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A LITERATURE REVIEW OF THE GENDER-DIFFERENTIATED IMPACTS OF CLIMATE CHANGE ON WOMEN'S AND MEN'S ASSETS AND WELL-BEING IN DEVELOPING COUNTRIES

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ABSTRACT

Climate change increasingly affects the livelihoods of people, and poor people experience especially negative impacts given their lack of capacity to prepare for and cope with the effects of a changing climate. Among poor people, women and men may experience these impacts differently. This review presents and tests two hypotheses on the gender-differentiated impacts of climate change on women and men in developing countries. The first hypothesis is that climate-related events affect men's and women's well-being and assets differently. The second hypothesis is that climate-related shocks affect women more negatively than men. With limited evidence from developing countries, this review shows that climate change affects women's and men's assets and well-being differently in six impact areas: (i) impacts related to agricultural production, (ii) food security, (iii) health, (iv) water and energy resources, (v) climate-induced migration and conflict, and (vi) climate-related natural disasters. In the literature reviewed, women seem to suffer more negative impacts of climate change in terms of their assets and well-being because of social and cultural norms regarding gender roles and their lack of access to and control of assets, although there are some exceptions. Empirical evidence in this area is limited, patchy, varied, and highly contextual in nature, which makes it difficult to draw strong conclusions. Findings here are indicative of the complexities in the field of gender and climate change, and signal that multidisciplinary research is needed to further enhance the knowledge base on the differential climate impacts on women's and men's assets and well-being in agricultural and rural settings, and to understand what mechanisms work best to help women and men in poor communities become more climate resilient.

Keywords: Climate change, gender, assets, impacts, developing countries

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A LITERATURE REVIEW OF THE GENDER-DIFFERENTIATED IMPACTS OF CLIMATE CHANGE ON WOMEN'S AND MEN'S ASSETS AND WELL-BEING IN DEVELOPING COUNTRIES

Amelia H. X. Goh¹

1. OVERVIEW, FRAMEWORK AND HYPOTHESES

The negative impacts of climate change are becoming increasingly evident today, including long term changes in average temperature and rainfall; changes in the intensity, timing, and geographic distribution of rainfall; an increase in the frequency of extreme events such as drought and flood; and sea level rise (IPCC 2007; Verner 2011). These impacts will have detrimental effects on agricultural productivity, biodiversity and ecosystem services. Although some crops in some regions of the world may experience gains, research predicts that the overall impacts of climate change on agriculture will be negative, threatening global food security (Keane et al. 2009; Nelson et al. 2009; Nelson et al. 2010). The rural poor in developing countries, many of whom are already food insecure, are likely to experience the most severe effects (IPCC 2007) and are in greatest need of adaptation strategies and development assistance to cope with changing weather patterns (Keane et al. 2009). Yet, it is the poor, vulnerable, and marginalized within these countries who have the least capacity or opportunity to prepare for the impacts of a changing climate given their limited resources (Nelson et al. 2010).

Assets are important for the poor because they can help them cope better with shocks, including climate shocks and the longer term impacts of climate extremes. In examining pathways out of poverty for the poor, research on asset-based approaches to development and poverty alleviation since the 1990s has shown that control over assets plays a fundamental role in increasing incomes, reducing vulnerability, and empowering people to move out of poverty (Bebbington 1999; Moser 2007; Sen 1997; Sherraden 1991). Assets, broadly defined (see Box 1), may include natural, physical, financial, human, social, and political capital (Adato et al. 2007; Meinzen-Dick et al. 2011). Literature reviewed by Giesbert and Schindler (2010) found that better-off households typically sell assets in order to maintain their consumption when facing shocks. In contrast, poorer households often reduce assets and consumption simultaneously. Distress sales of assets may cause households to forego future investments in health, nutrition, and education, including for children in the household (Davies 2010; Hoddinott 2006; Hoddinott and Quisumbing 2003). In the context of climate change, access to and control of assets can be particularly important for the poor, where assets such as secure land and water rights, agricultural technologies, livestock, knowledge, and social capital can help individuals and households adapt to increasing variability of production.

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Box 1: Different types of assets

- **Natural capital:** land, water, trees, genetic resources, livestock, soil fertility
- **Physical capital:** agricultural inputs, business equipment, houses, consumer durables, vehicles and transportation, water supply and sanitation facilities, and communications infrastructure
- **Human capital:** education, skills, knowledge, information, health, nutrition, time, labor
- **Financial capital:** savings, credit, and inflows
- **Social capital:** membership in organizations and groups, social and professional networks
- **Political capital:** citizenship, enfranchisement, and effective participation in governance

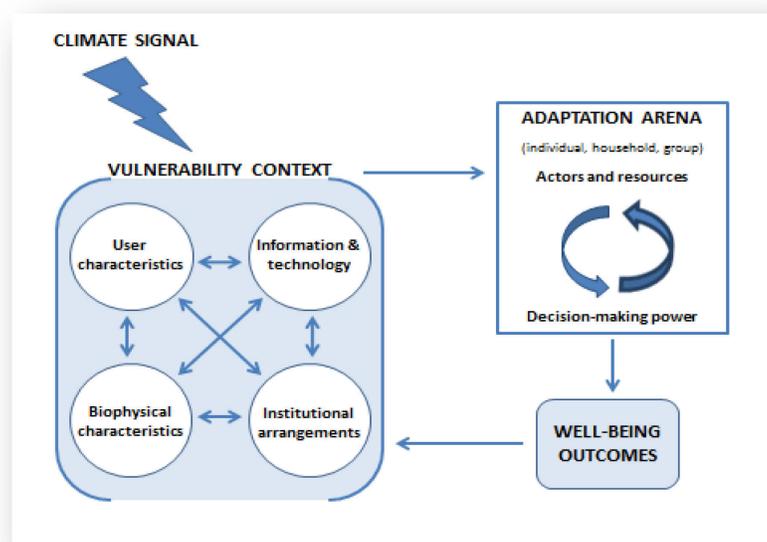
The rural poor, however, are not a monolithic unit. A body of empirical evidence indicates that women experience poverty and deprivation in different ways from men (FAO 2011) and can be differentially affected by shocks (Cohen and Young 2007; Quisumbing, Kumar, and Bassett 2008; Sabarwal, Sinha, and Buvinic 2010). Evidence also indicates that there are many disparities in men's and women's access to and control over key assets. Women usually have fewer assets and rights than men, are more vulnerable to loss of these assets and rights due to separation, divorce, or widowhood, and have less access to capital, extension, inputs, and resources for agricultural production (Antonopoulos and Floro 2005; Deere and Doss 2006; Deere and Leon 2003; Peterman, Behrman, and Quisumbing 2010; Quisumbing 2003; Quisumbing 2009). Yet women's asset holdings often have positive effects on important development outcomes including household food security and human capital formation (for example, Hallman 2000; Smith et al. 2003; FAO 2011). Therefore, helping women gain more access to and control of key assets could help achieve many development gains and improvements in human well-being, and this may be particularly important in the context of climate change.

The International Food Policy Research Institute (IFPRI) and partners provide a useful framework (Figure 1) for examining the differential impact and response of women and men to climate change and for understanding the importance of information, livelihood resilience, institutions, and asset accumulation in terms of vulnerability to climate change and adaptation responses (IFPRI 2011). The framework, a product of a project on "Enhancing Women's Assets to Manage Risk under Climate Change: Potential for Group-Based Approaches", is set against a vulnerability context that includes a set of interrelated factors such as user characteristics, biophysical characteristics, information and technology, and institutional arrangements.

