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Gendered Dimensions of Climate Change Impacts: Challenges and Adaptive Strategies

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A R T I C L E I N F O

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A B S T R A C T

Climate change poses a significant global challenge that exacerbates existing social, economic, and cultural inequalities, particularly through the lens of gender. This review systematically investigates the gendered dimensions of climate change impacts, focusing on the unique challenges faced by women and men in rural areas, as well as the adaptive strategies employed to mitigate these effects. This study employed a systematic literature review approach following established protocols. A structured search strategy was implemented across various academic databases (Web of Science, Scopus, Google Scholar, ScienceDirect) and trusted sources (United Nations Women, the Intergovernmental Panel on Climate Change (IPCC). Women, often responsible for critical tasks such as water collection, fuel gathering, and food production, experience heightened burdens due to limited access to land, financial resources, and decision-making platforms. Conversely, men are disproportionately affected by job losses in climate-sensitive sectors, leading to economic insecurity and shifts in traditional family roles. The central hypothesis guiding this review posits that addressing gender disparities in climate adaptation and mitigation is essential for achieving social justice and enhancing the effectiveness of climate action. This review underscores the critical need for inclusive and equitable strategies that foster resilience and sustainability in vulnerable communities while highlighting the intersectionality of gender and climate change. Strategies identified include capacity-building initiatives, inclusive policies, gender-responsive financing mechanisms, and participatory governance. Integrating indigenous knowledge and promoting cross-sectoral collaboration are pivotal for fostering equitable resilience. Achieving these goals necessitates collective action to dismantle structural barriers, ensuring that climate policies address the needs of all stakeholders. This study contributes to the growing recognition that sustainable communities cannot be achieved without addressing gendered impacts and fostering inclusive solutions for a more equitable future.

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Introduction

Climate change, often described as the defining global challenge of the 21st century, is not only an environmental crisis but also a deep social and economic challenge with distinct gendered dimensions (Mehta et al., 2024). Its consequences, such as rising temperatures, erratic rainfall patterns, melting glaciers, and increasing frequency of extreme weather events, have far-reaching impacts on ecosystems, economies, and human livelihoods. While climate change affects all populations, its consequences are neither uniformly distributed nor gender-neutral. It increasingly disrupts livelihoods, with poor communities bearing the brunt of its adverse effects owing to the limited capacity to anticipate and adapt to its challenges. Within these vulnerable populations, the impact often differs between women and men (IFPRI, 2012). The intersection of climate change and gender inequalities reveals distinct and multifaceted challenges, as social norms, cultural roles, and economic disparities exacerbate the vulnerability of marginalized groups, particularly women. Women often experience heightened economic insecurity during climate shocks, such as droughts and floods, leading to resource allocation biases favoring males (Fruttero et al., 2024).

Women's responsibilities, especially in rural and marginalized communities, are centered on managing natural resources such as water, fuel, and food. These roles place them at the forefront of climate change research. For instance, prolonged droughts and unpredictable rainfall increase the time and effort required to secure water and firewood, thereby reducing women's opportunities for education, income generation, and community participation (Segnon et al., 2024). Moreover, women often lack land rights, financial resources, and access to climate-resilient technologies, further restricting their ability to adapt to environmental change. On the other hand, men often face significant pressures related to their traditional roles as primary earners, especially in sectors such as agriculture and fisheries, which are highly vulnerable to climate change. Economic stress owing to declining productivity frequently leads to male migration in search of alternative livelihoods, leaving women to shoulder additional responsibilities at home. This shift, while empowering in some cases, often amplifies women's workloads and stress levels.

