Malaria resurgence in the East African highlands: temperature trends revisited. *Proc Natl Acad Sci* 103(15):5829–5834.
458. Zhou X-N, et al. (2008) Potential impact of climate change on schistosomiasis transmission in China. *Am J Trop Med Hyg* 78(2):188–194.
459. McCreesh N, Nikulin G, Booth M (2015) Predicting the effects of climate change on Schistosoma mansoni transmission in eastern Africa. *Parasit Vectors* 8:4.
460. Altizer S, Ostfeld RS, Johnson PTJ, Kutz S, Harvell CD (2013) Climate change and infectious diseases: from evidence to a predictive framework. *Science* 341(6145):514–519.
461. Lopez AL, Macasaet LY, Ylade M, Tayag EA, Ali M (2015) Epidemiology of cholera in the Philippines. *PLoS Negl Trop Dis* 9(1):e3440.
462. Agtini MD, et al. (2005) The burden of diarrhoea, shigellosis, and cholera in North Jakarta, Indonesia: findings from 24 months surveillance. *BMC Infect Dis* 5(1):1–11.
463. Sigudu TT, Tint KS, Archer B (2015) Epidemiological description of cholera outbreak in Mpumalanga Province, South Africa, December 2008–March 2009. *South Afr J Infect Dis* 30(4):125–128.
464. Rancourt N (2013) *Gender and vulnerability to cholera in Sierra Leone* (Oxfam GB).
465. Anker M, Arima Y (2011) Male-female differences in the number of reported incident dengue fever cases in six Asian countries. *West Pac Surveill Response J* 2(2):17–23.
466. Bhatt S, et al. (2013) The global distribution and burden of dengue. *Nature* 496(7446):504–507.
467. Burns K (2015) *Gender and Malaria* (UNDP).
468. Jenkins R, et al. (2015) Prevalence of malaria parasites in adults and its determinants in malaria endemic area of Kisumu County, Kenya. *Malar J* 14(1):1–6.

469. Ayele DG, Zewotir TT, Mwambi HG (2012) Prevalence and risk factors of malaria in Ethiopia. *Malar J* 11:195–195.
470. Dhangadamajhi G, Kar S, Ranjit M (2009) High prevalence and gender bias in distribution of Plasmodium malariae infection in central east-coast India. *Trop Biomed* 26(3):326–333.
471. Osborne JW (2006) Bringing balance and technical accuracy to reporting odds ratios and the results of logistic regression analyses. *Pract Assess Res Eval* 11(7).
472. Deribe K, et al. (2011) High prevalence of urinary schistosomiasis in two communities in South Darfur: implication for interventions. *Parasit Vectors* 4(1):1–5.
473. Matthys B, et al. (2007) Risk factors for Schistosoma mansoni and hookworm in urban farming communities in western Côte d'Ivoire. *Trop Med Int Health* 12(6):709–723.
474. Clements ACA, et al. (2008) Age and gender effects in self-reported urinary schistosomiasis in Tanzania. *Trop Med Int Health* 13(5):713–721.
475. Levy K, Woster AP, Goldstein RS, Carlton EJ (2016) Untangling the impacts of climate change on waterborne diseases: a systematic review of relationships between diarrheal diseases and temperature, rainfall, flooding, and drought. *Environ Sci Technol* 50(10):4905–4922.
476. Andersen LK, Hercogová J, Wollina U, Davis MDP (2012) Climate change and skin disease: a review of the English-language literature. *Int J Dermatol* 51(6):656–661.
477. Tak S, Driscoll R, Bernard B, West C (2007) Depressive symptoms among firefighters and related factors after the response to Hurricane Katrina. *J Urban Health* 84(2):153–161.
478. Noe R, et al. (2007) Skin disorders among construction workers following Hurricane Katrina and Hurricane Rita: an outbreak investigation in New Orleans, Louisiana. *Arch Dermatol* 143(11):1393–1398.
479. Stanke C, Murray V, Amlôt R, Nurse J, Williams R (2012) The effects of flooding on mental health: outcomes and recommendations from a review of the literature. *PLOS Curr Disasters* Edition 1.
480. Olf M, Langeland W, Draijer N, Gersons BPR (2007) Gender differences in posttraumatic stress disorder. *Psychol Bull* 133(2):183–204.