User characteristics encompass the fact that some individuals or groups may be more vulnerable to climate change impacts given their livelihood activities, assets (broadly defined), sociocultural norms, or cognitive ability. Biophysical characteristics describe the sensitivity of physical or ecological systems, for example, agricultural systems that individuals, households, or communities rely on for livelihoods. Information and technology refers to the access of actors to information about climate risks and appropriate responses, while institutional arrangements consider the markets, laws, policies, and sociocultural norms that

influence how different actors are affected by and respond to climate change. Across these factors, a climate signal such as long-term changes in average climate conditions, changes in climate variability patterns, or extreme weather events (such as droughts, floods, or hurricanes) may affect actors differently in terms of their assets and adaptation decisions or strategies (or lack thereof) in the adaptation arena, with different well-being outcomes at different spatial and temporal scales.

Figure 1: Conceptual Framework for the "Enhancing Women's Assets to Manage Risk under Climate Change: Potential for Group Based Approaches" Project (IFPRI 2011)



When considering the gender differentiated impacts of climate change against this framework, a hypothetical example may be that a climate signal such as a drought occurs in a rural agricultural environment that causes crops (a biophysical characteristic) to fail. The failure of subsistence crops may prompt women to sell off assets such as small livestock or seek other means of generating income to provide for her family. Men's larger involvement in cash crop production and waged labor may mean that they lose wages when these crops fail, or they may temporarily migrate to other areas in search of other jobs. These impacts demonstrate different user characteristics between women and men in the vulnerability context. A smaller income base due to crop failure may cause a household to decrease consumption or deplete their savings as coping strategies, affecting the well-being of the members of the household, but with gendered nuances. Women and children may suffer more food insecurity than men, children may drop out of school when school fees can no longer be afforded, and more women may become heads of households when their husbands migrate in search of work, which may additionally burden them. Another impact of the drought may be that women have to travel farther in search of water for household consumption or for irrigation, which further contributes to their "time poverty", a concept Bardasi

and Wodon (2006) use to describe individuals' lack of time for rest and leisure after taking into account the time spent working, whether in the labor market or in domestic work.

In terms of the *adaptation arena*, households with a larger asset base, access to information, or institutional support (*institutional arrangements* in the framework) may be able to change farming practices or diversify their crops to better withstand drought conditions. Again, however, the ability to adopt these adaptation strategies may be different for women and men depending on the assets they have access to or control of and the sociocultural context, which determines their rights, roles, and responsibilities. Many factors may influence how climate change affects the well-being of women and men differently. For example, in most households power dynamics between men and women will influence their responses to climate shocks differently (Carr 2008). The interdependencies, expectations, entitlements, and livelihood strategies that are established between women and men, among women, and among individuals within a community that play out in various contexts also cast influence on the impacts of climate change (Demetriades and Esplen 2008; Crane, Roncoli, and Hoogenboom 2011; Nielsen and Reenberg 2010). Additionally, social structures such as ethnicity, race, religion, and caste (for example, Ahmad and Fajber 2009) or demographics such as age, education, wealth, and size of household (for example, Deressa et al. 2009) further intersect with the gender dimension. These factors constitute the *institutional arrangements* that women, men, and communities are part of in their daily lives, which may also affect the way they perceive, understand, value, or respond to climate change in the *adaptation arena* (Roncoli, Crane, and Orlove 2009a).

Given what is already known on women's assets and lack of rights, and the different vulnerability of women and men, this paper takes as its starting point two hypotheses (H1 and H2) on the differential impact of climate-related shocks. Climate-related shocks refer to mostly short-term, primarily weather-related phenomena such as droughts, floods, hurricanes, or increased weather variability and on women's and men's assets and well-being. The hypotheses are as follows:

- **H1:** Climate-related shocks affect men's and women's well-being and assets differently.
- **H2:** Climate-related shocks affect women more negatively than men.

To test the hypotheses, this paper provides a review of literature on the gender differentiated impacts of climate change in the following six "impact areas," with a focus on developing countries:

1. impacts related to agricultural production,
2. impacts related to food security,
3. impacts on health,
4. impacts related to water and energy sources,
5. impacts from climate-related migration and conflict, and
6. impacts from climate-related natural disasters.

The impact areas identified draw from a scoping study by Brody, Demetriades, and Esplen (2008), who map linkages between gender and climate

change. In each impact area, this review evaluates how the evidence relates to H1 and H2, and what types of assets are affected. The objective of this review is to focus specifically on climate-related shocks and how they affect women and men in the short-term. It does not provide a detailed review of longer term adaptation and mitigation issues.

2. GENDER DIFFERENTIATED IMPACTS OF CLIMATE CHANGE – A REVIEW OF THE LITERATURE

Given the fairly recent interest in the topic of gender differentiated impacts of climate change, limited empirical information is available. The bulk of the available information comes from self-published literature by international organizations, nongovernmental organizations, and private foundations, as well as aid and disaster relief organizations. A smaller but slowly growing body of academic literature is looking into this area, especially in development and environment related journals, with publications starting a decade or so ago (for example, Annecke 2002; Carvajal-Escobar, Quintero-Angel, and Garcia-Vargas 2008; Denton 2002; Hemmati and Rohr 2009). While some publications provide a broad overview for navigating gender issues in the context of climate change, a majority of these are case studies that are specific to a certain area due to the highly contextual nature of the subject. According to Arrora-Johnson (2011), literature about climate change and gender has so far been written mainly to advocate for a gender perspective within international politics, and that it has been marred by a lack of data and evidence. This signals that caution is necessary when examining evidence for gender-differentiated impacts on climate change to ensure that claims are supported by sound findings and data, and are not merely based on assumptions, projections, or speculations. Accordingly, this literature review sets out to look particularly at case studies and examples that provide evidence to support or refute the two hypotheses. Appendix 1 provides tables summarizing the gendered findings and assets affected by climate signals in each of the impact areas discussed in this review.

Impacts related to agricultural production

Increased climate variability lowers agricultural production, with different impacts on women's and men's natural, physical, social, and financial capital.

Increasing climate variability presents challenges for agricultural production. Diminishing crop yields as a result of growing variability can affect women's and men's assets in different ways, demonstrating the connection between user and biophysical characteristics in the vulnerability context of the conceptual framework. Quisumbing et al. (2011) investigate the impacts of weather-related shocks (floods and droughts) on wives' and husbands' assets in Bangladesh and Uganda and hypothesize that the impact depends on involvement in agricultural production and exposure to weather risk. In Uganda, they find that floods have a positive effect on husbands' land accumulation, but since the majority of the land is owned by men, no significant effect was found on the jointly owned land or that owned exclusively by the wife. Drought, on the other hand, has a negative effect on wives' nonland

asset holdings, but no significant effect on jointly held or husbands' nonland assets. Drought produced no significant impact on husbands', wives', or joint land accumulation. In Bangladesh, flood shocks negatively affect only husbands' land accumulation but have no significant effect on jointly owned or wife-owned land. Drought shocks have a negative impact on husbands' nonland assets (mostly agricultural and consumer durables) in Bangladesh but no significant impact on wives' nonland assets. No significant impact was found for drought on husbands', wives', or joint land accumulation. The authors suggest that a lack of impact from these covariate, agriculture-related shocks on wives' assets in Bangladesh may reflect lack of direct exposure to agricultural risk because the women there rarely cultivate land independently, as well as the low level of women's ownership and control of agricultural assets.