Climate change also affects health outcomes differently for men and women. Women, particularly those in low-income settings, often have limited access to healthcare, sanitation, and hygiene facilities, which increases their susceptibility to diseases during climate-related crises. Pregnant and lactating women are especially vulnerable to heightened risks during disasters such as floods and heat waves (WHO, 2014). For example, during the 2010 floods in Pakistan, poor sanitation facilities led to an increase in waterborne diseases among women. Pregnant women faced additional complications due to a lack of medical care (Kirsch et al., 2012). Similarly, in India, heatwaves have had a severe impact on women working in agriculture, worsening dehydration and heat-related illnesses from prolonged exposure to extreme temperatures (Rohini et al., 2016). These health disparities underscore the intersectionality of gender and other social determinants that shape vulnerability to climate change. Despite these challenges, women are not merely passive victims of climate change but are also agents of resilience and adaptation. Their traditional knowledge of local ecosystems and their role in managing household resources uniquely position them to develop and implement community-level solutions. Women-led initiatives in sustainable agriculture, water management, and disaster preparedness have demonstrated the potential of gender-inclusive strategies to enhance resilience (Mohammed et al., 2022). In Kenya, women's groups have effectively implemented agroforestry practices, combining tree planting with crop cultivation to mitigate soil erosion and enhance food security (CGIAR, 2024). In Bangladesh, women-led community-based water management systems have improved access to clean water during floods, reducing health risks and ensuring resource sustainability. Women have organized groups to identify challenges and introduce sustainable, participatory water governance systems, gaining decision-making power at the local level and enhancing the livelihoods of over 4,500 inhabitants (CCDB, 2021). Similarly, in Nepal, women's participation in disaster preparedness programs has significantly reduced the loss of life and property during climate-related events. UNESCO supported training for women on their role in disaster risk reduction and preparedness in Nepal's Sunsari and Saptari districts, emphasizing the importance of women's involvement in disaster preparedness and education to reduce disaster impacts (UN Nepal, 2023).

Global policy frameworks, including the United Nations Framework Convention on Climate Change (UNFCCC) and Sustainable Development Goals (SDGs), recognize the importance of gender-responsive approaches to addressing climate change. These frameworks advocate the inclusion of women in decision-making processes and the integration of gender perspectives into climate action plans. However, translating these commitments into practice remains a significant challenge due to deep-rooted societal norms, limited institutional capacity, and inadequate funding for gender-focused initiatives (Damilola, 2024). This review article aims to systematically explore the gendered dimensions of climate change impacts, with a particular focus on the challenges faced by women and men, and the adaptive strategies employed to mitigate these effects. The novelty of this review lies in its interdisciplinary approach, which combines insights from climate science, gender studies, and policy analysis to identify synergies and gaps in existing frameworks. The central hypothesis guiding this review is that addressing gender disparities in climate adaptation and mitigation is not only critical for achieving social justice, but also pivotal for enhancing the overall effectiveness of climate action. This analysis underscores the critical role of inclusive and equitable strategies in fostering resilience and sustainability in vulnerable communities and highlights the intersection of gender and climate change. This study contributes to the growing recognition that sustainable and resilient communities cannot be achieved without addressing the gendered impact of climate change and fostering equitable solutions.

Methodology

This study employed a systematic literature review approach to explore the gendered dimensions of climate change impacts and adaptive strategies, guided by established protocols for conducting rigorous literature reviews (Cooper et al., 2018; Tranfield et al., 2003). The research theme, "Gendered dimensions of climate change impacts: challenges and adaptive strategies," was finalized as the foundation for the search process. Relevant academic databases, including Web of Science, Scopus, Google Scholar, ScienceDirect, Springer, and Emerald Insight, were utilized alongside trusted sources such as reports from the United Nations (UN) Women, the Intergovernmental Panel on Climate Change (IPCC), and the Food and Agriculture Organization (FAO). A structured search strategy using keywords such as "Gender and climate change," "Gendered impacts of climate change," "Adaptive strategies in climate change," "Climate change and rural livelihoods," and "Gender-responsive climate policies" was adopted to ensure comprehensive coverage of the topic.

