

Gender and Climate Change:  
A Closer Look at Existing Evidence

Global Gender and  
Climate Alliance  
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## 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.



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### 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.<sup>1</sup> 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

<sup>1</sup> 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 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 change<sup>2</sup>. 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

<sup>2</sup> 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.<sup>3</sup> 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

<sup>3</sup>For 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).<sup>4</sup> However, in some contexts, particularly in gleaning (shore-based) fisheries

<sup>4</sup>An 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.<sup>5</sup>

#### 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).<sup>6</sup> 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.<sup>7</sup>

#### 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

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

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

<sup>7</sup> 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.<sup>8</sup> 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

<sup>8</sup> 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).<sup>9</sup> Many of these health impacts of climate change vary by gender (24).<sup>10</sup> 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).<sup>11</sup> 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).<sup>12</sup>

<sup>9</sup> 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.

<sup>10</sup> 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.

<sup>11</sup> 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.

<sup>12</sup> 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

<sup>13</sup> 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).<sup>13</sup>

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).<sup>14</sup> 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),

<sup>14</sup> 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).<sup>15</sup> 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.<sup>16</sup> Gendered behavior patterns and access to care affect the gendered burden of these diseases, discussed below.<sup>17</sup>

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).<sup>18</sup> 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

<sup>15</sup> 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).

<sup>16</sup> 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).

<sup>17</sup> 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

<sup>18</sup> 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.<sup>19</sup> 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

<sup>19</sup> 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.<sup>20</sup> For example:

<sup>20</sup> 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.<sup>21</sup> 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>

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



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