Other studies on women's ownership of livestock during times of drought provide mixed results where some women gained increased control of assets in the form of livestock, while others were at risk of losing access to natural capital in the form of rangelands for livestock grazing. Kristjanson et al. (2010) found that repeated droughts in Niger strengthened women's control over livestock because they were able to invoke a cultural norm that made men responsible for household food security, with the result that men had to sell their livestock before women's. This led to an increase in women's relative control over livestock. However, in another study, the same authors found that many women in the Sahel felt that they would lose traditional access to resources if competition for rangeland and other livestock resources increased due to increasing climatic vagaries.

Income losses from climate impact on agriculture may also affect women and men differentially in terms of financial and social capital. For example, Buechler (2009) found that changes in climate and associated depletion of water resources in Sonora, Mexico, increasingly jeopardize women's livelihoods and social connections. . Women are less able to earn and control income from processing certain fruits and vegetables such as plums, apricots, figs, and olives due to warmer temperatures and water scarcity, also eroding their social connections as they become less able to exchange food products as gifts, a practice used to secure women's status in important social networks that act as safety nets and important social capital. Also in Mexico, Biskup and Boellstorff (1995) found that a prolonged drought caused the greatest economic stress to unmarried and widowed women with children who were severely resource-limited. Under these severe circumstances, some of these women resorted to selling their small livestock, which ultimately reduced their financial capital. Information on how the drought specifically affected men's assets or control of assets is not apparent from the study, but the authors allude to the fact that in the study area, a woman's inheritance is solely hers (whether it is land or livestock) and the husband must ask permission before he uses resources from the inheritance.

These examples show that crop losses and diminishing agricultural production influenced by climate change may lead to asset and livelihood losses for both women and men, but the effects are varied in different contexts. Ownership of land may influence women's and men's degree of exposure to climate shocks, while cultural norms may help some women gain increased control of assets such as livestock. Although this increased control of assets by women may seem like a positive outcome, a loss of men's assets may also weaken the overall economic

viability of the household, and as such may increase the household's overall vulnerability to climate shocks. Income losses from crop failure negatively affect the social support systems (a source of social capital) and financial capital of some women, but force other women to resort to distress sales of livestock.

Increased climate variability causes women and men to spend more time and labor (human capital) in agricultural production, but women is especially affected.

Women and men are changing their cropping practices in response to climate variability, with different impacts on well-being for both sexes. Nelson and Stathers (2009) find in Tanzania that changes to the mix of crops grown alters men's and women's access to and control of the income from crops, as well as their respective workloads. The overall picture is mixed: increased marketing of food crops (for example, sorghum and maize), which are grown by women, increase women's workloads despite the fact that they do not benefit from the profits. Conversely, the increased sale of groundnuts, bambara nuts, and cowpeas—traditionally sold by women—provided women with more access to and control of income. The introduction of sesame and sunflower led to more household income, but household members did not always share control of this income equally and these crops led to more weeding work for women. The study also reports that many farmers (no gender disaggregation) had to replant annual crops. Crops such as bulrush millet and groundnuts had to be replanted more often, as rains were “unpredictable, coming and then stopping abruptly”, which meant that time and seeds were wasted, and the quality of the crops affected.

In a case study in Guyana, Bynoe (2009) found that droughts and floods associated with the El Niño Southern Oscillation phenomenon in the late 1990s caused both women and men to spend more time planting and diversifying their crops, but women's workload increased as they had to find food for their families. Roncoli, Ingram, and Kirshen (2001) found that due to a drought, farmers in Burkina Faso became more interested in short- and medium-term sorghum varieties and women played an important role in the diffusion of these varieties through farmer to farmer exchange. However, the shift in cropping practices entailed costs and risks because these varieties were more vulnerable to weeds, pests, and water stress, and less productive than longer duration varieties. Although maize plantings increased among farmers (no gender disaggregation provided in the study) to shorten the hunger season, the drought caused the crop to fail, and an unusually heavy rain following the drought triggered a high proliferation of weeds that farmers could barely keep up removing. Because of this, they had no time to replant the maize.

These examples demonstrate a connection between user and biophysical characteristics in the vulnerability context. Women and men respond to climate signals by diversifying their crops, which requires additional human capital investments in the form of time and labor. This may be due to the unfamiliarity of dealing with new types of crops in comparison with crops that had been planted regularly in the past, or that more diversified farms require more labor and time to operate as different types of crops may require different treatment. These tasks contribute to the time demands of women and men, causing greater difficulties for women who have to deal with other household chores at the same time (as in the case of Bynoe 2009). Women may sometimes find opportunities to increase their

control of income through crop diversification, but this is context-specific and cannot be generalized.

Women and men have different access to the information (human capital) and agricultural inputs that are increasingly necessary with more climate variability.

Access to information and technologies are important tools for managing climate-related risks to agricultural production. As such, they establish connections between three components in the vulnerability context: user characteristics, biophysical characteristics, and information and technology. Some studies find that men are more likely to have access to these resources and the skills and power to use them and therefore may be better equipped to adapt compared to women (for example, CARE International 2010), while others (for example, Malhotra, Kanesathasan, and Patel 2012) find that information and communication technologies increasingly transform the economic opportunities available to poor and low-income women. In terms of climate change specifically, two examples are interesting to note, where women had less access to climate forecast information. Archer (2003) found in South Africa that women in farming communities did not have the same access as men to climate forecast information. Men preferred the radio as a medium of dissemination whereas women preferred seasonal forecasts provided through extension officers, in a “teach-in” situation. The women expressed this preference because they “like to ask questions”, and because “their time is not flexible enough to be able to sit and listen to a radio program at a fixed time”. Men, in contrast, said that they had no problem scheduling a regular time to listen to a radio broadcast. These findings suggest that constraints on women’s time and spatial mobility may limit their access to timely weather information. In another study, Roncoli et al. (2009b) found that gender, as well as ethnicity and politics, profoundly shaped the way that climate forecast information gained from participatory workshops was shared and accessed in Burkina Faso. Most of the workshop participants (93.4 percent) were men. In one village, male village leaders did not invite women to the workshop so that they would not have to reduce the number of places reserved for male farmers. Since the women in this village could not approach the male participants to ask for information (the reason for this was not mentioned in the study, but it could perhaps be due to cultural norms), many women in this village failed to get the climate forecasts even by second hand.

In Jamaica, Vassell (2009) finds that farmers have abandoned native seed varieties and are becoming more dependent on new hybrid seeds for crops that require more water and fertilizer, yet drought makes it difficult for them to grow such crops. The high cost of agricultural inputs such as fertilizers and women’s lower income status means that women are less able than men to afford the cost of fertilizers and water that are essential to produce high yields from their crops.

Taken together, the literature in this section shows that increasing climate variability tends to lower agricultural production, with different impacts on women’s and men’s well-being and assets, including land, livestock, financial and social capital, in agreement with H1. Both women and men also spend more time and labor in agricultural production as a result of increasing climate variability, but women experience a heavier workload due to other domestic chores they have to perform. As it is, even without considering climate aspects, literature elsewhere already shows that women tend to spend disproportionately more time than men in

agricultural labor and household work (see, for example, Bardasi and Wodon 2006; Nellemann, Verma, and Hislop 2011; Onta and Resurreccion 2011). The women in these examples also have less access to agricultural technologies and inputs and this may place them at a greater disadvantage in terms of climate impacts, as hypothesized in H2.

Impacts related to food security

Lowered agricultural production from increased climate variability can result in lower incomes and smaller harvests from subsistence agriculture. This leads to decreased food consumption, which could have gendered human capital outcomes.

