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Gendered vulnerabilities in climate shocks: the role of social protection interventions

To cite this article: Aparajita Dasgupta 2024 *Environ. Res.: Climate* 3 045023

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PAPER

Gendered vulnerabilities in climate shocks: the role of social protection interventions

OPEN ACCESS

RECEIVED

26 April 2024

REVISED

18 October 2024

ACCEPTED FOR PUBLICATION

30 October 2024

PUBLISHED

20 November 2024

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Keywords: gendered impacts, climate change, social protection

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Abstract

This review explores how climate change exacerbates gender inequalities and the potential of social protection programs to alleviate these impacts. It examines how women disproportionately bear the brunt of climate shocks and discusses pathways through which programs like public works initiatives, cash transfers, and social insurance can bolster women's resilience in this framework. Despite the potential of these programs, challenges such as implementation gaps and limited engagement of women in program design hinder the effectiveness of social protection programs. Limited research on the gendered effects of social insurance underscores the need for further investigation and gender-responsive policy interventions.

1. Introduction

Climate change is rapidly reshaping the world we live in, fundamentally altering the risks individuals and households face. Beyond the well-documented environmental consequences, these transformations carry profound socioeconomic implications, including increased poverty (Hallegatte *et al* 2014), exacerbated income inequality (Cevik and Jalles 2023), and heightened social instability (Koubi 2019). Yet, amidst these multifaceted changes, one aspect stands out starkly: the disproportionate impact of climate change on women and the intricate interplay of gender dynamics with its evolving risks. One way that this gendered impact is most evident is in the way that climate shocks amplify vulnerabilities and deepen gaps that already exist.

The global climate crisis is poised to intensify gendered vulnerabilities and compound the effects of intersecting forms of discrimination against women. Large-scale weather shocks, from devastating droughts to torrential floods, disrupt critical services like water supply, sanitation, and energy provision. Simultaneously, they inflict significant damage on households, necessitating extensive time investments in household recovery efforts (Quisumbing *et al* 2017, Fruttero *et al* 2024). In particular, gender inequality exacerbates women's vulnerability during climatic shocks, making them more susceptible to the adverse effects of these crises. As a consequence of climate disruptions, women, who are frequently responsible for procuring basic resources like food, fuel, and water, are facing more and more difficulties (Pinho-Gomes and Woodward 2024). They have less time and resources for advocacy and decision-making as a result of this additional pressure, which further marginalizes them in relief operations and larger societal responses to climate catastrophes.

Underlying these challenges is the fact that gender inequality remains deeply entrenched, and gendered differences in climate change susceptibility both reflect and perpetuate it. Women face numerous barriers to economic independence and human capital development. These include lower labor force participation, diminished wages, limited land ownership, barriers to credit, and the weight of caring for family members, fulfilling traditional domestic roles, increased family responsibilities due to male migration, and heightened vulnerability to disasters converge to magnify women's exposure to climate-related risks (Eastin 2018, Koubi 2019, Maitra and Tagat 2024). Moreover, extremely ingrained social norms continue to restrict their mobility and agency, further diminishing their ability to mitigate the adverse impacts of climate change (Gray and Mueller 2012, Fruttero *et al* 2023).

Climatic shocks not only deepen economic inequities but also heighten social and political marginalization, increase gender-based violence (GBV), disrupt education, and adversely affect health outcomes (UN Women 2022, Deininger *et al* 2023, IDLO 2024). These shocks exacerbate existing inequalities, particularly for women in low-income and rural areas, by limiting their access to decision-making processes and relief efforts.

In this delicate balance, the challenges borne by women become all too apparent. Women are compelled to dedicate more time to domestic responsibilities, managing the fallout from climate shocks (Fruttero *et al* 2024). Yet, they also allocate increasing hours to income-generating activities, striving to compensate for the losses inflicted upon their households (Quisumbing *et al* 2017, Maitra and Tagat 2024, Afridi *et al* 2022).

As these burdens multiply, it becomes evident that the climate crisis significantly undermines women's ability to advocate for gender-specific issues. In this context, persistent gender disparities further expose women to heightened vulnerability while constraining their capacity to adapt effectively (Bjorkman-Nyqvist 2013, Maitra and Tagat 2024, Afridi *et al* 2022).

In this landscape, social protection emerges as a potent policy tool wielded by governments to help individuals and households navigate the risks tied to income and livelihoods. The importance of these initiatives in advancing gender equality and empowering women and girls has come to light more in recent years. Beyond its fundamental role in reducing poverty and inequality, social protection programs are increasingly recognized for their potential as a response to the challenges posed by climate change. Remarkably, the ability of social protection programs to manage large-scale disasters has improved in recent years as a result of improvements in planning, implementation, and finance. Furthermore, gender-responsive humanitarian initiatives have increased in response to a growing understanding of the gendered effects of disasters.

However, despite growing interest among policymakers in strengthening social protection programs to address gendered impacts, a research gap persists. While there has been a growing body of research in this domain (Jordan *et al* 2021), empirical evidence on the efficacy of gender-sensitive social protection interventions in improving these outcomes remains scarce.

