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# Addressing the interconnectedness challenges of climate change and women's Health: A gendered perspective

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**Abstract**

Climate change's effects on health, such as increased exposure to heat, poor air quality, extreme weather events, changed vector-borne disease transmission, diminished water quality, and decreasing food security, differ between men and women due to biological, social, and cultural factors. Climate change threatens to exacerbate current gender-based health disparities in India, which is experiencing fast environmental change. The incorporation of a gendered perspective into existing climate, development, and disaster-risk reduction policy frameworks can reduce negative health effects. Climate risk mitigation necessitates cross-sector collaboration, improved data collection, monitoring of gender-specific targets, and fair stakeholder participation. Empowering women as social change agents can help to strengthen mitigation and adaptation policies.

**Keywords:** Climate change, women, food security, empowering

## Introduction

Climate change is an important global health issue that has rapidly gained prominence on the global health agenda (Duncan, 2006; Levy & Patts, 2015) [1, 2]. Its negative impacts on the Earth's ecology have resulted in an increase in natural disasters, vector-borne diseases, poor air quality, and dramatic temperature fluctuations, all of which have an impact on human health (Duncan, 2006; Rylander *et al*., 2013) [3, 4]. Numerous studies have confirmed the link between climate change and human health, with poverty, food insecurity, geographic isolation, and deteriorating societal norms identified as major factors that increase the harmful effects of climate change (Jerneck, 2018; Langer *et al*., 2015) [5, 6].

According to the United Nations Framework Convention on Climate Change, women are more vulnerable to the effects of climate change and bear a greater burden. This is also true for health implications, as climate change increases the probability of gender-based health inequities. Women are at a higher risk due to biologic, political, and cultural factors, according to the World Health Organization (WHO) and the American College of Obstetricians and Gynecologists. Poverty exacerbates women's health vulnerabilities, amplifying risk on a regional level. Globally, 1.3 billion people in low- and middle-income countries live in poverty, with women accounting for 70% (WHO, 2002) [7]. India is a culturally and geographically varied country that is currently experiencing increasing industrialization and urbanization, as well as a growing population. Since 2000, technological and economic advancement has resulted in positive advances in development indices; yet, significant gender-based health inequities persist (Balarajan *et al*., 2011; Bhalotra and Clots-Figueras, 2014) [8, 9]. These economic gains have been accompanied with a nearly doubling of $CO_2$ emissions per capita, and the advantages of industrialization have been unequally distributed among the population (World Bank Group, 2018a, 2018b) [10, 11]. As a result of these changes, women, particularly those living in poverty, are more likely to suffer negative health consequences from the widespread effects of heat trapping greenhouse gas emissions (GHGs), both now and in the future. While climate change threatens to exacerbate gender-based health inequities, women's social responsibilities and ability to influence change provide opportunity for remedies. Policymakers must move beyond traditional distinctions between health, gender, and the environment and embrace proactive gender-based solutions to preserve women's health while also mobilizing their social capacity to mitigate, adapt, and respond to climate risks.

In terms of social and cultural challenges, women frequently lack access to land ownership, education, and paid labour, making them more vulnerable to climate change (Jerneck, 2018; Langer *et al*., 2015) [12, 13]. Women frequently experience unequal access to economic and technical resources following natural catastrophes and climate-related extreme weather occurrences (Jerneck, 2018; Langer *et al*., 2015) [14, 15]. There is a complex relationship between climate change and women's health that is based on gender inequality (Sorensen *et al*., 2018; United Nations, 2020; World Health Organization, 2014) [16, 17, 18].

**Heath Impacts and Risk**

Climate change impacts health through several processes, such as heat, poor air quality, extreme weather events, and meteorological changes that affect vector-borne disease, water quality, and food security (Crimmins *et al*., 2016) [19]. Climate change is causing widespread repercussions in India and is expected to worsen with future climate scenarios (Barros *et al*., 2014) [20]. The Indian government has declared that it intends to maintain economic growth while also reducing GHG emissions. However, persistent economic growth rates, as measured by gross domestic product, do not always imply sustainable human development. India currently ranked 131 on the United Nations Gender Inequality Index. An economic growth strategy that fails to address gender concerns is likely to exacerbate current gender disparities.