Climate-extreme events such as drought may lead to food insecurity and malnutrition in households, with different human capital impacts for men, women, and children. These impacts relate to different user characteristics and how they interact with sociocultural norms in the vulnerability context. Hoddinott and Kinsey (2000) find in rural Zimbabwe that the 1994–95 droughts had adverse effects on the body mass of women, but not men. However, all women did not bear these effects equally. Wives and daughters experienced adverse effects but daughters-in-law of the household head experienced no effects. The authors suggest that daughters-in-law may have access to resources outside the household such as remittance income that offsets the impact of the drought. Their results also show that the accumulation of livestock may protect women against the adverse consequences of this shock, as household holdings of livestock were associated with higher measures of body mass index (BMI) for wives of the household head. A follow up study by Hoddinott (2006) finds that adult women who were adversely affected by the drought in terms of BMI recovered relatively quickly, but very young preschoolers (12–24 months) lost growth velocity. While children who resided in relatively well-off households eventually recovered this lost growth velocity, children from poorer homes did not. This suggests that drought can present short-term impacts for women's health, but long term impacts for children's growth and development in asset-poor households.

Because women are the main providers of food and meals for their families, women may bear a greater burden to fulfill this task when climate events occur. Jungehülsing (2010) assesses the impacts of hurricanes Mitch and Stan leading to flooding in Chiapas, Mexico, and found that while men lost income from remunerated work on farms, women lost the fruits, vegetables, chickens, and ducks from their home yards. These losses seriously affected women's ability to feed their families since they previously obtained a significant portion of their daily food from their own yards. Similarly, Angula (2010) finds in Namibia that during droughts, out of their submissiveness to their husbands, women first explore other means of ensuring food security before discussing the matters of food shortage with their husbands. Women were also first to diversify their livelihoods through basketry, processing nuts and oil, or through sales of their livestock such as chickens, pigs, or goats to raise money to buy food.

In Burkina Faso, Roncoli, Ingram, and Kirshen (2001) find that heads of household (gender not explicitly stated) take diverse measures to cope with food shortages due to severe drought. These include reducing the number of women cooking and charging one woman to cook a common meal rather than allowing

each woman to cook separately, supervising women more strictly in how they handle grain for cooking, using a smaller container to measure grain or extending the time between grain allocations to women, and relying on women's contributions of grain from their own fields or bought with their own money. The authors also find that food management strategies entail a combination of control, conflict, compliance, and cooperation among men and women, young and old, within the household. When households had exhausted all resources and strategies to obtain food, they pawned their crops, borrowed money, and women resorted to selling cloth, utensils, and jewelry that they had set aside for their daughters' weddings. Goats and sheep belonging to women were sold in distress sales. In some cases women volunteered these sales and in others the heads of household seized the animals and sold them. It is not apparent in this study if men specifically parted with their own assets or households sold off jointly owned assets to cope with the drought, and there is also no specific mention of the household types, although the authors allude to the fact that there were some monogamous and polygynous households.

Women may suffer disproportionately in terms of food intake in times of extreme climate events, but men also face negative consequences due to food shortages. In examining the impact of droughts in agropastoralist communities in northeast Kenya, for example, Serna (2011) find that when food shortage was prevalent, a common practice, especially among women, was to reduce meal intakes. This increased women's health problems as well as that of children and lactating mothers. Men turn to other means of earning income by collecting and selling bush products like gum and resin or by cutting trees for firewood and charcoal, but also report weakness because of low quantities of food intake whilst doing hard manual labor.

Examined together, these examples show that climate change may affect the food security of men, women, and children in different ways (H1), but women and children often suffer more in terms of health and in terms of growth and development, both which form part of human capital (H2). During times of climate stress, women in particular are more hard-pressed to provide meals for their families since they are primarily responsible for household food security and, as evident here, reduce their food intake so others may eat more, or part with assets such as jewelry and small livestock or take on additional work to smooth consumption during climate shocks (H2).

Impacts on health

Climate change affects the human capital of women and men differently in the form of mortality and in terms of their physical and psychological health, some of which is indirectly related to food insecurity.

Only a few studies have empirically tested the differential impacts of climate change on women's and men's physical health, and most have been conducted in developed countries. Although climate impacts in developed countries are not the focus of this paper, the examples provided here point to some possible impacts that may also occur in developing countries but remain understudied. Studies reviewed by the World Health Organization (2009) on the effect of heat waves show that women in Europe are more at risk of dying, in both relative and absolute terms,

(Kovats and Hajats 2008), with an increased risk for elderly women owing to physiological reasons (Havenith 1998). In the United States, elderly men seem to be more at risk in heat waves than are women, as was seen in the Chicago heat wave of 1995, likely due to social isolation among elderly men (Semenza 1996; Whitman 1997). Several studies which examined the links between meteorological conditions and the incidence of eclampsia in pregnancy find increased incidence during climatic conditions characterized by low temperature, high humidity, or high precipitation, with an increased incidence especially during the first few months of the rainy season (for example, Neela and Raman 1993; Subramaniam 2007; Wacker et al. 1998).

A more severe climate impact on health may occur for women and children due to the indirect effects of malnutrition, which make them additionally susceptible to diseases—and this may be especially evident in poor developing countries. Reyes (2002) examines the effects of the 1997–98 El Niño phenomenon in Peru and explains that gender inequalities in food distribution and consumption within households were common. Even during periods where households appeared to have sufficient food, women and children seemed to have a lesser share of the food. Widespread malnutrition during the El Niño floods and landslides further exposed these women and children to epidemics such as acute respiratory and diarrheal infections, malaria, dengue, and cholera. Pregnant women were also recorded to have a higher risk of contracting malaria, which causes serious complications during pregnancy.

The psychological impact of climate events may also affect women and men differently. For example, Coêlho (2004) finds that women in a drought affected area are more anxious and emotionally distressed than men in general. This may be due to difficulties women face to execute their roles as producers and providers. Mitchell, Tanner, and Lussier (2007) come across similar findings in the Ganga river basin in India, where psychosocial effects of a flood were more pronounced for women who, in addition to their distress and losing their support networks, had to look after other family members.

Additionally, perceptions of illnesses caused by climate change among the rural poor are interesting to note, although many of these claims require further investigation. Through their survey in Nigeria, Agwu and Okhimambe (2009) find that when asked about health issues, women and men in one community listed malaria, hypertension, ulcer, diarrhea, asthma, and diabetes as ailments that they perceive to be “ushered in” by the changing climate, with malaria being the most widespread. The community reported that thirty years ago, they could rely on local medicinal herbs for treating illnesses; now they have to go to substandard clinics for treatment. This in some way reflects that the natural resources that communities once relied on for treating ailments were no longer easily available.

On the whole, the differential impacts from climate change on women’s and men’s physical health are not very distinct in the literature reviewed, but in one example (Reyes 2000), the indirect effects of malnutrition place women and children at higher risk from contracting diseases in post disaster situations. The psychological and emotional toll of climate events appears to be heavier for women as they are unable to carry out their tasks and roles, especially to provide care for their children and other family members. In this section, there is limited evidence of differential impacts of climate on men’s and women’s physical, psychological, and

emotional health, all of which are aspects of human capital (H1), but women do seem to suffer more (H2), at least in the evidence found here, likely due to factors such as their physiological make-up, their roles as primary caregivers, and their lack of access to food and nutrition. These factors are illustrative of different user characteristics in the vulnerability context.

Impacts related to water and energy resources

Climate variability drives the increasing scarcity of natural resources, which mostly affects women's human capital in the forms of health, time, and labor, due to their traditional roles as water and food collectors for the household.