481. Hammen C (2005) Stress and depression. *Annu Rev Clin Psychol* 1(1):293–319.
482. Hawton K, van Heeringen K (2009) Suicide. *The Lancet* 373(9672):1372–1381.
483. Liu A, et al. (2006) An epidemiologic study of posttraumatic stress disorder in flood victims in Hunan China. *Can J Psychiatry* 51(6):350–4.
484. Li X, et al. (2010) A study on the relationship between posttraumatic stress disorder in flood victim parents and children in Hunan, China. *Aust N Z J Psychiatry* 44(6):543–550.
485. Kim H, Han SB, Kim JH, Kim JS, Hong E (2010) Post-Nargis medical care: experience of a Korean disaster relief team in Myanmar after the cyclone. *Eur J Emerg Med* 17(1):37–41.
486. Mills MA, Edmondson D, Park CL (2007) Trauma and stress response among Hurricane Katrina evacuees. *Am J Public Health* 97(Supplement 1):S116–S123.
487. Harville EW, Xiong X, Pridjian G, Elkind-Hirsch K, Buekens P (2009) Postpartum mental health after Hurricane Katrina: A cohort study. *BMC Pregnancy Childbirth* 9(1):1.
488. Mason V, Andrews H, Upton D (2010) The psychological impact of exposure to floods. *Psychol Health Med* 15(1):61–73.
489. Paranjothy S, et al. (2011) Psychosocial impact of the summer 2007 floods in England. *BMC Public Health* 11(1):1.
490. Tunstall S, Tapsell S, Green C, Floyd P, George C (2006) The health effects of flooding: social research results from England and Wales. *J Water Health* 4(3):365–380.
491. Bryant RA, et al. (2014) Psychological outcomes following the Victorian Black Saturday bushfires. *Aust N Z J Psychiatry* 48(7):634–643.
492. McDermott BM, Cobham VE, Berry H, Stallman HM (2010) Vulnerability factors for disaster-induced child post-traumatic stress disorder: the case for low family resilience and previous mental illness. *Aust N Z J Psychiatry* 44(4):384–9.
493. McDermott B, Cobham V, Berry H, Kim B (2014) Correlates of persisting posttraumatic symptoms in children and adolescents 18 months after a cyclone disaster. *Aust N Z J Psychiatry* 48(1):80–86.
494. Lowe SR, Sampson L, Gruebner O, Galea S (2015) Psychological resilience after Hurricane Sandy: the influence of individual- and community-level factors on mental health after a large-scale natural disaster. *PLoS ONE* 10(5):e0125761.
495. Boscarino JA, Hoffman SN, Adams RE, Figley CR, Solhkhah R (2014) Mental health outcomes among vulnerable residents after Hurricane Sandy: implications for disaster research and planning. *Am J Disaster Med* 9(2):97–106.
496. Ehrlich M, et al. (2010) Loss of resources and hurricane experience as predictors of postpartum depression among women in southern Louisiana. *J Womens Health* 19(5):877–884.
497. Hadley C, Patil CL (2006) Food insecurity in rural Tanzania is associated with maternal anxiety and depression. *Am J Hum Biol* 18(3):359–368.
498. Hadley C, et al. (2008) Food insecurity, stressful life events and symptoms of anxiety and depression in east Africa: evidence from the Gilgel Gibe growth and development study. *J Epidemiol Community Health* 62(11):980–986.
499. Tsai AC, et al. (2012) Food insecurity, depression and the modifying role of social support among people living with HIV/AIDS in rural Uganda. *Soc Sci Med* 74(12):2012–2019.
500. Wutich A, Ragsdale K (2008) Water insecurity and emotional distress: coping with supply, access, and seasonal variability of water in a Bolivian squatter settlement. *Soc Sci Med* 67(12):2116–2125.
501. Stevenson EGJ, Ambelu A, Caruso BA, Tesfaye Y, Freeman MC (2016) Community water improvement, household water insecurity, and women's psychological distress: an intervention and control study in Ethiopia. *PLoS ONE* 11(4):e0153432.
502. Kolves K, Kolves KE, De Leo D (2013) Natural disasters and suicidal behaviours: a systematic literature review. *J Affect Disord* 146(1):1–14.