This study adds to the body of work that tries to understand how the impacts of climate shocks are often gendered in nature and the role of social protection policies in shaping these outcomes. We focus on the interactions between climate shocks and government policies, with a particular focus on gender-sensitive social protection programs. By critically examining the existing evidence base, it sheds light on the practical outcomes and challenges associated with gender-sensitive social protection initiatives.

First, the analysis framework of this paper evaluates how climate shocks incur disproportionate costs on women across various domains of life. It then examines the role of social protection programs and their gendered impact on climate resilience, focusing on education, employment, domestic violence, food security, and health. We detail how gender, climate change, and social protection interact, concentrating on three areas: social insurance, cash transfer programs, and public works. This discussion incorporates case studies from South Asia-India's MGNREGA, Bangladesh's Chars Livelihood Programme, and Pakistan's Ehsaas Program alongside Brazil's Bolsa Família, analyzing their effectiveness and weaknesses in addressing these challenges.

The search was conducted on various academic databases, including Google Scholar, JStor, Springer, and socialprotection.org, as well as websites of protection programs such as the Rural Development and Cooperatives Division and other websites like UNICEF, IDLO, and the Bureau of Labor Statistics¹.

To get a list of social protection programs that include climate-resilience considerations, we use Lowe *et al* (2019) and Ulrichs *et al* (2019). Programs such as India's MGNREGA, Bangladesh's Chars Livelihood Programme, Pakistan's Ehsaas Program, and Brazil's Bolsa Família cash transfer scheme were identified based on their integration of climate resilience considerations into their framework. For each program, we conducted a targeted search for literature specifically addressing gendered outcomes, examining studies, reports, and evaluations that discuss the gender dimensions of these programs and their impact on climate resilience. Overall, We focus on the following programs to examine the link between social security and its role in addressing the gendered impact of climate change.

¹ The search strategy involved a combination of keywords to refine and narrow the review's focus. Following Costella *et al* (2023), primary search terms included 'social protection', 'social assistance', 'safety net', 'cash transfer', 'social insurance', 'public works', and 'social security'. To establish the link between social protection and climate change, additional terms such as 'climate', 'climate change', and 'climate risk' were incorporated. Furthermore, to investigate the gendered implications, terms like 'gender', 'women' and 'men' were included. A snowball method was also employed, wherein bibliographies from relevant papers were examined to identify additional sources that may have been missed during the initial search.

2. Gendered impact of climate shocks

Extensive research has revealed that women are often disproportionately affected by climate shocks. This section focuses on the effects of climate shocks on gendered outcomes across a range of domains, including education, employment, domestic violence, and food security. Studies like Dasgupta and Karandikar (2021) and Bjorkman-Nyqvist (2013) reveal that rainfall shocks can lead to a decline in educational opportunities for girls, often resulting in increased dropout rates and reallocation of time towards domestic responsibilities. Employment patterns are also affected, as shown by Feeny *et al* (2021) and Sabarwal *et al* (2010), with women facing higher barriers to formal employment following climatic shocks. Additionally, climatic shocks exacerbate domestic violence and dowry deaths, as indicated by Abiona and Koppensteiner (2018) and Sekhri and Storeygard (2014), and worsen food security, with women often bearing the brunt of household adjustments to mitigate the impact, as observed in studies like Quisumbing *et al* (2017) and Asfaw and Maggio (2018).

2.1. Education and time use

Climate shocks put women and girl children at greater hurdles to education, especially in rural places. Women and girls often take on additional household duties during climate shocks, such as gathering firewood and water, and face greater odds of getting married young to mitigate financial strains brought on by adverse conditions, leading them to miss school or drop out (UNICEF 2022). Their time is frequently taken up with caring for others and handling home duties, which aggravates during climatic emergencies (Eastin 2018, Fruttero *et al* 2024).

Furthermore, girls are more likely to withdraw from educational pursuits and take on increased commitment to domestic responsibilities in response to fluctuations in agricultural productivity (Jacoby and Skoufias 1997, Bjorkman-Nyqvist 2013, Maitra and Tagat 2024). Bjorkman-Nyqvist (2013), using rainfall variation data from Uganda, demonstrates that households react to rainfall shocks by adjusting the level of schooling and resources allocated to girls, while boys largely remain unaffected. Consequently, rainfall shocks have adverse effects on women's opportunities for human capital accumulation, triggering significant reorganization of activities within households, with women bearing disproportionately higher costs. Maitra and Tagat (2024) finds that in India, women tend to disengage from educational pursuits during periods of rainfall variability, especially in regions reliant on rain-fed agriculture. This trend could detrimentally impact women's capacity to build human capital, as adjustments in labor allocation due to rainfall fluctuations are typically short-term responses with potential long-term consequences, especially for females who withdraw from educational institutions.

Furthermore, their research indicates that women, unlike men, often increase their time spent on domestic chores in response to rainfall shocks, while men allocate more time to self-employment and casual wage labor. Additionally, Dasgupta and Karandikar (2021) find that positive rainfall shocks in rural India worsen learning outcomes for all children, with female children in rice-dominant districts experiencing the most significant decline; a 0.2 standard deviation gap compared to negative shock years. This is attributed to increased dropout rates during positive shocks, countered by decreased dropout rates and increased participation in employment and domestic work during negative shocks.