In many developing countries, cultural traditions make women responsible for collecting water, even when this involves long hours performing heavy physical labor or travelling long distances. Rural women in most developing countries are also responsible for sourcing fuel such as wood, charcoal, and agricultural wastes that are needed for household activities such as cooking, boiling water, or for keeping warm. Annecke (2002) describes that there is now a great deal known about the struggles of women to obtain fuel and the social impacts of the continued reliance on biomass or low-grade fuels. She describes that in southern Africa, qualitative and quantitative research has documented distances women walked to collect wood and the implications of wood collection on women's health and well-being. By examining the total amount of time individuals spend working, whether in the labor market, in domestic chores, or in collecting water and wood, Bardasi and Wodon (2006) find in Guinea that the total working time is higher for women than for men in urban as well as rural areas. With climate change as well as other anthropogenic environmental degradation, there is a likelihood that natural capital such as water, wood, and other fuels used for energy generation may become scarcer in some regions of the world. In the case of some developing countries, women are likely to spend more time and labor on these collection tasks. These tasks contribute to their time poverty, and bring negative consequences to their health and well-being.

In Vietnam, for example, Shaw et al. (2008) find that women have to collect water from water sources that are farther and farther away as each drought take its toll. Asheber (2010) finds similar results in Ethiopia, and Dankelman et al. (2008) in Senegal, where women were more severely affected by water shortages than men, largely due to their role as water collectors for the household. The women had to travel farther in search for water, as well as spend more time checking different wells for water availability.

Difficulties in accessing fuel sources are often indirect impacts of climate change. A study by Leduc (2008) finds that decreasing snowfall in the past six years in Nepal is contributing to a longer dry season, which decreases crop production and increases famine. This has prompted income-driven deforestation by the community, which has severely reduced the availability of trees for fuel wood. Women have to walk much farther to obtain fuel wood, and this was viewed as a dangerous task on steep slopes that took about six hours every three days.

Water and fuel shortages caused directly and indirectly by climate change pose considerable time and labor burdens for women, more so than for men, as the examples in this section show. The longer the women spend searching for these

natural resources, the less time and energy they likely have for performing other household tasks, indicating an increase in time poverty. The differential impacts of climate change are evident here (H1) due to the distinct role of women to source and secure water and fuel for the household, which may also negatively impact women's and girls' health (human capital) and well-being in the longer run (H2). The examples also point to women's vulnerability in connection with biophysical characteristics that is largely due to their roles as compared to men. Hannan (2011) further explains that an increase in women's work load and burdens as a result of climate change may mean that they have to forego opportunities that are important for their economic empowerment, such as education or training and income-generating activities. In some cases, women are forced to take their daughters from school to assist them with work on the farm or in the household, which has long-term detrimental effects on the empowerment of these girls (Hannan 2011).

Impacts from climate-related migration and conflict

Climate induced migration has different impacts for women and men in terms of human capital and income.

The literature reviewed indicates that men are more mobile and more likely to migrate to areas unaffected by climate events in search of employment, whereas women are less mobile, and more likely to stay back in the affected area to care for the family and household. Increasing rates of male outmigration as a consequence of climate signals may bring consequences for households. Agwu and Okhimambe (2009) find in Nigeria that during flood periods and the dry season, temporary migration of men to urban areas result in women being left alone to take care of the household. Women may engage in petty trading to supplement income from the men. In most cases, girls and young boys also get involved through street hawking of commonly required household items like tomatoes and pepper and drinking water. In two other communities examined in the same study, temporary male migration was found to increase the workload of the women and expose them to physical and sexual abuse as they scrambled for depleting commodities or entered into early marriages.

Nelson and Stathers (2009) find that unpredictable rainfall, declining soil fertility, and increased incidence of crop pest and diseases are leading to more frequent crop failure and increased yield variability in Tanzania, prompting an increase in seasonal migration by men. Men were reported to engage in unprotected sex outside the marriage while away from their wives, and this contributed to the spread of HIV/AIDS in the village. A survey by Babagura (2011) reported similar findings in South Africa, where men who migrated were said to return with HIV/AIDS and pass on the disease to their wives. As a result of the death of men and women from HIV/AIDS, there were many orphans in the community surveyed.

Although households may benefit from remittances sent from male migrants, the case is not always straightforward among very poor households. Men with few skills to take up work in the urban sector and few resources to pay for living expenses in towns may be ill-prepared to deal with the challenges posed by migration, and may have little means to remit their income. Babagura (2011)

provides anecdotal evidence where reverse remittance may also occur, where migrants who have moved to urban areas may need financial support from their households in rural areas.

The social impacts of migration may also affect women and men differently. In Bangladesh, a study by Kartiki (2011) finds that destruction caused by the cyclone Aila in 2009 forced some affected households to migrate, and the social impacts experienced by women differed from those experienced by men. While men often managed to find work under a government sponsored food for work program, women from these households reported losing access to whatever limited livelihood options they previously enjoyed. Women migrants reported that their situation was made worse by a lack of privacy and poor access to proper sanitation facilities in the few, overcrowded shelters. Many households also reported tension between the migrants and receiving communities over resources including water and employment.

Climate induced scarcity of natural resources may precipitate conflict, with different impacts for women and men in the forms of increased mortality and the loss of physical assets and rights.

Omolo (2011) finds that in northern Kenya, climate variability and change have led to increased droughts and floods which have increased poverty and competition over scarce resources, leading to conflicts particularly in the form of armed livestock raiding. Men were more likely to die in such conflicts, resulting in an increase in female-headed households. According to Omolo (2011), women are particularly vulnerable to insecurity and conflict because they are responsible for their children and thus cannot flee during raids, and also because they have poor customary rights to land, wells, and livestock. In the study area, a woman belongs to the husband's clan once she is married, but the clan can be "less forthcoming" with assistance when her husband has died. In times of crisis, women and children may also be sent to stay with distant relatives, or to urban areas where they remain vulnerable to food insecurity.

Climate change is an influencing factor in migration decisions

Various factors with different gender dimensions may influence decisions to migrate as an adaptation response to climate signals. For example, Jungehülsing (2010) finds in Chiapas, Mexico, that migration decisions are linked to land ownership. In approximately half the cases of male migrants studied, the impacts from climate change constitute an important factor in their decision to migrate, since men in that region typically work in agriculture and own land. However, in the case of women, who mostly did not own land, this relationship was less evident or was only indirectly related to the effects of climate change. Women tend to migrate due to lost income resulting from the depressed regional economy, primarily in activities related to selling food or other items. Single mothers were more likely to migrate than married mothers because they are the sole providers for their families and they have no other choice but to do so when their livelihoods are eroded.

The occurrence of droughts may also influence marriage decisions and marriage-related migration because of wedding-related expenses. Gray and Mueller (2011) find that drought increases long-distance and labor-related moves by men

in Ethiopia but reduces marriage-related moves by women, reflecting decreased financial capital to finance wedding expenses and form new households. In the same way, Hoogeveen, van der Klaauw, and van Lomwel (2004) find in Zimbabwe that after a drought, men are likely to be reluctant to get married and to pay bride wealth, which consists of a substantial number of cattle. Dillon, Mueller, and Salau (2011) investigate the extent that Nigerian households engage in internal migration to insure against ex ante and ex post agricultural risk due to weather-related variability and shocks, and found that households were more inclined to send men out of the village and retain women in the household in response to ex post covariate shocks. The authors suggest that this could be due to several possible factors. Covariate shocks such as droughts may lower bride prices. Hence, households may retain women in the hope of receiving a higher bride price in the future. There also may be differences in male and female expected earnings from migration, and women's labor may be more valuable in the home.