The initial search yielded approximately 373 papers and reports, and 280 were screened based on titles, abstracts, and keywords to ensure relevance. The inclusion criteria required articles to explicitly address gendered dimensions of climate change impacts and/or adaptive strategies, be published in peer-reviewed journals or reputable sources between 2003 and 2024, and focus on rural contexts due to their distinct socioeconomic and environmental vulnerabilities. After removing duplicates and irrelevant studies, a shortlist of 155 articles were reviewed in detail, and a final selection of 58 articles was made based on thematic alignment and methodological rigor (Figure 1).

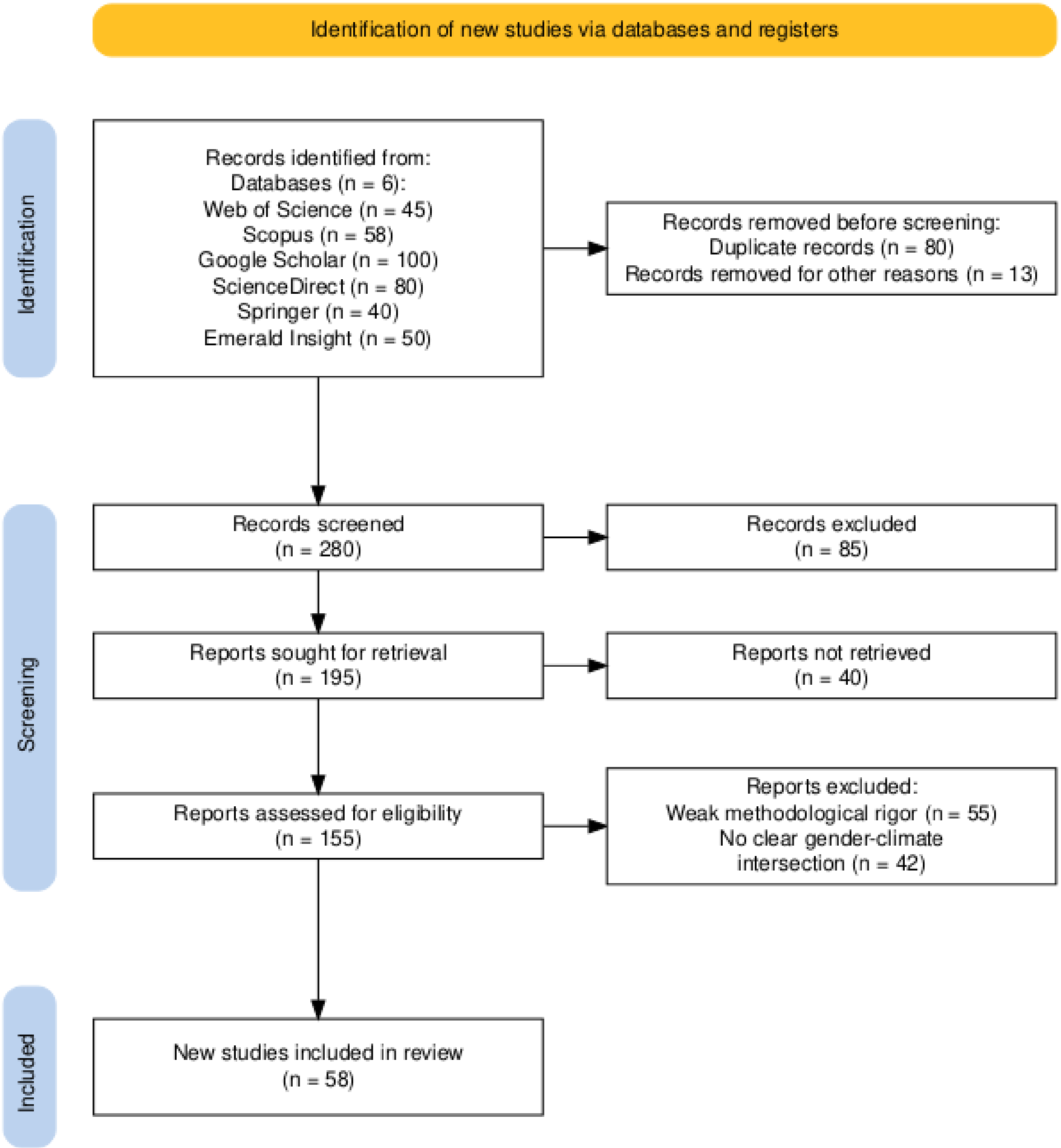

Figure 1. Systematic literature review methodology using PRISMA flow diagram.

The selected studies were systematically analyzed to extract insights into gender-specific challenges, adaptive strategies, structural and cultural barriers, and policy recommendations for gender-responsive climate action. Recurring themes, emerging trends, and gaps in the literature were identified and cross-referencing was used to enhance robustness. Although this review provides a comprehensive synthesis, it is limited by its reliance on secondary data and the variability in methodologies of the reviewed studies.

Differential Vulnerabilities of Men and Women to Climate Change

The differential vulnerability of individuals to environmental hazards is caused by several social, economic, historical, and political factors that operate on multiple scales (Thomas et al., 2019). Climate change affects men and women in rural areas differently, owing to their distinct social roles, responsibilities, and vulnerabilities. Such differences derive from the gender division of labor, inequalities in access to resources, and differential exposure to climate risks.

Women in rural areas often bear responsibility for water collection, fuelwood gathering, and food preparation. Climate change exacerbates resource scarcity and increases the time and effort required for these tasks. For example, prolonged drought or deforestation can force women to travel longer distances to fetch water or firewood, reduce the time available for income-generating activities, and expose them to health risks and physical exhaustion. The extended time spent on resource collection also increases women's exposure to violence and harassment in certain regions, compounding their vulnerability. Similarly, limited access to healthcare and sanitation in rural areas makes women more vulnerable to the health impacts of climate change such as waterborne diseases during floods or heat stress.