2.2. Employment

Due to the gendered division of domestic labor, women in poorer countries are disproportionately affected by climate-related economic downturns. Women often manage resources critical for family survival, such as subsistence farming, gathering fuel, and collecting water, while men typically engage in wage labor or cash crop production. When climate shocks disrupt food production, water supply, or access to fuel, women face heightened vulnerability, as their subsistence roles are directly impacted (Babacan 2021, Pinho-Gomes and Woodward 2024). The additional burden of securing household resources leaves women with fewer opportunities to participate in formal employment or earn income, further increasing their exposure to climate-related risks (Eastin 2018).

There are other complicated and multidimensional relationships between female labor force participation and economic crises caused by the effects of climate change. The economic crises resulting from climate impacts exacerbate these challenges by lowering female labor force participation (Babacan 2021). For instance, climate-induced economic crises interrupt job prospects, resulting in unemployment and pushing women into vulnerable informal work (Fruttero *et al* 2024). Because they frequently take on the care of children, the elderly, and other dependents, which limits their capacity to participate in paid employment, these crises also increase women's domestic burden and caregiving obligations (Buechler 2009, Eastin 2018, Babacan 2021). Their time and energy for engaging in the labor force are diminished by the combined responsibilities of job and caregiving, leading to decreased rates of participation (Fruttero *et al*

2024). Reduced labor force participation also leads to diminished wages and fewer opportunities to access land ownership, and credit, further amplifying economic vulnerability (Agrawal *et al* 2019, Bureau of Labor Statistics (BLS) 2022, Fruttero *et al* 2024). Crises also limit women's access to education and training, which makes it more difficult for them to learn new skills, enhance their employment chances, and grow in their jobs (Fruttero *et al* 2024). This makes it harder for women to recover from climate shocks and adapt to future crises (Bureau of Labor Statistics BLS (2018)).

For instance, rainfall shocks have a similarly detrimental impact on employment (Feeny *et al* 2021), using rainfall data from Vietnam, finds that rainfall shocks experienced early in life have a long temporal reach by reducing the probability of formal sector employment for women but not for men. Sabarwal *et al* (2010), in a global review on the economic impacts of weather shocks on women, finds that the employment response to economic shocks differs by the relative income of the household. They find that traditionally, women from low-income households enter the labor force during economic crises, while those from wealthy households often withdraw, while men's labor force participation rates typically remain unchanged. Economic crises also influence fertility decisions among women, with adverse effects on child schooling and health, particularly for girls in low-income countries.

In addition, investigating other susceptible groups, such as those facing gender discrimination and poor infrastructure (e.g. lack of training facilities, mobility aids, and accessible transportation), reveals an increase in the vulnerability of disabled people by exacerbating their job access during crisis (Bonaccio *et al* 2020). Furthermore, elderly women without family support suffer increased risks during climate shocks, as they generally rely on informal, subsistence jobs that are readily disrupted (Age International 2021).

2.3. Domestic violence

Domestic violence often escalates during climate crises, especially in contexts where patriarchal institutions and gender inequality are prevalent (Eastin 2018). As climate-induced stresses increase, women face heightened vulnerabilities due to their limited access to assets, economic security, and legal protections (Eastin 2018). The mechanisms linking climate change to GBV include changes in physiological well-being, economic insecurity, migration patterns, resource scarcity, and infrastructure disruptions (Bonilla-Anariba *et al* 2024). These factors interact and are shaped by local gendered cultural and social norms.

Evidence from Abiona and Koppensteiner (2018) suggests that rainfall shocks in Tanzania significantly increase the likelihood of domestic violence incidence in households. Similarly, research by Sekhri and Storeygard (2014) finds that in India, negative rainfall shocks are associated with higher reported cases of domestic violence and dowry deaths.

The same pattern is echoed in the case of temperature shocks. Warmer temperatures are associated with higher levels of violence, including homicide and political violence (Iyer and Topalova 2014, Mares and Moffett 2015, Gangopadhyay and Nilakantan 2018). Specifically, Gangopadhyay and Nilakantan (2018) find that a one standard deviation increase in maximum temperature in India increases the number of riots by 55%. Moreover, research by Bollfrass and Shaver (2015) indicates that provinces experiencing positive temperature deviations see increased conflict, which may include Intimate Partner Violence (IPV).

During periods of environmental stress, households may experience heightened economic strain and psychological distress, leading to increased conflicts and violence (Iyer and Topalova 2014, Bollfrass and Shaver 2015, Mares and Moffett 2015, Gangopadhyay and Nilakantan 2018). This rise in IPV can negatively impact the efficacy of social protection programs in several ways. Firstly, households affected by IPV may face challenges in accessing and utilizing social protection benefits effectively due to disrupted family dynamics and control over resources (van de Vliert *et al* 1999).