Examined as a whole, the examples in this section show that natural resource scarcity precipitated by climate change may bring about varied impacts for women and men in terms of their human, physical, and financial capital. The occurrence of conflicts over natural resources may also be correlated to the direct or indirect impacts of climate change. Barnett and Adger (2007) explain that climate change increasingly undermines human security in the present day, and will increasingly do so in the future by reducing access to, and the quality of, natural resources that are important to sustain livelihoods. The erosion of human security in turn increases the risk of violent conflict. Evidence is still patchy but better methods and approaches to systematically investigate the impact of climate change on human security and conflict are being developed (such as Ratner et al. 2011). Migration and conflict due to climate-related factors present different impacts for women and men (H1) but the negative consequences of these impacts are mixed as both women and men can be negatively affected, albeit in different ways.

Impacts from climate-related natural disasters

Climate-related natural disasters have immediate and longer term impacts that are different for women and men depending on the extent of physical, human and social capital they have access to under various social, economic, and cultural contexts.

Immediate impacts

The immediate impact of climate-related disasters such as hurricanes and floods on individuals is determined by their ability to evacuate in time to safer grounds. Such action may be prompted by warning information (a form of human capital) disseminated through mass media, which not all individuals have access to. Other sociocultural factors and life skills such as the ability to swim (another form of human capital) may also be determinants of life and death during natural disasters (Nellemann, Verma, and Hislop 2011). For example, during floods in Gujarat, India, Ahmad and Fajber (2009) find that disaster warnings often come through media such as the television, radio, or mobile phones, which are more frequently used by men than by women. Also, according to the same authors, most women cannot swim, whereas at least 40 percent of the men can—skill that could be a crucial

determinant for survival. The actual percentage of women, who can swim, however, is not apparent from the study, making comparisons of the relative swimming abilities of women and men impossible. The authors allude to the fact that in the study area girls and women are not encouraged to learn how to swim, largely for reasons of cultural appropriateness or modesty.

Cultural norms may also prevent women from moving freely during times of disaster. Although not caused by climate change, such evidence can be found in the case of the Asian Tsunami in 2004. More women were reported to have died than children or men in the Andaman and Nicobar islands due to gender inequalities, rather than “by chance” (UNISDR 2008). Their roles as caregivers and mothers meant that when the tsunami hit, women put the safety of their children and assets before their own survival. Patt, Dazé, and Suarez (2009) suggest that women tend to prioritize the good of others much more than men. They also describe that women’s greater awareness of social bonds enables women to demonstrate greater cooperation and altruism to the community. On this notion, the authors suggest that “women may suffer the effects of disasters more than men not just because cultural factors put them and keep them in harm’s way, but because they themselves choose to prioritize the health and safety of others over their own health and safety.”

The findings above appear to support Neumayer and Plumper’s (2007) observation in 141 countries that natural disasters (broadly defined and not limited to climatic events) on average kill more women than men, or kill women at a younger age than men, particularly in countries where women have very low social, economic, and political status. In countries where women have comparable status to men, natural disasters affect women and men almost equally. However, Patt, Dazé, and Suarez (2009) note that gender-differentiated roles do not always result in higher losses for women. Evidence from Central America indicates that immediate mortality caused by Hurricane Mitch was higher for men (Bradshaw 2004), likely because men tend to be more engaged in outdoor activities in that region.

Other social factors such as caste may influence the survival of women and men in disaster situations. Ahmad and Fajber (2009) find in Gujarat, India, that women are more vulnerable to climate variability than men, but the vulnerability of individual women varies according to their socioeconomic group and access to entitlements. Caste intersects with gender to determine who is vulnerable, where they live, and their access to resources such as communication and information systems. Lower caste groups may be unable to enter flood shelters because of social practices— ritual pollution—that discriminate against them. Poor tribal groups also reside in low-lying, flood-prone areas on the outskirts of the village, making it difficult for them to access relief, or get information on impending disasters.

Longer term impacts

The longer term impacts of climate-related disasters on individuals’ well-being have to do with their access to post disaster support such as food, shelter, medical aid, and post disaster recovery support. The evidence here shows that women tend to be more vulnerable and have less access to resources, assistance, and support than men in the aftermath of climate events, but again, sociocultural norms influence these impacts. In Pakistan, research by IDMC (2011) reveals that some women

who were displaced by floods in 2010 received less assistance than others as the male heads of household shared the bulk of the food and other items with their wives and children while ignoring the needs of other female family members. Additionally, the demands of purdah (which regulates the interaction of unrelated women and men) made it difficult for women to access food aid, showers, latrines, emergency supplies, and doctors, with implications for their health and hygiene.

When a disaster destroys livelihoods and assets, both women and men suffer, but women may suffer more in some contexts. In a study of the post disaster situation of the 2008 Cyclone Nargis in Myanmar, the Women's Protection Technical Working Group (WPTWG 2009) found that 60 percent of female-headed households lived in unsatisfactory shelters, female-headed households made up the highest percentage of the low income groups, and children from female-headed households frequently dropped out of school due to financial constraints and to help with household chores. Additionally, Nellemann, Verma, and Hislop (2011) caution that in times of natural and climate-related disasters, due to the erosion of social controls and protections that normally regulate the behavior within households and communities, women and children face a greater risk of becoming targets for exploitation, gender-based violence, and human trafficking when they are unaccompanied, separated, or orphaned.

Studies in Bangladesh (Baden 1994; Khondker 1996; both cited in Cannon 2002) find that the loss of utensils and other household essentials as a result of floods poses a great hardship for women and undermines their well-being because of their dependence on economic activities linked to the home. They also find women to be less likely to succeed in restoring their livelihoods after a flood. In Jamaica, studies report men to be more open to helping in women's tasks such as cooking, cleaning, and childcare in post-hurricane situations, although women still primarily bear these responsibilities (Vassell 2009).

The examples of differential impacts (H1) faced by women and men in climate-related natural disasters provided in this section are closely linked to sociocultural norms (that is, institutional arrangements). Again, because of their roles as caregivers, social expectations of what is acceptable for women in different societies, and lack of access to income generating activities and assets, women (and children) tend to fare worse and are more vulnerable than men in facing the immediate impact as well as the longer term impacts of such disasters (H2).

3. DISCUSSION

In examining the literature across the six impact areas, we can make several observations of how climate change differentially affects the assets and well-being of women and men. Evidence is limited, patchy, varied, and highly contextual in nature. The nature of the literature makes it challenging to draw any strong conclusions, and to effectively compare and contrast between case studies. Available studies that do examine gender-differentiated climate impacts offer information that is not surprising, and is largely consistent with the assumption that climate impacts may affect men and women differently (H1) and that women tend to suffer more negatively in terms of their assets and well-being (H2). The findings are also consistent with the framework in Figure 1, which shows that different users

(that is, men and women) are affected differently based on varying contexts of vulnerability.