503. Dixon PG, et al. (2014) Association of weekly suicide rates with temperature anomalies in two different climate types. *Int J Environ Res Public Health* 11(11):11627–11644.
504. Müller H, et al. (2011) Higher environmental temperature and global radiation are correlated with increasing suicidality—a localized data analysis. *Chronobiol Int* 28(10):949–957.
505. Page LA, Hajat S, Kovats RS (2007) Relationship between daily suicide counts and temperature in England and Wales. *Br J Psychiatry* 191(2):106–112.
506. Kim Y, Kim H, Kim D-S (2011) Association between daily environmental temperature and suicide mortality in Korea (2001–2005). *Psychiatry Res* 186(2–3):390–396.
507. Ajdacic-Gross V, et al. (2007) Seasonal associations between weather conditions and suicide—evidence against a classic hypothesis. *Am J Epidemiol* 165(5):561–569.
508. Dixon P, et al. (2007) Effects of temperature variation on suicide in five US counties, 1991–2001. *Int J Biometeorol* 51(5):395–403.
509. Roy P, Tremblay G, Oliffe JL, Jbilou J, Robertson S (2013) Male farmers with mental health disorders: a scoping review. *Aust J Rural Health* 21(1):3–7.
510. Kennedy J, King L (2014) The political economy of farmers' suicides in India: indebted cash-crop farmers with marginal landholdings explain state-level variation in suicide rates. *Glob Health* 10(1):1–9.
511. Hanigan IC, Butler CD, Kokic PN, Hutchinson MF (2012) Suicide and drought in New South Wales, Australia, 1970–2007. *Proc Natl Acad Sci U S A* 109(35):13950–13955.
512. Alston M, Kent J (2008) The big dry: the link between rural masculinities and poor health outcomes for farming men. *J Sociol* 44(2):133–147.
513. Judd F, et al. (2006) Understanding suicide in Australian farmers. *Soc Psychiatry Psychiatr Epidemiol* 41(1):1–10.
514. McGinn T, et al. (2015) *Shelter from the storm: a transformative agenda for women and girls in a crisis-prone world* (UNFPA, New York).
515. Rylander C, Odland JO, Sandanger TM (2013) Climate change and the potential effects on maternal and pregnancy outcomes: an assessment of the most vulnerable - the mother, fetus, and newborn child. *Glob Health Action* 6. doi:10.3402/gha.v6i0.19538.
516. Barmania S (2014) Typhoon Haiyan recovery: progress and challenges. *The Lancet* 383(9924):1197–1199.
517. Kissinger P, Schmidt N, Sanders C, Liddon N (2007) The effect of the Hurricane Katrina disaster on sexual behavior and access to reproductive care for young women in New Orleans. *Sex Transm Dis* 34(11).
518. Leyser-Whalen O, Rahman M, Berenson AB (2011) Natural and social disasters: racial inequality in access to contraceptives after Hurricane Ike. *J Womens Health* 20(12):1861–1866.
519. De Souza R-M (2014) Resilience, integrated development and family planning: building long-term solutions. *Reprod Health Matters* 22(43):75–83.
520. D'Agnes L, D'Agnes H, Schwartz JB, Amarillo ML, Castro J (2010) Integrated management of coastal resources and human health yields added value: a comparative study in Palawan (Philippines). *Environ Conserv* 37(4):398–409.
521. Heyward C (2012) A growing problem? Dealing with population increases in climate justice. *Ethical Perspect* 19(4):703–732.
522. Di Chiro G (2011) Acting Globally: Cultivating a thousand community solutions for climate justice. *Development* 54(2):232–236.
523. Tran N-T, Taylor R, Antierens A, Staderini N (2015) Cholera in pregnancy: a systematic review and meta-analysis of fetal, neonatal, and maternal mortality. *PLoS ONE* 10(7):e0132920.
524. Paixão ES, Teixeira MG, Costa M da CN, Rodrigues LC (2016) Dengue during pregnancy and adverse fetal outcomes: a systematic review and meta-analysis. *Lancet Infect Dis* 16(7):857–865.