Moreover, IPV can perpetuate cycles of poverty and vulnerability, making it difficult for individuals, particularly women, to break free from abusive situations and engage in income-generating activities or community support networks provided by social protection programs (Abiona and Koppensteiner 2018). Additionally, the psychological trauma resulting from IPV can undermine individuals' ability to participate in program requirements or seek help from support services, further reducing the impact of social protection interventions. For instance, Miguel (2005) found that exposure to extreme rainfall in rural Tanzania causes a marked increase in the killing of old women who are suspected of being 'witches,' frequently by family members. This violence is driven more by income shocks during crises than cultural norms.

2.4. Food security and health

Gender norms and roles exacerbate women's vulnerability during crises, as they often become primary 'shock absorbers,' absorbing the impacts through measures like reducing food consumption or selling personal assets (Quisumbing *et al* 2017). Temperature shocks are shown to severely affect household welfare, reducing consumption, food consumption, and daily caloric intake (Asfaw and Maggio 2018). This paper finds that the negative welfare effects are more severe for households in Malawi where land is solely managed

by women, revealing the gendered inequalities exacerbated by temperature shocks. Furthermore, Mwesigye (2021) find similar vulnerabilities in female-headed households in Uganda, highlighting their heightened susceptibility to food insecurity in the face of weather-related shocks.

Additionally, climate shocks disproportionately affect women's health, amplifying existing vulnerabilities. Women, who typically have lower calorie intake than men, face a heightened risk of poor physical health during disasters due to nutritional deficiencies (Tong *et al* 2011, Rahaman *et al* 2023). A study by Tong *et al* (2011) finds that the 1997 Red River flood in North Dakota was a catastrophic natural disaster, causing widespread disruption to communities. It led to significant health risks for pregnant women, including increased rates of anemia, eclampsia, and low birth weight. The disaster also resulted in demographic shifts and worsened birth outcomes.

These differential effects of climate shocks by gender can diminish the effectiveness of social protection programs aimed at supporting vulnerable populations, as women might prioritize immediate household needs over long-term resilience-building or participation in such programs (Nelson 2011, Lowe *et al* 2019). Consequently, the added strain from climate shocks on women's roles as caregivers, food providers, and household managers can undermine the potential effectiveness of social protection initiatives designed to support them.

Climate shocks can further diminish the effectiveness of social protection programs by exacerbating existing limitations in access, particularly for women. Structural barriers already impede women's engagement with social protection initiatives. Time poverty, domestic responsibilities, and mobility constraints serve as significant obstacles that restrict women's participation and access to the benefits of these programs (Devereux 2006, Lowe *et al* 2019). When climate shocks occur, these barriers are further amplified. Increased domestic duties and responsibilities, triggered by the need to manage the immediate impacts of climate-related crises within households, divert women's time and attention away from engaging with social protection programs (Lowe *et al* 2019).

Climate shocks exacerbate the barriers to women's participation in social protection programs, particularly concerning time poverty. Moreover, the increased household responsibilities triggered by climate-related crises become an additional obstacle for women participating in public works projects and attending community meetings where decisions about these initiatives are made (Devereux 2006, Gutierrez and de Pryck 2010, Zaidi *et al* 2017). The cumulative effect of climate shocks on time poverty intensifies existing barriers, impeding women's active involvement in social protection programs and reducing the efficacy of these initiatives.

Intra-household dynamics can also influence women's control over resources received through social protection programs. Decision-making power, often skewed against women, impacts their ability to utilize program benefits effectively. In certain contexts, women might have limited control over the funds received from social protection programs, affecting their decision-making and investment capabilities (Lowe *et al* 2019, Watson 2023).

During climate-related crises, these dynamics often become more pronounced. Research from Fletcher and Knuttila (2016) on the gendered effects of droughts in the Canadian Prairie province of Saskatchewan shows that the added stressors stemming from climate shocks tend to reinforce traditional gender roles and power structures within households; women are typically assigned caregiving and nurturing roles during environmental crises, resulting in limited agency over practical adaptation strategies due to material and ideological constraints. As a consequence, women's limited control over program resources becomes even more evident during these periods of heightened vulnerability, undermining their capacity to make decisions about resource allocation. This reduction in decision-making power can further curtail their ability to leverage social protection benefits effectively.

Furthermore, it is notable that climate shocks significantly impact men. Climate shocks have distinct effects on males and women. Boys are more likely to experience problems due to extreme weather events because they are more susceptible to shocks during pregnancy. For instance, early-life droughts in South Africa increased the prevalence of mental and physical problems, especially in men (Dinkelman 2017, Fruttero *et al* 2024). In a similar vein, prenatal exposure to Colombian floods was associated, more strongly in men, with increased incidence of mental impairments in adulthood (Carrillo 2020).

3. The role of social protection programs

Social protection programs play a dual role in mitigating the impact of climate shocks on women. First, they serve as critical responses to help women recover after losing ground due to climate-related disruptions, providing essential support such as financial aid, healthcare, or job retraining. Second, these programs act as buffers that prevent women from being adversely affected in the first place, offering preventative measures like insurance schemes, cash transfers, employment-providing schemes, or other safety nets. Together, these

efforts ensure that women are both supported in recovery and protected against potential future losses in the face of climate shocks.