Food insecurity caused by crop failure often disproportionately affects women as they prioritize feeding their families over themselves, leading to malnutrition. Likewise, women in rural areas are often involved in small-scale agriculture or informal work that is highly sensitive to climate change, such as droughts or floods. These disruptions can result in reduced incomes, exacerbating poverty and limiting their ability to invest in adaptive strategies. Compounding these challenges is the lack of access to education and skill-building opportunities, which restricts women's ability to transition into more resilient forms of livelihood.

Rural men are typically employed in sectors such as construction, fishing, and mining, which are highly vulnerable to climate change. Job loss owing to declining productivity or resource availability can lead to economic instability, migration, and psychological stress. This stress is frequently associated with increased rates of substance abuse and domestic violence, which further destabilize household dynamics. Climate-induced job losses often force men to migrate to urban areas in search of employment opportunities. This migration can lead to changes in family structures, increasing women's workload as they manage both domestic and agricultural responsibilities in the absence of male household members. Such transitions can sometimes lead to women's empowerment through greater decision-making roles, although this is often accompanied by increased strain and limited support.

Although both men and women face climate challenges, their experiences are shaped by their gender roles. Women's vulnerabilities are rooted in their dependence on natural resources for household tasks, and their limited access to land, credit, and technology. Conversely, men face psychological and social pressures as primary breadwinners, compounded by job losses in climate-sensitive industries such as agriculture, fishing, and mining. For example, in regions like Sub-Saharan Africa, prolonged droughts have led to reduced agricultural productivity, forcing men to migrate in search of work, which disrupts families and increases stress (Mitra et al., 2022). Similarly, in Southeast Asia, declining fish stocks due to warming oceans have strained the livelihoods of male fishers, exacerbating financial insecurity and mental health issues (Kay et al., 2023). The interconnected nature of these vulnerabilities calls for gender-sensitive adaptation strategies to address the unique challenges faced by both men and women.