**Heat Impacts**

The average annual temperature in India in 2030 is expected to rise by 1.7 to 2.2 degrees Celsius over the 1970s, with corresponding increases in the severity and length of heatwaves (Barros *et al*., 2014) [21]. The health consequences are already evident, with an increase in the number of deaths caused by high temperatures during the last 15 years (Akhtar, 2007; Azhar *et al*., 2014; McMichael *et al*., 2008) [22, 23, 24]. Although solid surveillance data are available, multiple studies have shown that women, particularly older women and pregnant women, bear a disproportionate burden of heat-related health consequences (Kovats and Hajat, 2008; Sarofim *et al*., 2016; Schifano *et al*., 2009) [25, 26, 27]. Women's physiological compensation to elevated temperatures differs from men's, contributing to their biologic sensitivity. They sweat less, have a greater working metabolic rate, and thicker subcutaneous fat, all of which reduce radiative cooling (Duncan, 2006) [28]. Cultural vulnerabilities include inadequate access to healthcare and cooling facilities due to personal safety concerns and a lack of personal transportation, culturally prescribed heavy clothing garments that limit evaporative cooling, and a lack of awareness of women's heat vulnerabilities among local, national, and global decision makers and health care personnel.

Pregnancy also increases vulnerability. Prolonged exposure to high temperatures has been linked to stillbirth, congenital birth defects, and preterm delivery, regardless of maternal ethnicity or age, with younger mothers having an even higher risk of negative outcomes (Balbus and Malina, 2009; Basu *et al*., 2016; Ha *et al*., 2017; Strand *et al*., 2011; Van Zutphen *et al*., 2012) [29, 30, 31, 32, 33]. High ambient temperatures have also been linked to pregnancy problems, including gestational hypertension, preeclampsia, and poor newborn outcomes (Makhseed *et al*., 1999; Kakkad *et al*., 2014) [34, 35]. Heat is teratogenic during critical phases of development (Van Zutphen *et al*. 2012) [36]. It also increases vasoactive substance production, blood viscosity, and endothelial cell function, thereby altering placental blood flow and increasing the risk of hypertensive crises and stillbirth (Ha *et al*., 2017) [37].

**Air Quality**

Increased atmospheric $CO_2$, rising temperatures, and shifting precipitation patterns all lead to poor outdoor air quality, which has a severe influence on human cardiopulmonary health (Fann *et al*., 2016) [38]. Physiologically, ozone and PM2.5 inflame airways and enter the circulation, causing endothelial cell dysfunction and oxidative stress, worsening cardiopulmonary illness and leading to premature death (Beggs & Bambrick, 2006) [39]. Several experimental studies have found that lung deposition of inhaled particles varied between men and women, with women having larger loads (Chen *et al*., 2005) [40]. Furthermore, women are more likely to have cardiovascular issues, as evidenced by a recent study in which intima media thickness of arteries in women was strongly connected with ambient levels of PM2.5, but not in males (Künzli *et al*., 2005) [41]. According to Sørensen *et al*. (2003) [42], women may be more susceptible to the harmful effects of airborne pollution due to higher rates of anaemia.

In India, the average PM2.5 concentration increased from 60 µg/m3 in 1990 to 76 µg/m3 in 2015. This was accompanied by an increase in ambient ozone exposure from 62 to 76 ppb and a 150% surge in air pollution-related mortality (Health Effects Institute, 2017) [43]. In addition to the direct health burden, poor air quality has been linked to increased healthcare utilization. In November 2017, PM2.5 concentrations in Delhi exceeded 1,200 µg/m3, above the WHO's upper guideline of 25 µg/m3 (WHO, 2018a) [44]. This led to a 30% rise in all-cause hospital admissions (Doshi, 2017) [45].

The use of biomass for domestic cooking and heating also has a major impact on human exposure to ambient air pollution (Chafe *et al*., 2014) [46], accounting for roughly 24% of ambient air pollution from PM2.5 in India. Around a quarter of the world's 1.6 billion people without access to electricity live in India, while another 300 million people in India have "very, very limited access to electricity" (World Bank Energy database, 2018). As a result, people in rural areas turn to inefficient energy sources like biomass, while in cities they use waste plastic.