The interactions between social protection programs, climate, and gender are complex and interconnected. Social protection programs, such as cash transfers, social insurance, and public works, aim to reduce poverty and vulnerability by providing financial support and services. First of all, they have significant gendered impacts in the form of providing economic security & empowerment, supporting health & education, and enhancing their voice and agency (Adeyeye and Fischer 2023, Perezniето and Holmes 2023). As we mentioned earlier, women frequently experience increased economic insecurity due to lower wages, unpaid caregiving responsibilities, and restricted access to resources. Social protection programs can address these disparities by offering financial assistance and creating opportunities for economic empowerment (Adeyeye and Fischer 2023). Since girls and women frequently have less access to education and healthcare. Programs for social protection can increase access to these necessary services, which will benefit health and educational outcomes (Perezniето and Holmes 2023). They can strengthen women's agency and voice in their homes and communities by granting them financial independence (Perezniето and Holmes 2023).

Secondly, climate change disproportionately affects women due to existing gender inequalities. Due to their reliance on natural resources for subsistence, which is threatened by climate change, women are more susceptible than men, especially in rural areas (Adeyeye and Fischer 2023). Women do, however, have important resource management skills, which makes their participation in adaptation measures crucial for enhancing community resilience (Adeyeye and Fischer 2023).

Finally, the intersection of social protection, climate change, and gender reveals several critical interactions. One way is by incorporating climate adaptation methods into social protection programs to manage climate hazards. For instance, Adeyeye and Fischer (2023) shows financial transfer involvement in climate-resilient farming methods used in the G5 Sahel countries, namely Burkina Faso, Chad, Mali, Mauritania, and Niger. The second way is in the strategies for climate adaptation that take into account gender-specific vulnerabilities and make use of women's expertise and abilities to make it more successful. Thirdly interaction is evident in giving women access to resources and technology that are climate resilient (Adeyeye and Fischer 2023). The rationale behind this relationship is that integrating social protection, climate, and gender considerations ensures a holistic approach that addresses poverty, gender inequality, and climate vulnerability for sustainable development (Adeyeye and Fischer 2023, Perezniето and Holmes 2023). It enhances community resilience to climate impacts by supporting vulnerable populations and promotes gender equality by empowering women to benefit equally from social protection and climate adaptation programs.

Social protection programs also address broader challenges, including health, GBV, and education which encourage women's empowerment and resilience in the face of climate change. Women's agency and resilience are greatly enhanced by education, which gives them the information and abilities necessary to make decisions and obtain resources. According to Mochizuki and Bryan (2024), women with higher levels of education are more capable of implementing climate-smart agriculture and other adaptable practices in response to climate change.

In India, women's political representation lessens the detrimental effects of climate change on their agency and voice outside the home. This emphasizes how education helps women become capable of taking on leadership roles (Takeshima *et al* 2022). Women can participate more completely in communal and economic activities when social protection initiatives that address GBV serve to build safer surroundings (Mukhopadhyay and Das 2019). To create resilient communities, programs that use gender-based approaches must support gender equality and assist in dismantling the structural barriers (Mochizuki and Bryan 2024). Health problems are exacerbated by climate change, particularly for women, due to their heightened vulnerability. Women's well-being and capacity to adjust to climate change can be improved by focused social protection initiatives that target health inequities (Mukhopadhyay and Das 2019).

Though overlooked, women's indigenous knowledge of nutrition and health is essential for community resilience; empowering them can increase agency and assist initiatives for climate adaptation (Babele *et al* 2022). This knowledge differs from that of men due to women's unique roles within their communities, particularly in managing food systems and health practices. Because of the special responsibilities that women play in their communities-particularly in managing food systems and health practices-this knowledge is different from that of men. For instance, Bonda tribal women in Odisha deploy traditional knowledge to safeguard natural resources and mitigate the consequences of climate change. Their environmentally conscious agricultural methods have been crucial in mitigating environmental degradation and guaranteeing food security (Satapathy 2024). Similar to this, incorporating indigenous knowledge into climate health projects in the Torres Strait Islands, Australia, improves community welfare by assisting people in preserving their cultural identity and taking care of their land (Lansbury *et al* 2022).

Thus, the programs can foster new initiatives that improve women's empowerment and climate resilience by using gender-transformative approaches, such as community-based adaptation techniques and agroecological practices (Babele *et al* 2022). Social protection programs that enhance women's agency and adaptive capacity are essential in climate change hotspots, addressing challenges like poor working conditions and institutional failures to strengthen their resilience (Rao *et al* 2019, 2021). Although there has been progress in acknowledging women's agency in climate resilience, their participation is still restricted by structural disparities and social norms. Therefore, inclusive social protection measures are necessary to meet their particular concerns.

In the following section, we examine how access to social protection programs can enhance the resilience of women and girls facing climate shocks. We examine the literature focusing on public works programs, cash transfers, and social insurance to explore their role in developing climate shock resilience for women.