525. Desai M, et al. (2007) Epidemiology and burden of malaria in pregnancy. *Lancet Infect Dis* 7(2):93–104.
526. Rijken MJ, et al. (2012) Malaria in pregnancy in the Asia-Pacific region. *Lancet Infect Dis* 12(1):75–88.
527. Friedman JF, Mital P, Kanzaria HK, Olds GR, Kurtis JD (2007) Schistosomiasis and pregnancy. *Trends Parasitol* 23(4):159–164.
528. Machado CR, et al. (2013) Is pregnancy associated with severe dengue? A review of data from the Rio de Janeiro Surveillance Information System. *PLoS Negl Trop Dis* 7(5):e2217.
529. Parekh FK, Hernandez JN, Krogstad DJ, Casapia WM, Branch OH (2007) Prevalence and risk of Plasmodium falciparum and P. vivax malaria among pregnant women living in the hypoendemic communities of the Peruvian Amazon. *Am J Trop Med Hyg* 77(3):451–457.
530. Khan WA, et al. (2014) Asymptomatic Plasmodium falciparum malaria in pregnant women in the Chittagong Hill districts of Bangladesh. *PLoS ONE* 9(5):e98442.
531. Tan PC, et al. (2012) Dengue infection and miscarriage: a prospective case control study. *PLoS Negl Trop Dis* 6(5):e1637.
532. McGready R, et al. (2012) Adverse effects of falciparum and vivax malaria and the safety of antimalarial treatment in early pregnancy: a population-based study. *Lancet Infect Dis* 12(5):388–396.
533. Ciglenecki I, et al. (2013) Cholera in pregnancy: outcomes from a specialized cholera treatment unit for pregnant women in Léogâne, Haiti. *PLoS Negl Trop Dis* 7(8):e2368.
534. De Beaudrap P, et al. (2013) Impact of malaria during pregnancy on pregnancy outcomes in a Ugandan prospective cohort with intensive malaria screening and prompt treatment. *Malar J* 12(139):10–1186.
535. Hanf M, et al. (2014) Dengue epidemics and adverse obstetrical outcomes in French Guiana: a semi-ecological study. *Trop Med Int Health* 19(2):153–158.
536. McClure EM, et al. (2014) The association of parasitic infections in pregnancy and maternal and fetal anemia: a cohort study in coastal Kenya. *PLoS Negl Trop Dis* 8(2):e2724.
537. Rogawski ET, et al. (2012) The effects of malaria and intermittent preventive treatment during pregnancy on fetal anemia in Malawi. *Clin Infect Dis* 55(8):1096–1102.
538. Ajanga A, et al. (2006) Schistosoma mansoni in pregnancy and associations with anaemia in northwest Tanzania. *Trans R Soc Trop Med Hyg* 100(1):59–63.
539. Strand LB, Barnett AG, Tong S (2011) The influence of season and ambient temperature on birth outcomes: a review of the epidemiological literature. *Environ Res* 111(3):451–462.
540. Carolan-Olah M, Frankowska D (2014) High environmental temperature and preterm birth: a review of the evidence. *Midwifery* 30(1):50–59.
541. Hobel CJ, Goldstein A, Barrett ES (2008) Psychosocial stress and pregnancy outcome. *Clin Obstet Gynecol* 51(2):333–348.
542. King S, Dancause K, Turcotte-Tremblay A, Veru F, Laplante DP (2012) Using natural disasters to study the effects of prenatal maternal stress on child health and development. *Birth Defects Res C Embryo Today* 96(4):273–288.

543. Harville E, Xiong X, Buekens P (2010) Disasters and perinatal health: a systematic review. *Obstet Gynecol Surv* 65(11):713–728.
544. Portier C, et al. (2010) A human health perspective on climate change: a report outlining research needs on the human health effects of climate change. *Environ Health Perspect*. doi:10.1289/ehp.1002272.
545. Grace K, Davenport F, Hanson H, Funk C, Shukla S (2015) Linking climate change and health outcomes: Examining the relationship between temperature, precipitation and birth weight in Africa. *Glob Environ Change-Hum Policy Dimens* 35:125–137.
546. Deschenes O, Greenstone M, Guryan J (2009) Climate change and birth weight. *Am Econ Rev* 99(2):211–17.
547. Andalón M, Azevedo JP, Rodríguez-Castelán C, Sanfelice V, Valderrama-González D (2016) Weather shocks and health at birth in Colombia. *World Dev* 82:69–82.