Women spend more time at home and are so disproportionately exposed. Research suggests that women may have a higher risk of inhaled particle accumulation in lung tissue, leading to systemic hypoxia from lung disease-related anaemia (Chen *et al*., 2005) [47]. Anaemia affects more than half of all pregnant women in India. Ambient air pollution has been associated with congenital birth abnormalities, stillbirths, and intrauterine growth restriction (Glinianaia *et al*., 2004) [48]. This impact could be attributed to placental hypoxia or the harmful effects of air pollution.

**Disaster Related Impacts**

According to a recent Lancet analysis, the number of weather-related disasters, such as storms, flooding, and wildfires, increased by 46% between 2007 and 2016. The Intergovernmental Panel on Climate Change predicts that in India, extreme precipitation occurrences during the monsoon season will rise while non monsoon season rainfall will decrease (Barros *et al*., 2014) [49]. This pattern puts many populous areas at great danger of both monsoon floods and dry season droughts (Asokan & Dutta, 2008) [50]. Flooding brings health concerns such as trauma, drowning, and exposure to germs and hazardous substances in contaminated floodwaters. Furthermore, the Intergovernmental Panel on Climate Change predicts that

the frequency of cyclones in India will decrease while the intensity of those that do occur will likely increase (Barros *et al*., 2014) [51]. Urban clusters with weak infrastructure and high population density exist along India's coasts, making them very vulnerable.

Women are more likely to die during cyclones and floods (WHO, 2014) [52]. In 1991, when cyclones killed 140,000 people in Bangladesh, 90% of the dead were women (Aguilar, 2004) [53], and in 2008, when cyclone Nargis struck Myanmar, 61% of the 130,000 deaths were women as well. This gap could be explained by a mix of societal inequities in access to basic social commodities, culturally dictated roles, and biological vulnerabilities (Moosa & Tuana, 2014) [54]. The gender disparity in mortality has been observed to be greater when women have a lower socioeconomic standing in a given region (WHO 2014) [55]. Other research reveals that cultural variables contribute to vulnerability when women are at home caring for children and the elderly while waiting for family to return from a disaster-related evacuation. Poor literacy and education may also be a contributing factor. If public warnings do not consider women's access to information, as well as the possibility that homebound women in remote areas only speak a minority language, women will be unable to take appropriate precautions to protect their lives.

Women of all ages are more calorie deprived than men, resulting in poor physical health and vulnerability to resource shortages caused by disasters (Rahman, 2013) [56]. Furthermore, low initial nutritional status and physical fitness may impede escape and survival during the acute phase of a disaster. Cannon *et al*. (2003) [57]. Pregnant women are an especially vulnerable demographic, and those who give birth in the aftermath of catastrophes have been reported to have an increased risk of problems such as preeclampsia, uterine haemorrhage, and low birthweight children (Tong *et al*., 2011) [58].

Women and girls, particularly the elderly or those from poorer socioeconomic backgrounds, are more vulnerable to physical, sexual, and domestic abuse in the aftermath of climate-related disasters (International Federation of the Red Cross and Red Crescent, 2007; United Nations Development Programme, 2001) [59, 60]. Women may be separated from their families, friends, and other support systems, and they may avoid shelters out of fear of being abused. Furthermore, impoverished, unmarried, elderly, teenage girls, and women with disabilities are frequently the most vulnerable since they have fewer personal, family, economic, and educational resources from which to seek protection, assistance, and support. Furthermore, these same risk factors are associated with a higher incidence of mood disorders as depression and anxiety (Norris *et al*., 2002) [61]. Adequate mental healthcare provision poses a challenge to global health-care systems, particularly in India, where government health allocations per capita average $5 per year (World Bank Group, 2018a) [62]. Following disasters, women experience disproportionate employment loss and slow personal economic recovery because the best and only positions available are generally in construction and reconstruction operations, both of which are usually male-dominated (Tobin-Gurley *et al*., 2010) [63]. According to the World Bank, 84% of Indian women are currently classified as having vulnerable employment (World Bank Group, 2018a) [64].