3.1. Public works programs

Public works programs offer guaranteed employment or compensation for labor to build community assets. They can bolster climate shock resilience by building climate-resilient infrastructure, such as natural resource management infrastructure, water conservation, and collection systems, or measures to fortify against droughts and floods (Agrawal *et al* 2019). Participant wages, often received in cash, boost household purchasing power akin to standard cash transfers. This financial injection addresses immediate needs and builds resilience against future shocks, benefiting women and vulnerable groups (Ulrichs *et al* 2019).

Several public works programs have prioritized environmental considerations explicitly when selecting their main infrastructure projects. India's MGNREGA scheme, for example, works to enhance sustainable rural livelihoods through rejuvenation of the natural resource base, with around 80% of projects linked to natural resource development (Jordan *et al* 2021). Additionally, it includes the gender-sensitive provisions of one-third reservation at worksites for women, equal wages to men and women, and specific works for pregnant and lactating women.

In settings where social norms restrict non-agricultural employment opportunities for women, rural public works programs that provide guaranteed employment (such as MGNREGA) can also function as a way to reduce women's employment loss by providing local job alternatives and acting as a buffer against household income shocks. This is supported by Afridi *et al* (2022), who demonstrates that offering employment opportunities near their residences aids women in mitigating adverse income shocks to a greater extent compared to men. They find that MGNREGA assists women in overcoming the detrimental impacts of droughts on the labor market.

On the same policy, Maitra and Tagat (2024) find that both males and females increase their time allocation to NREGS work in response to a rainfall shock and there is no evidence of any gender difference. Additionally, Dasgupta (2017) finds beneficial impacts of the program in buffering short-term drought shocks but not so much effective in mitigating long-term drought shocks that have accumulated in the past and finds no significant gender differences in the impact on children's long-term health outcomes in rural Andhra Pradesh, India.

A study conducted by Jordan *et al* (2021) examines MGNREGA's potential to reduce women's vulnerability to climate risks through qualitative analysis in Uttar Pradesh, Rajasthan, and Madhya Pradesh. They find that despite MGNREGA's gender-sensitive provisions, it faces implementation challenges such as uneven benefit distribution, unpaid care work responsibilities, and lack of gender-sensitive monitoring persist, which hinder its ability to mitigate the impacts of climate risks on women effectively.

In the aftermath of extreme weather events, (Lawson-McDowall *et al* 2013) highlights how women's involvement in public works programs aimed at post-shock recovery may face obstacles due to inadequate adjustments for their increased time or mobility limitations. The oversight of these time constraints resulted in unutilized positions reserved for women in a Joint Resilience Initiative Cash for Works program following an extreme drought in Somalia in 2011. During the program's design phase, community focus groups neglected to factor in time constraints, as women were not directly consulted.

Nesbitt-Ahmed (2023) presents Bangladesh's Chars Livelihoods Programme (CLP) as a successful example of a gender-sensitive, climate-adaptive public works programme². Chars, being formed from silt deposits, are highly vulnerable to erosion and flooding. The inhabitants face numerous challenges, including limited livelihood options, with many relying on selling their physical labor for survival. It helped in enhancing women's economic stability, helping them adapt to climate change, and reducing their vulnerability to climate-related mental health issues. The program included measures like constructing

² The program was launched in 2004 to support extremely poor families in the northwest island chars of Bangladesh. It operated in two phases: Phase One (2004–2010) and Phase Two (2010–2016). Through partnerships with NGOs, the CLP has completed over twenty initiatives throughout 10 districts, providing support to approximately 133 026 families.

flood-resistant facilities, providing asset transfers and training, and establishing support groups (Costella *et al* 2023). Successful outcomes included safeguarding 95% of recipients from asset loss after floods and enhancing women's resilience compared to men. Active women's engagement in program design ensured tailored interventions, optimizing asset transfers to mitigate natural hazards. Additionally, the program supported informed decision-making among women during asset purchases to mitigate unintended consequences

Furthermore, in detail, the CLP tackles seasonal poverty (Monga) by providing guaranteed jobs through the Infrastructure Employment Programme to locals, especially women, while building essential infrastructure like sanitary facilities and safe housing. Additionally, the initiative gives people access to assets that generate income, like sewing machines and animals, thus advancing gender equity and household empowerment. Besides, financial help for erosion victims guarantees that vulnerable populations receive essential support during crises, and training programs for 1500 youths in garment production boost employability, especially for women. When taken as a whole, these initiatives help to strengthen community assets and promote climate resilience (Rural Development and Cooperatives Division RDCD (2024)).

3.2. Cash transfer programs

Cash transfers provide crucial income support, particularly vital during environmental stress like droughts or floods Ulrichs *et al* (2019). They mitigate climate shocks by bolstering absorptive, anticipatory, and adaptive capacities. Firstly, they allow individuals to meet essential needs during crises, building critical buffers. Secondly, they empower people to save and prepare for potential shocks. Lastly, they enable households to develop assets and engage in less vulnerable income-generating activities. While Ulrichs *et al* (2019) does not explicitly address gendered impacts, connecting their results to other work we discuss which shows that women often act as shock absorbers during climate crises supports the possibility that the gains from these transfers help mitigate the disproportionate impact on women.