548. Morrow S (2014) *Typhoons and lower birth weights in The Philippines* (University of San Francisco).
549. Xiong X, et al. (2008) Exposure to Hurricane Katrina, post-traumatic stress disorder and birth outcomes. *Am J Med Sci* 336(2):111–115.
550. Tong VT, Zotti ME, Hsia J (2011) Impact of the Red River catastrophic flood on women giving birth in North Dakota, 1994–2000. *Matern Child Health J* 15(3):281–288.
551. Basu R, Malig B, Ostro B (2010) High ambient temperature and the risk of preterm delivery. *Am J Epidemiol* 172(10):1108–1117.
552. Vicedo-Cabrera AM, Iñiguez C, Barona C, Ballester F (2014) Exposure to elevated temperatures and risk of preterm birth in Valencia, Spain. *Link Expo Health Environ Public Health Track* 134:210–217.
553. Schifano P, et al. (2013) Effect of ambient temperature and air pollutants on the risk of preterm birth, Rome 2001–2010. *Environ Int* 61:77–87.
554. He J-R, et al. (2016) Ambient temperature and the risk of preterm birth in Guangzhou, China (2001–2011). *Environ Health Perspect* 124:1100–1106.
555. Wang J, Williams G, Guo Y, Pan X, Tong S (2013) Maternal exposure to heatwave and preterm birth in Brisbane, Australia. *BJOG Int J Obstet Gynaecol* 120(13):1631–1641.
556. Currie J, Rossin-Slater M (2013) Weathering the storm: hurricanes and birth outcomes. *J Health Econ* 32(3):487–503.
557. Zahran S, Snodgrass JG, Peek L, Weiler S (2010) Maternal hurricane exposure and fetal distress risk. *Risk Anal* 30(10):1590–1601.
558. Khan AE, et al. (2011) Drinking water salinity and maternal health in coastal Bangladesh: implications of climate change. *Environ Health Perspect* 119(9):1328–1332.
559. Khan AE, et al. (2014) Salinity in drinking water and the risk of (pre) eclampsia and gestational hypertension in coastal Bangladesh: a case-control study. *PLoS ONE* 9(9):e108715.
560. Kinney DK, Miller AM, Crowley DJ, Huang E, Gerber E (2008) Autism prevalence following prenatal exposure to hurricanes and tropical storms in Louisiana. *J Autism Dev Disord* 38(3):481–488.
561. Hu Z, Li T (2016) Too hot to hold: the effects of high temperatures during pregnancy on endowment and adult welfare outcomes. Available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2709889.
562. Alam E, Collins AE (2010) Cyclone disaster vulnerability and response experiences in coastal Bangladesh. *Disasters* 34(4):931–954.
563. Government of Bangladesh (2008) *Cyclone Sidr in Bangladesh: damage, loss and needs assessment for disaster recovery and reconstruction* (Ministry of Finance, Government of Bangladesh, Dhaka).
564. Alam K, Rahman MH (2014) Women in natural disasters: a case study from southern coastal region of Bangladesh. *Int J Disaster Risk Reduct* 8:68–82.
565. Mallick B (2014) Cyclone shelters and their locational suitability: an empirical analysis from coastal Bangladesh. *Disasters* 38(3):654–671.
566. Paul BK (2012) Factors affecting evacuation behavior: the case of 2007 Cyclone Sidr, Bangladesh. *Prof Geogr* 64(3):401–414.
567. Ahsan MN, Takeuchi K, Vink K, Warner J (2016) Factors affecting the evacuation decisions of coastal households during Cyclone Aila in Bangladesh. *Environ Hazards* 15(1):16–42.
568. Swarup A, Dankelman I, Ahluwalia K, Hawrylyshyn K (2011) *Weathering the Storm: Adolescent Girls and Climate Change* (Plan).
569. Lane R, McNaught R (2009) Building gendered approaches to adaptation in the Pacific. *Gen Dev* 17(1):67–80.
570. Laqeretabua A, Pillay A (2013) *The 2012 Fiji floods: gender sensitivity in disaster management* (UN WOMEN, Suva).
571. Horney JA, MacDonald PD, Van Willigen M, Berke PR, Kaufman JS (2010) Individual actual or perceived property flood risk: did it predict evacuation from Hurricane Isabel in North Carolina, 2003? *Risk Anal* 30(3):501–511.