Gendered challenges in the face of climate change

Climate change complicates pre-existing social and economic disparities, disproportionately affecting men and women in terms of societal roles, resource availability, and adaptation skills. Although structural biases often make women more vulnerable, men face unique obstacles, particularly in climate-affected industries and livelihood transition. These gendered problems are deeply embedded in conventional roles, resource distribution, and cultural expectations.

Challenges Faced by Women

Disproportionate workload and resource scarcity

Women in rural communities frequently handle resource-intensive home chores such as fetching water and firewood. Climate change-induced droughts and deforestation considerably increase the time and effort required for these duties (Goldsworthy, 2009). For example, in Sub-Saharan Africa, women and girls walk an average of 6 kilometers daily to collect water, often carrying approximately 20 liters per trip. This task consumes significant time and energy, limiting opportunities for education and paid employment (USAID, 2018). In India, women spend approximately 374 hours annually collecting firewood, averaging over an hour daily (CCA, 2015). This increased workload ultimately limits their options for pursuing education and paid employment opportunities. Moreover, the physical burden of carrying heavy loads over long distances can lead to chronic health issues such as musculoskeletal disorders. In certain regions, women are also at a heightened risk of harassment or violence while traveling through remote or unsafe areas to collect resources. The loss of natural resources due to climate change has further compounded these challenges. In some areas, declining agricultural yields force households to rely more heavily on natural resources, intensifying women's workloads and deepening their vulnerability to climate shocks. The ripple effects of these challenges extend beyond individual women, as overburdened caregivers often struggle to provide adequate care for their children, perpetuating cycles of poverty and vulnerability.

Limited economic opportunities

Climate stress has a significant impact on women's engagement in agriculture, particularly in subsistence farming. Women often lack access to critical resources, such as land, credit, and agricultural supplies, which limits their ability to invest in climate-smart agricultural practices and trap them in prolonged cycles of poverty (Udumann et al., 2024). For instance, in Kenya, women farmers are typically excluded from formal land ownership, preventing them from obtaining loans or insurance to adapt to climate impacts. Similarly, in Bangladesh, female farmers face challenges in accessing climate-resilient seeds and irrigation systems due to financial and societal barriers. Gender-based barriers in accessing extension services, training programs, and technology further exacerbate this inequality, leaving women at a significant disadvantage in adopting sustainable agricultural practices or diversifying their livelihoods. For example, in India, cultural norms often prevent women from attending agricultural extension meetings, which are predominantly male-oriented, limiting their knowledge of sustainable practices. Climate-induced disruptions such as floods, droughts, and extreme weather events disproportionately impact sectors dominated by women, including small-scale agriculture, informal markets, and handicrafts. For instance, in the Philippines, typhoons frequently destroy small-scale farms and stalls run by women in local markets, cutting off critical income streams.

This economic vulnerability is compounded by societal norms that prioritize male employment, often diverting limited household resources, such as loans or training opportunities, away from women. Without adequate support, women remain trapped in cycles of poverty and are unable to build resilience to future climate shocks.

Health and safety risks

Climate-related disasters can exacerbate health disparities. Women, particularly pregnant and nursing mothers, are at an increased risk of malnutrition and waterborne infections owing to limited access to healthcare (Sorensen et al., 2018). This lack of access increases the risk of complications such as preterm labor, maternal mortality, and infant malnutrition. For example, during floods or droughts, unavailability of clean water significantly increases the prevalence of gastrointestinal and vector-borne diseases, disproportionately affecting women and children. Water scarcity during menstruation is particularly problematic. At the time, there is a need for additional water for both sanitary and cultural reasons, including washing garments. There are increased odds of infection in the absence of clean water (Mehta et al., 2024). These issues are further exacerbated in displacement camps where overcrowding and poor sanitation facilities create significant health hazards for women and girls. During emergencies, women are particularly exposed to gender-based violence, such as trafficking and exploitation in displacement scenarios (Desai & Mandal, 2021). The breakdown of social structures during disasters often leads to a lack of secure space for women and girls, heightening their vulnerability. Furthermore, mental health challenges such as anxiety and depression are common among women coping with the compounded stresses of climate-induced displacement, poverty, and caregiving responsibilities.