Moreover, the effectiveness of cash transfer programs has been demonstrated in various contexts. For instance, Mexico's Oportunidades Program, previously known as Progresa and later as Prospera, is a conditional cash transfer initiative targeting poverty reduction and social development, particularly among vulnerable populations Solórzano (2016) explores the relationship between social protection and climate change resilience among impoverished rural households in hurricane and drought-prone regions of Yucatan. The study finds that while Oportunidades primarily serve as a safety net, enhancing short-term coping abilities, its impact on adaptive capacity varies based on household poverty profiles. Despite these challenges, the program shows promise in empowering women through supplementary activities and fostering cooperative community engagement.

Corona Corona and Gammage (2017) further examines the Progresa-Oportunidades-Prospera program, highlighting its potential to economically empower women by granting them greater control over household resources and facilitating their participation in the labor market. However, challenges such as reinforcing existing gender roles in cash transfer distribution and co-responsibilities persist.

The Bolsa Família program in Brazil incorporates climate resilience development considerations into its framework. The program involves providing additional cash benefits to extremely poor families in exchange for ecological services performed by household members, alongside offering business and training opportunities for sustainable enterprises (Schwarzer *et al* 2016). The vulnerability of women during droughts is closely linked to food and water security, affecting meal quantity, quality, and access. In this context, women often sacrifice their meals for their children, increasing their risk of malnutrition. In this case, Bolsa Família provides financial support, which can help mitigate these issues and reduce health risks associated with water shortages and malnutrition (Nogueira *et al* 2022).

Lemos *et al* (2016) examine the adaptive capacity of poor agricultural households in Northeast Brazil in response to economic shocks, finding that despite the positive impact of Bolsa Família on income, the program has not adequately addressed the risk of food insecurity during economic downturns, suggesting a persistent 'poverty trap'.

For instance, a study by Fitz and League (2021) finds that a 15% increase in rainfall raises boys' likelihood of paid labor by 7.3 percentage points and girls' by 4.4 points, but Bolsa Família reduces this likelihood to 1.1 points for girls, fully mitigating the impact. However, it does not have the same effect on boys. The study concludes that Bolsa Família acts as an effective safety net, keeping children in school and out of the labor force during rainfall-induced income shocks, with potential long-term benefits for human capital and poverty reduction. They also suggest the need to focus the program on populations, such as children, who are more responsive to shocks to enhance its effectiveness.

Furthermore, one of the other safety net programs in Pakistan is the Benazir Income Support Program (BISP), one of the largest social assistance initiatives in the country. It was launched with well-established infrastructure and coverage to cushion the impacts of covariate shock (includes natural, economic and

political) (Watson *et al* 2017). In the short run, the program aimed to maintain consumption smoothing, while its long-term goal was to build poor households' adaptive capacity to covariate shocks. BISP helps poor households increase their food consumption and empowers women. Complementary programs, such as Waseela-e-Taleem, aim to increase child school enrollment. Research led by (Phulpoto *et al* 2022) on the impacts of BISP cash transfers also highlights positive effects on women's empowerment (Phulpoto *et al* 2022).

Moreover, an evaluation of the program's effect on environmental poverty by (Nawaz and Iqbal 2021) reveals that 57% of families experience multidimensional environmental poverty. The results show that in sectors including housing, water, sanitation, and energy, BISP cash transfers dramatically alleviate environmental poverty. According to a recent assessment, BISP has also improved consumption smoothing, decreased rates of poverty, and given women more influence (Cheema *et al* 2014). However, evidence indicates that BISP is politically biased and misapplied, even despite its significance in reducing poverty and addressing vulnerabilities. Uneven funding distribution among provinces is another problem, with less developed areas receiving less support from the program (Islam and Hasan 2019).

While cash transfer programs have shown promising results in alleviating poverty and supporting livelihoods, it is imperative to consider their gendered impacts and ensure that they are designed and implemented in a way that effectively addresses the unique challenges faced by women during economic crises.

3.3. Social insurance

Social insurance refers to a form of social protection program backed by government initiatives, designed to provide financial protection and support to individuals or families against economic and social risks, with a particular focus on developing countries³. These programs typically involve contributions from beneficiaries through regular payments or contributions, ensuring that people receive assistance during times of need. By providing safety nets, social insurance can encourage risk reduction and resilience-building efforts (Agrawal *et al* 2019). Macro-insurance solutions, where the government pays for premiums or covers specific risks, can extend insurance coverage to vulnerable populations who may not afford premiums, ensuring inclusivity and broader protection (Suminski *et al* 2016). Research has also shown that combining social protection instruments with risk management tools such as insurance can be effective in mitigating the effects of climate shocks in the context of developing countries (Suminski *et al* 2016, Agrawal *et al* 2019, Kundo *et al* 2021).

Given that women often bear the first brunt of household income shocks due to climate-related events, it is possible that social insurance programs might provide higher gains for women's outcomes. Social insurance can improve women's adaptive capacity to respond to climate shocks (Nelson 2011, Costella *et al* 2023). For example, insurance payouts can enable women to recover more quickly from setbacks. However, literature on the effect of social insurance in mitigating the impact of climate shocks on women is scarce, and further research is required on this topic.