**Food Insecurity and Malnutrition**

Under changing climatic circumstances, India is seeing both increases in extreme precipitation and declines in seasonal rainfall, resulting in longer periods of drought (Barros *et al*. 2014) [65]. Variable precipitation paired with rising seasonal temperatures can have a significant impact on crop, livestock, and fishery output, resulting in food poverty and economic instability. Many places in India are already water-stressed as a result of unsustainable groundwater usage for irrigation and industrial applications, particularly in Rajasthan, Punjab, and Haryana (Rodell *et al*., 2009) [66]. The expected country-wide agricultural loss due to drought in 2030 is estimated to be more than $7 billion, significantly affecting the income of 10% of the Indian population (Barros *et al*. 2014) [67]. For example, the Indo-Gangetic plains currently produce 14-15% of the world's wheat, feeding around 200 million people (Ortiz *et al*. 2008) [68]. Heat stress and drought are expected to reduce production by 51% by 2030. Furthermore, sorghum grain yield is expected to drop by 2-14% by 2020 and continue to fall substantially throughout the century (Srivastava *et al*., 2010) [69].

Women are especially vulnerable to the consequences of food instability and nutritional inadequacies caused by increased needs during menstruation, pregnancy, and lactation. Furthermore, nutritional scarcity can be exacerbated by cultural norms that prioritize food provision for children and adult males. Poor nutritional status, resulting in anaemia, is common among mothers and children in India (World Bank Group, 2018a) [70]. Micronutrient deficiencies are linked to cognitive deficits such as reduced attention span, decreased working memory, emotional and behavioral problems, and impaired sensory perception, all of which lead to poor educational outcomes (Jáuregui-Lobera, 2014) [71]. Maternal undernutrition has a significant impact on neonatal development and is linked to intrauterine growth restriction, pregnancy problems, and perinatal death (Food and Agriculture Organization [FAO], 2013). According to the Food and Agriculture Organization (FAO), in areas where iron deficiency anaemia is common, the risk of women dying after childbirth increases by up to 20%.

Furthermore, in poor countries, women are the primary agricultural producers, accounting for 60-80% of total food (German Development Institute, 2017) [72]. Thus, their livelihoods and nutritional status are jeopardized when changing climatic circumstances impede good agricultural production. Prevalent cultural standards exacerbate these risks to women's well-being. Despite producing the majority of food, less than 10% of female farmers own land, and only 2% have legal paperwork (German Development Institute, 2017) [70]. Women suffer as a result of their relative lack of control over farmlands, as well as their inability to obtain crop insurance to cover losses caused by environmental change.

**Water Scarcity and Water Borne Diseases**

Fresh water is distributed unevenly over the world, with the biggest scarcity occurring in densely populated places. Changing rainfall patterns, rising rates of evaporation, and

population expansion are expected to expose an extra 1-4 billion people to drought by the end of the century (Watts *et al*., 2017) [73]. The present burden of water-borne disease in India is considerable, but it is impossible to precisely measure due to a lack of reporting, inadequate surveillance, and a decentralized data infrastructure. According to 2015 estimates, only 62% of urban communities and 28% of rural groups in India have improved sanitation (World Bank Group, 2018a) [74].

Water scarcity compels individuals to drink from potentially tainted sources. Women have traditionally been responsible for providing water for the family, and primary water handlers are at a higher risk of developing waterborne infections (Birch *et al*., 2012) [75]. Water scarcity also results in more time spent harvesting water and less time spent on other forms of livelihood. During the dry season in India's water-stressed areas, it is estimated that a woman spends 30% or more of her daily energy expenditure harvesting water (WHO, 2014) [76]. Furthermore, the hard labour involved in water harvesting exposes women and female children to cumulative spine and neck damage, which can result in persistent skeletal pain. Travelling great distances for water also raises the risk of heat stress and heat stroke, as well as putting women's physical safety at risk from violent crime (Jalees, 2005) [77]. A lack of clean water and sufficient sanitation infrastructure also causes significant health risks to women, particularly during menstruation and pregnancy when more frequent hygiene is required (Birch *et al*., 2012) [78].

Poverty worsens the health effects of water scarcity for women. Poorer residents in cities frequently pay higher water prices due to a lack of ownership of water pipes. In such places, a lack of access to water has been associated to increased female mortality rates (Sandys 2005) [79].

**Vector Borne Diseases**

Temperature and precipitation changes are increasing the geographic range and quantity of disease vectors, exposing more people to tick-borne and mosquito-borne infections (Beard *et al*., 2016) [80]. Malaria, Dengue, Chikungunya, and Japanese Encephalitis are examples of significant vector-borne diseases (VBDs) that are endemic in India. Although public health and meteorological surveillance data are typically sparse, some regional studies have revealed associations between disease prevalence and climatic variables (Khan *et al*., 1996) [81]. Although climate has a substantial influence on VBD prevalence, behavioral and physiologic factors dictate disease burden at the local level. For example, the recent increase in Dengue fever in certain regions of India is most likely due to permissive environmental conditions that promote mosquito development, as well as population growth, unplanned urbanization, deteriorating basic sanitary conditions, and inadequate local water supply and waste management systems (Gupta & Reddy, 2013) [82].