Even if the general observation is such that women are often more negatively affected, there are some exceptions to the pattern. Men may be more negatively impacted by climate change because they own land (Quisumbing et al. 2011), or because women are able to invoke cultural norms that make men responsible for household food security (Kristjanson 2010). Among women, differential climate impacts may also occur depending on their marital status, relationship to the head of household or family situation. Single women, single mothers, women who are not first wives, and other female members of the household may have less access to resources and assistance during climate shocks, as was seen in the case of food distribution in Pakistan (IDMC 2011), and in the distress sales of livestock owned by widowed mothers in Mexico (Biskup and Boellstorff 1995). Societal structures such as caste may also determine the vulnerability of both women and men, as seen in India, where lower caste people are shunned from evacuation shelters (Ahmad and Fajber 2009). Men may also experience negative impacts as in the case of the drought in Kenya (Serna 2011), where they have little energy to perform the hard labor required of them in the pursuit of alternative livelihood options, or in the case of higher mortality for men in the wake of Hurricane Mitch (Bradshaw 2011).

These exceptions signal that the gender-differentiated impacts of climate change are not always rigid, straightforward, or predictable. These impacts vary among individuals depending on context and may be mediated by a host of other sociocultural, economic, ecological, or political factors, as indicated by institutional arrangements in the framework. Demetriades and Esplen (2008) caution that women cannot be treated as a monolithic group when looking at their vulnerability to climate change. They explain that the tendency has been to conceptualize women everywhere as a homogenous, subjugated group, "the poorest of the poor". They find that such representations are problematic on multiple accounts, particularly in their failure to account for the complex interactions between gender and other forms of disadvantage based on class, age, race, ethnicity, and sexuality. They also caution that climate change research that "abstracts women from their social realities eclipses the relational nature of gendered power and the interdependency of women and men, and paints a distorted picture of women's vulnerabilities, choices and possibilities". They also emphasize the need to communicate men's vulnerabilities where they do exist, and to recognize the positive contributions that men can and are making to gender equality and sustainable environment goals.

There were several instances in the literature review where it was difficult to compare and contrast between the impacts experienced by women and men or to understand if there were any differences at all because the literature either focused more on women (and less on men) or was based on data and observations that were not disaggregated by gender. In this respect, a key research need is systematical and empirical studies on how climate change impacts women and men, separately and jointly, in terms of their vulnerabilities, well-being and assets, and also to understand the contextual factors that mediate these impacts and the ensuing responses. A larger base of such knowledge and the availability of gender-disaggregated datasets (see Singh, Swenson, and Kalyanpur 2010 for a discussion

on this topic) would not only help researchers to discern the impacts of climate change, but also to identify common themes, gaps, and needs (if any) across case studies. A better integration of social sciences with natural sciences to better understand the differences in the way that climate change affects women and men could also present a more holistic, nuanced picture of how gender intersects with various other factors (such as biophysical, institutional, technological factors) in different settings.

In this respect, Roncoli et al. (2009b) explain that ethnographic fieldwork and participant observation can provide a distinctive lens into the dynamics of climate and culture, and illuminate how local communities are perceiving, understanding, valuing, and responding to climate change. Such an approach may be helpful to fill the knowledge gaps in understanding the gender dimension of climate change. A study of the impact of the 1998 Hurricane Mitch in Honduras (Paolisso, Ritchie, and Ramirez 2002) lends further support to this approach and offers important insights for understanding gender-differentiated impacts of climate change. The study shows that men and women reported similar impacts of the hurricane on agriculture and their homes but they valued these impacts differently, depending on whether the impact falls within or outside their gender roles and responsibilities. Men ranked impacts that affected their agricultural and income-generating work as high-impact areas while women ranked impacts related to food production and household domestic work as high-impact areas. The authors propose that the gender division of labor is an important cultural filter that in conjunction with physical and economic criteria defined how men and women perceived the impacts of the hurricane, and provides a cultural framework within which to assess disaster impacts on social relations and to design mitigation strategies. Further, the study demonstrates that understanding the complexity of local agricultural systems—the gender division of labor, temporal factors (such as timing and cycles of crops being planted), spatial dimensions (such as local topography) and economic factors (such as which crops are used for income and which crops for subsistence)—is key to capturing the heterogeneity of disaster impacts. Likewise, for a more holistic understanding of the gender dimension of climate change, each component (user characteristics, biophysical characteristics, information and technology, and institutional arrangements) within the conceptual framework must be considered by drawing expertise and methodologies from different disciplines (for example, crop science, economics, social science, meteorological science). Elucidating how gender intersects with each of these components will be key to understanding the performance of individuals, groups, and communities in the adaptation arena and hence to design interventions for climate change adaptation that are well suited to different contexts and that account for the gender dimension. This knowledge will also be crucial for informing climate change mitigation efforts and providing a stronger foundation to discuss gender concerns in climate change discourse and policy.

APPENDIX 1

Tables summarizing gendered findings and assets affected by climate signals in each impact area - the findings are presented in the order according to their mention in the literature review.

i) Impacts related to agricultural production

Author	Year	Country	Climate signal	Gendered findings	Affected asset(s) or well-being outcome(s)
Quisumbing, Kumar, and Behrman	2011	Bangladesh and Uganda	Droughts and floods	The impact of weather shock on men's and women's assets appears to depend on involvement in agricultural production and exposure to weather risk. Higher involvement in agriculture presents more impact from weather related shocks.	Natural capital (land) and physical capital (nonland assets such as agricultural and consumer durables)
Kristjanson et al.	2010	Niger and Sahel	Drought	In Niger, women's control over livestock was strengthened as men had to sell their livestock before women's. In the Sahel, women could lose access to resources needed to support livestock, if these resources became scarcer.	Natural capital (livestock)
Buechler	2009	Mexico	Warmer temperatures, depletion of water sources	Women's livelihoods, control of income and social connections jeopardized by disintegration of fruit and vegetable home-processing industries. Men had more varied employment options.	Social capital, income
Biskup and Boellstorff	1995	Mexico	Prolonged drought	Unmarried and widowed women with children suffered most from crop failure, and resorted to selling small livestock.	Natural capital (livestock)
Nelson and Stathers	2009	Tanzania	Drought	Change of cropping practices towards more drought tolerant crops, with mixed outcomes for women's and men's labor and income. Women and men gained income from different types of crops, but weeding work is increased for women in some instances.	Income
Bynoe	2009	Guyana	Droughts and floods due to El Nino	Women and men spend more time planting and diversifying food crops, more women reported having increased workload compared to men	Human capital (time and labor)
Roncoli, Ingram, and Kirshen	2001	Burkina Faso	Severe drought, then unusual heavy	Farmers diversified to plant short and medium duration sorghum varieties diffused by women, but with costs and risks. Maize crop failed and heavy proliferation of weeds	Human capital (time and labor)

Author	Year	Country	Climate signal	Gendered findings	Affected asset(s) or well-being outcome(s)
Archer	2003	South Africa	rainfall Climate variability	due to rains. Women may have less access than men to timely weather forecast information due to the medium through which such information is channeled.	Human capital (information)
Roncoli et al.	2009b	Burkina Faso	Droughts (mostly)	Participatory workshops that disseminated climate forecast information were attended mostly by men (93.4 percent) and men from at least one village were documented to reserve spaces at the workshop for male farmers. As a result, women did not have as much access to the forecast information as men.	Human capital (information)
Vassell	2009	Jamaica	Climate variability	New hybrid seeds which require more water and fertilizer are a poor fit for farmers as water becomes increasingly scarce, and fertilizer prices increase. Women suffer more as they are less able to afford these farm inputs.	Income

ii) Impacts related to food security

Author	Year	Country	Climate signal	Gendered findings	Affected asset(s) or well-being outcome(s)
Hoddinott and Kinsey	2000	Zimbabwe	Drought	Women, but not men, were adversely affected by the 1994–95 drought in terms of body mass. However, these effects are not borne equally by all women, and the relationship to the head of the household has an effect. Accumulation of livestock may protect women against the adverse consequences of this shock.	Human capital (health)
Hoddinott	2006	Zimbabwe	Drought	Although adult women were adversely affected, they recovered quickly. Very young preschoolers (12–24 months) from poorer households were adversely affected, losing growth velocity (a longer term impact).	Human capital (health)
Jungehülsing	2010	Mexico	Hurricanes Mitch and Stan (floods)	Men were more affected in the sphere of remunerated work, while most women were affected primarily in the 'sphere of the home', affecting their ability to feed their families.	Human capital (health)