572. Elliott JR, Pais J (2006) Race, class, and Hurricane Katrina: social differences in human responses to disaster. *Soc Sci Res* 35(2):295–321.
573. Smith SK, McCarty C (2009) Fleeing the storm(s): an examination of evacuation behavior during Florida's 2004 hurricane season. *Demography* 46(1):127–145.
574. Casey-Lockyer M, et al. (2013) Deaths associated with Hurricane Sandy – October–November 2012. *Morb Mortal Wkly Rep* 62(20):393–397.
575. Whittaker J, Eriksen C, Haynes K (2016) Gendered responses to the 2009 Black Saturday bushfires in Victoria, Australia. *Geogr Res* 54(2):203–215.
576. Handmer J, O'Neill S (2016) Examining bushfire policy in action: preparedness and behaviour in the 2009 Black Saturday fires. *Environ Sci Policy* 63:55–62.
577. Eriksen C, Gill N, Head L (2010) The gendered dimensions of bushfire in changing rural landscapes in Australia. *J Rural Stud* 26(4):332–342.
578. Tyler M, Fairbrother P (2013) Bushfires are “men’s business”: the importance of gender and rural hegemonic masculinity. *J Rural Stud* 30:110–119.
579. Parkinson D, Farrant B, Duncan A (2015) Women and children. *Climate Change Adaptation for Health and Social Services*, eds Walker R, Mason W (CSIRO Publishing, Clayton South, AU), pp 117–139.
580. Phillips BD, Jenkins P (2016) Gender-based violence and disasters: South Asia in comparative perspective. *Women and Disasters in South Asia: Survival, Security and Development*, eds Racioppi L, Rajagopalan S (Routledge, New York), pp 225–250.
581. Nasreen M (2008) *Violence against women during flood and post-flood situations in Bangladesh* (ActionAid Bangladesh, Dhaka).
582. Thornton WE, Voigt L (2007) Disaster rape: vulnerability of women to sexual assaults during Hurricane Katrina. *J Public Manag Soc Policy* 13(2):23–49.
583. Anastario M, Shehab N, Lawry L (2009) Increased gender-based violence among women internally displaced in Mississippi 2 years post–Hurricane Katrina. *Disaster Med Public Health Prep* 3(1):18–26.
584. Schumacher JA, et al. (2010) Intimate partner violence and Hurricane Katrina: predictors and associated mental health outcomes. *Violence Vict* 25(5):588–603.
585. Larrance R, Anastario M, Lawry L (2007) Health status among internally displaced persons in Louisiana and Mississippi travel trailer parks. *Ann Emerg Med* 49(5):590–601.e12.
586. Harville EW, Taylor CA, Tesfai H, Xu Xiong, Buekens P (2011) Experience of Hurricane Katrina and reported intimate partner violence. *J Interpers Violence* 26(4):833–845.
587. Fagen JL, Sorensen W, Anderson PB (2011) Why not the University of New Orleans? Social disorganization and sexual violence among internally displaced women of Hurricane Katrina. *J Community Health* 36(5):721–727.
588. Fothergill A (2008) Domestic violence after disaster: voices from the 1997 Grand Forks Flood. *Women and Disasters: From Theory to Practice*, eds Phillips BD, Morrow BH (International Research Committee on Disasters, 131–154).
589. Carrington K, McIntosh A, Hogg R, Scott J (2013) Rural masculinities and the internalisation of violence in agricultural communities. *Int J Rural Criminol* 2(1):3–24.
590. Whittenbury K (2013) Climate change, women’s health, wellbeing and experiences of gender based violence in Australia. *Research, Action and Policy: Addressing the Gendered Impacts of Climate Change*, eds Alston M, Whittenbury K (Springer, New York), pp 207–221.
591. Parkinson D, Zara C (2013) The hidden disaster: domestic violence in the aftermath of natural disaster. *Aust J Emerg Manag* 28(2):28–35.
592. Houghton R (2009) “Everything became a struggle, absolute struggle”: post-flood increases in domestic violence in New Zealand. *Women, Gender and Disaster: Global Issues and Initiatives* (SAGE Publications, New Delhi), pp 99–111.