Although the MGNREGA program in India, the Chars Livelihood Programme in Bangladesh, the Bolsa Familia program in Brazil, and the BISP in Pakistan are considered social protection programs, they are not classified as social insurance programs. On the other hand, some other social insurance programs in developing nations concentrate on climate resilience. For example, InsurResilience (G7 Initiative), particularly in Africa, Asia, and Latin America; African Risk Capacity for African governments; Pacific Catastrophe Risk Initiative for Pacific Island nations; Caribbean Catastrophe Insurance Facility for Caribbean nations; Index-Based Agriculture Micro-Insurance for small farmers in Africa, Asia, and Latin America; and the HARITA Pilot in Ethiopia, which provides support to farmers, South Africa's Unemployment Insurance Fund offers benefits for job loss, maternity, and illness in formal and informal works are a few examples of social insurance programs that promote climate resilience (Suminski *et al* 2016, Costella *et al* 2023).

Many of the previously stated climate insurance programs can support women in developing climate resilience both directly and indirectly; however, to have the greatest possible impact, they should take gender-specific factors into account, such as making sure that women have access to insurance and that relief measures are beneficial to them. However, all their effectiveness depends on affordability, external support, and integration with broader climate adaptation efforts in developing countries (Suminski *et al* 2016).

4. Conclusion

In conclusion, the success of social protection programs in mitigating the gendered impacts of climate shocks lies in their implementation of gender-sensitive measures and targeted interventions. Public works programs, exemplified by initiatives like India's MGNREGA and Bangladesh's CLP, have effectively provided

³ The analysis in this section is based on the effectiveness of some of these programs in developing countries.

employment opportunities for women, bolstering their resilience to economic downturns. These programs have prioritized climate-resilient infrastructure projects and incorporated gender-sensitive provisions to address the unique challenges faced by women during climate-related crises. For instance, the CLP has been successful due to its active engagement of women in program design, ensuring tailored interventions and optimal asset transfers to mitigate natural hazards.

Despite their potential benefits, social protection programs also face several limitations and challenges that hinder their effectiveness in mitigating the gendered impacts of climate shocks. One prominent example is the implementation challenges encountered by programs like India's MGNREGA, as highlighted by Jordan *et al* (2021). These challenges include uneven benefit distribution, unpaid care work responsibilities, and a lack of gender-sensitive monitoring, which impede the program's ability to effectively address the impacts of climate risks on women. Additionally, inadequate adjustments for women's increased time or mobility limitations in public works programs aimed at post-shock recovery, as noted by Lowe *et al* (2019), can result in unutilized positions reserved for women. For instance, the authors note that the oversight of time constraints led to inefficiencies in a Cash for Works program following a drought in Somalia in 2011, demonstrating the importance of considering gender-specific needs during program design and implementation. Furthermore, Corona and Gammage (2017) highlights the persistence of an instrumental view of women as caregivers in cash transfer programs, reinforcing existing gender roles and co-responsibilities. This perpetuation of gender norms can limit women's autonomy and hinder their empowerment, underscoring the need for greater gender sensitivity in program design and implementation. These limitations highlight the importance of addressing structural barriers and ensuring the meaningful inclusion of women in decision-making processes to enhance the effectiveness of social protection programs in mitigating the gendered impacts of climate shocks.

While existing literature addresses the broad impacts of these programs on well-being, there's a noticeable scarcity of data focusing specifically on gendered outcomes. This lack of gender-specific data limits our understanding of how climate change and social protection programs affect women and men differently. Conducting gender-sensitive assessments; involving the systematic collection, and analysis of gender-disaggregated data for impact assessments of social protection programs is essential to bridge this knowledge gap. The gendered effects of social protection programs and gender concerns related to climate adaptation and resilience have mostly been researched independently, with minimal integration (Adeyeye and Fischer 2023). Moreover, there is limited empirical evidence of social protection programs contributing to resilience against climate shocks (Islam and Hasan 2019), and the two research areas have seldom explored their interactions or connections.

Many studies primarily use households as the unit of analysis, which may obscure the specific vulnerabilities and experiences of women. For instance, data constraints often limit gendered analysis to comparing households based on the sex of the household head, overlooking the diverse experiences of other women in the household. As a result, the impacts of crises or interventions on women in male-headed households, who represent the majority of adult women in many contexts, may be overlooked.

Additionally, existing conceptual frameworks that have emerged mainly focus on the connection between climate change and social protection programs, but they often overlook the important roles that gender can play within this context (Ulrichs *et al* 2019, Costella *et al* 2023). Additionally, as Costella *et al* (2023) notes, much of the existing literature and practice around social protection and climate change predominantly focuses on managing shocks and disasters, such as extreme weather events, while neglecting other important climate-related risks like slow onset events. Consequently, the existing body of research may not fully capture the complexities of how climate shocks impact women's participation in social protection programs, particularly in the context of long-term environmental changes.

Data availability statement

No new data were created or analysed in this study.

Acknowledgments

I would like to thank Yashasvini Gupta and Anulya Parameswaran for providing excellent research assistance in the draft preparation.

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