Men and women are at varying risk of developing VBDs since they spend their days in various situations and face different biological dangers. Pregnant women are an especially vulnerable population. They are more likely to come into touch with vectors since they spend more time at home near household standing water. Furthermore, physiological changes during pregnancy heighten vulnerability. Higher $CO_2$ generation, which acts as a chemoattractant for mosquitos, as well as increased peripheral blood flow and skin temperature, all enhance the chance of bite. Furthermore, hormonally driven changes in immunologic function might inhibit host defenses, resulting in increased viremia and parasitemia (Kourtis *et al*., 2014) [83]. According to future research, pregnant women are three times more likely than non-pregnant women to develop severe malaria (Rijken *et al*., 2012) [84]. Malaria infection during pregnancy causes anaemia and reduced transplacental nutrition transfer due to placental parasite sequestration, resulting in intrauterine growth restriction and increased maternal sensitivity to hemorrhagic complications of birth (Steketee *et al*., 1996) [85]. According to recent research of three areas in India, malaria was responsible for 23% or more of maternal mortality between 2004 and 2006, making it the leading cause of maternal death during pregnancy.

Other VBDs cause various pregnancy problems. Dengue virus, which has been more severe and widespread in India over the last decade (Mutheneni *et al*., 2017) [86], is linked to an increased risk of caesarean birth, preeclampsia, and intrauterine growth restriction (Pouliot *et al*., 2010) [87]. The Zika virus, which is similarly spread by the aedes mosquito, is an emerging climate-linked infectious illness that causes terrible fetal outcomes such as microcephaly, central nervous system abnormalities, and poor cognitive development (Petersen *et al*., 2016) [88].

**Women Adaptation and Coping Mechanisms**

The term "climate adaptation strategies" refers to many approaches created to mitigate the negative effects of climate change on society, environment, and the economy. These solutions recognize the crucial need to make immediate preparations for, and respond to, the challenges that a changing climate presents. Adaptation measures include strengthening infrastructure resilience, protecting water resources, promoting sustainable agriculture, improving early warning systems, and incorporating climate considerations into urban design. Furthermore, efforts usually emphasize eco-friendly approaches, disaster risk reduction, and the preservation of local knowledge. The process of adapting to climate change is not a one-size-fits-all endeavor; rather, it necessitates individualized and context-specific solutions that take into consideration the unique vulnerabilities, resources, and climate risks that different locations and populations confront. Building resilience and ensuring a sustainable future in the face of climate uncertainty necessitates carefully integrating adaptation measures into wider climate action strategies.

Gender-responsive adaptation strategies and efforts are an important strategy to climate change mitigation that acknowledges the inherent gender differences in vulnerability and resilience to climate impacts. These policies and programmes seek to address and correct the special issues that women and gender-diverse people confront in the context of climate change. Gender-responsive adaptation recognizes that gender identities connect with other characteristics including age, class, and ethnicity, magnifying vulnerabilities and altering adaptive capacity. Such programmes include steps that improve women's access to resources, involvement in decision-

making, and capacity building. They also evaluate the diverse effects of climate change on women, ranging from greater care costs caused by natural catastrophes to potential modifications in conventional gender roles within communities. These policies seek to promote fairness, empower marginalized communities, and increase overall resilience in the face of climate change by providing gender-inclusive climate adaptation.

## Conclusion

According to this analysis, women's health is more vulnerable to climate change, particularly in low- and middle-income countries. These studies imply that sociological, cultural, and economic factors contribute to women's heightened vulnerability. It is beneficial to include a gender perspective in climate change responses. The themes of women's exposure to climate change hazards, health impacts, vulnerability, and response options are highly influenced by gender disparity issues. Recognizing these could help with the implementation and success of climate change policies on a societal scale. When developing and implementing climate change policies and initiatives, it is critical to recognize that the current issue of gender imbalance exacerbates the effects of climate change on women's health. Policies and strategies must take a comprehensive approach and design interventions based on distinct gender features.

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