593. Ross LJ (2012) A feminist perspective on Katrina. *The Women of Katrina: How Gender, Race, and Class Matter in an American Disaster* (Vanderbilt University Press, Nashville, TN), pp 15–23.
594. Montgomery H (2011) Rumours of child trafficking after natural disasters. *J Child Media* 5(4):395–410.
595. International Federation of Red Cross and Red Crescent Societies (2015) *Unseen, unheard: gender-based violence in disasters* (Geneva).
596. Hunter LM, Castro J, Kleiber D, Hutchens K (2015) Swimming and gendered vulnerabilities: evidence from the Northern and Central Philippines. *Soc Nat Resour*:1–6.
597. Rahman A, Linnam M, Mashreky SR, Hossain MJ, Rahman F (2014) The prevalence of naturally acquired swimming ability among children in Bangladesh: a cross sectional survey. *BMC Public Health* 14(1):1–5.
598. Paul BK, Dutt S (2010) Hazard warnings and responses to evacuation orders: the case of Bangladesh’s cyclone Sidr. *Geogr Res* 100(3):336–355.
599. Haynes K, et al. (2009) “Shelter-in-place” vs. evacuation in flash floods. *Environ Hazards* 8(4):291–303.
600. Moosa CS, Tuana N (2014) Mapping a research agenda concerning gender and climate change: a review of the literature. *Hypatia- J Fem Philos* 29(3):677–694.
601. Hawkins R, Ojeda D (2011) Gender and environment: critical tradition and new challenges. *Environ Plan Soc Space* 29(2):237–253.
602. Seager J (2009) Death by degrees: taking a feminist hard look at the 2° climate policy. *Kvind Køn Forsk* (34):11–21.
603. Resurreccion BP (2013) Persistent women and environment linkages in climate change and sustainable development agendas. *Womens Stud Int Forum* 40:33–43.
604. Alaimo S (2009) Insurgent vulnerability and the carbon footprint of gender. *Kvind Køn Forsk* (34):22–35.
605. Hemmati M, Röhr U (2009) Engendering the climate-change negotiations: experiences, challenges, and steps forward. *Gen Dev* 17(1):19–32.
606. Macgregor S (2014) Only resist: feminist ecological citizenship and the post-politics of climate change. *Hypatia* 29(3):617–633.
607. Buck HJ, Gammon AR, Preston CJ (2014) Gender and geoengineering. *Hypatia* 29(3):651–669.
608. Cuomo CJ (2011) Climate change, vulnerability, and responsibility. *Hypatia* 26(4):690–714.
609. Gaard G (2015) Ecofeminism and climate change. *Womens Stud Int Forum* 49:20–33.
610. Agostino A, Lizarde R (2012) Gender and climate justice. *Development* 55(1):90–95.
611. Bendlin L (2014) Women’s human rights in a changing climate: highlighting the distributive effects of climate policies. *Camb Rev Int Aff* 27(4):680–698.
612. Bee B, Biermann M, Tschakert P (2013) Gender, development, and rights-based approaches. *Research, Action and Policy: Addressing the Gendered Impacts of Climate Change* (Springer, New York), pp 95–108.
613. Arora-Jonsson S (2011) Virtue and vulnerability: Discourses on women, gender and climate change. *Glob Environ Change-Hum Policy Dimens* 21(2):744–751.
614. MacGregor S (2010) “Gender and climate change”: from impacts to discourses. *J Indian Ocean Reg* 6(2):223–238.
615. Alston M (2011) Gender and climate change in Australia. *J Sociol* 47(1):53–70.
616. Sultana F (2014) Gendering climate change: geographical insights. *Prof Geogr* 66(3):372–381.
617. MacGregor S (2010) A stranger silence still: the need for feminist social research on climate change. *Nature, Society, and Environmental Crisis*, eds Carter B, Charles N, pp 124–140.
618. Tuana N (2013) Gendering climate knowledge for justice: catalyzing a new research agenda. *Research, Action and Policy: Addressing the Gendered Impacts of Climate Change*, eds Alston M, Whittenbury K (Springer, New York), pp 17–31.

THE IMPACTS OF CLIMATE CHANGE ARE
ALREADY BEING EXPERIENCED BY EACH AND
EVERY PERSON AROUND THE WORLD.