Angula	2010	Namibia	Drought	Women would first explore other means of ensuring food security before discussing the matters of food shortage with their husbands. Women were first to diversify their livelihoods (basketry, sale of small livestock).	Natural capital (livestock)
Roncoli, Ingram, and Kirshen	2001	Burkina Faso	Drought	Women came under tighter control by heads of households in terms of the grain they used for cooking, used grain from their own fields or bought with their own money, and had to part with nonfarm assets (for example, jewelry) and/ or small livestock through voluntary or involuntary means.	Financial capital, natural capital (livestock) and physical capital (jewelry)
Serna	2011	Kenya	Drought	Reduction of meal intake by individuals especially amongst women, thus increasing their risk of health problems as well as that of children and lactating mothers. Men also weak from malnutrition and laborious physical work to collect forest products for sale.	Human capital (health)

iii) Impacts on health

Author	Year	Country	Climate signal	Gendered findings	Affected asset(s) or well-being outcome(s)
Kovats and Hajats*	2008	Europe	Heat wave	Women more likely to die than men.	Mortality
Havenith*	1998	Europe	Heat wave	Older women likely to die.	Mortality
Semenza* Whitman et al.*	1996 1997	USA	Heat wave	Older men more at risk to die, due to social isolation.	Mortality
Neela and Raman*, Subramaniam* Wacker et al.*	1993 2007 1998	Global	Climate variability	Higher incidence of eclampsia in pregnancy.	Human capital (health)
Reyes	2002	Peru	Flood and landslide from El Nino	Women and children ate less food in general, and were more susceptible to diseases (for example, malaria, cholera and dengue).	Human capital (health)
Coêlho	2004	Brazil	Drought	Women were more anxious and emotionally distressed than men in general, maybe due to difficulties women face to execute their roles as producers and providers.	Human capital (health)
Mitchell, Tanner and Lussier	2007	India	Flood	Higher psychosocial effects for women, due to loss of social networks and difficulty to care for family.	Human capital (health)

Agwu and Okhimambe	2009	Nigeria	Climate change	Women and men perceived that climate change 'ushered in' ailments, with malaria being the most widespread. Lack of access to traditional medicines.	Human capital (health)
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*Cited in World Health Organization (2009)

iv) Impacts related to water and energy resources

Author	Year	Country	Climate signal	Gendered findings	Affected asset(s) or well-being outcome(s)
Shaw et al.	2008	Vietnam	Drought	Women had to fetch water from further away; time spent increased and more physical labor exerted.	Natural capital (water), human capital (time, labor)
Asheber et al.	2010	Ethiopia	Drought	Women perceived to more severely affected than men due to water collection burden; time spent increased and more physical labor exerted.	Natural capital (water), human capital (time, labor)
Dankelman et al.	2008	Senegal	35 percent less rainfall on average across country	Women spent increasing amounts of time checking water levels in boreholes; water is of poor quality.	Natural capital (water), human capital (time, labor)
Leduc	2008	Nepal	Drought	Decreased agricultural production causes increased deforestation for income generation in communities. Women have to travel further in search for fuel wood.	Natural capital (trees), human capital (time, labor)

v) Impacts from climate-related migration and conflict

Author	Year	Country	Climate signal	Gendered findings	Affected asset(s) or well-being outcome(s)
Nelson and Stathers	2009	Tanzania	Unpredictable rainfall	Increasing trend of seasonal and voluntary male (out) migration, with increased incidence of HIV which undermines family relationships.	Human capital (health)
Babagura	2010	South Africa	Climate change	Increasing trend of seasonal and voluntary male (out) migration, with increased incidence of HIV – passed on to wives. Increased burden on women to care for sick family members.	Human capital (health)

Agwu and Okhimambe	2009	Nigeria	Floods and dry seasons	Male (out) migration increases responsibilities and workload of women in the household.	Human capital (time, labor)
Babagura	2011	South Africa	Climate change	Male (out) migration may not necessarily bring remittances to rural households, reverse "remittance" may occur.	Financial capital, income
Kartiki	2011	Bangladesh	Cyclone Aila	Displaced men able to find work through public works programs, but women could not restore their livelihoods. Migrant households feel unwelcomed by receiving communities.	Physical capital (homes), income
Omolo	2011	Kenya	Droughts and floods	Cattle raiding increases with fatal outcomes for men; increased number of female-headed households vulnerable to food insecurity.	Natural capital (livestock), income
Gray and Mueller	2011	Ethiopia	Drought	Drought increases long distance and labor-related moves by men, but decreases marriage related moves by women. Reflects decreased ability to finance wedding expenses and new household formation.	Financial capital
Jungehülsing	2010	Mexico	Impacts from climate change	Climate change is a more important factor driving men's decisions to migrate than women's, since men owned agricultural land, except in the case of single mothers.	Income
Hoogeveen, van der Klaauw, and van Lomwel	2004	Zimbabwe	Less rainfall	Fewer marriages after a drought due to men's inability to pay bride wealth.	Financial capital
Dillon, Mueller and Salau	2011	Nigeria	Weather-related variability and shocks	Households were more inclined to send men out of the village and retain women in the household in response to ex post covariate shocks.	Financial capital

vi) Impacts from climate-related natural disasters

Author	Year	Country	Climate signal	Gendered findings	Affected asset(s) or well-being outcome(s)
Ahmad and Fajber	2009	India	Flood/hurricanes	Women more vulnerable to disasters due to "gendered" nature of early warning information; women lack the ability to swim compared to men. Lower caste people more vulnerable.	Human capital (early warning information, swimming skills)
UNISDR	2008	Andaman and Nicobar	Asian tsunami (not climate-related, but viewed as proxy)	Women suffered higher mortality due to being socially isolated, putting the safety of children and assets before their own and having to protect their modesty.	Mortality

Bradshaw	2004	Central America	Hurricane Mitch	Men suffered higher mortality due to the "outdoor" nature of their work and life, versus "indoor" nature of women's work and life.	Mortality
Neumayer and Plumper	2007	Multi-country, multi-year review	Natural disasters (including non-climate-related ones)	In societies where the socioeconomic class of women is low, natural disasters will kill directly and indirectly via related post disaster events more women than men, or will kill women at a younger age than men.	Mortality
WPTWG	2009	Myanmar	Cyclone Nargis	After the disaster, female-headed households were least able to recover their livelihoods and were most vulnerable to violence. Children dropped out of school due to financial constraints or to help with household chores.	Physical capital (homes, belongings)
IDMC	2011	Pakistan	Flood	Practice of "purdah" made it difficult for women to access post disaster aid and support. Men discriminate among women when they distributed food received from aid agencies in the household.	Human capital (health)
Cannon	2002	Bangladesh	Flood	Loss of utensils and other household essentials as a result of floods posed a great hardship for women because of their dependence on economic activities linked to the home.	Physical capital (homes, utensils)
Vassell	2009	Jamaica	Hurricane	Traditional men's and women's roles may be altered in disaster recovery efforts, where men are more open to help women in domestic work.	Human capital (time and labor)

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