Challenges Faced by Men

Impact on livelihoods

Men in rural regions, who have traditionally been considered as providers, face declining agricultural output as a result of climate change. The declining agricultural output caused by prolonged droughts, erratic rainfall patterns, and soil degradation has resulted in widespread poverty and economic despair (Chisoro, 2013). These challenges are particularly acute for men engaged in climate-sensitive sectors, such as farming, fishing, and forestry, where fluctuating yields and resource scarcity directly threaten their incomes. The loss of financial stability often forces men to seek alternative income sources, some of which may involve risky or illegal activities, such as unregulated mining, poaching, or timber logging. Engagement in such activities not only endangers their health and safety, but also contributes to environmental degradation, creating a vicious cycle of resource depletion and poverty. Furthermore, men's inability to secure consistent incomes undermines their sense of identity and social standing, exacerbating their feelings of failure and frustration.

Migration and family strain

Men frequently move to cities in pursuit of employment because of falling wages, leaving women running homes and farms by themselves. The lack of male figures alters traditional family roles, forcing women to adjust to new obligations while balancing their emotional load (Gul et al., 2018). The absence of male family members creates a significant emotional and financial burden on women who often struggle to balance caregiving, farming, and community obligations. While migration may provide temporary financial relief through remittances, it often comes at the expense of family cohesion. Children may experience emotional distress due to the prolonged absence of their fathers, and women may face additional societal pressures or stigmas as de facto heads of households. Moreover, migrant men often encounter exploitative working conditions, low wages, and precarious living arrangements in urban areas, which limit the long-term benefits of migration. In some cases, migration also leads to intergenerational conflicts, as younger men adopt urban lifestyles and values that may clash with traditional rural norms upon their return. These dynamics further strain family relationships and social cohesion.

Mental health challenges

The pressure to fulfill societal expectations as primary breadwinners contributes to stress, anxiety, and depression among men when their livelihoods are threatened (Johnston et al., 2023). This is especially typical in rural areas where economic opportunities are limited and climate shocks disrupt established lifestyle patterns. The inability to meet familial and societal expectations often manifests as feelings of inadequacy, guilt, and a loss of purpose. Mental health issues such as stress, anxiety, and depression are increasingly prevalent among men who face these challenges. Men are less likely than women to seek help for mental health problems because of cultural stigmas around vulnerability and the perception that seeking help is a sign of weakness. This reluctance exacerbates their struggles and often leads to harmful coping mechanisms such as substance abuse or aggression. The impact of mental health challenges extends beyond individuals, affecting families and communities. For instance, men struggling with psychological distress may withdraw emotionally or physically, straining relationships and reducing their capacity to contribute to household and community well-being.

While both genders need resources such as credit, technology, and knowledge to adapt to climate change, structural hurdles frequently prevent women from accessing these resources, while males might not have the support they need to switch to other sources of income after losing their jobs. Extreme weather poses bodily risks for both men and women. While men are exposed to work hazards while attempting to preserve assets or participate in rescue operations, women are more likely to die because of caregiving obligations and mobility limitations.

Role of Gender in Climate Resilience and Adaptation

Role of Women in Resilience Building and Adaptation

Climate change adaptation and resilience-building require novel and inclusive approaches, with gender playing a crucial role in determining how men and women contribute to and experience adaptive activities. This section investigates how women and men use resilience tactics based on traditional knowledge, innovation, and changing roles.

Rural women often have considerable knowledge of local biodiversity and sustainable practices, which are critical for responding to climate change (Carvalho et al., 2024). Their contribution to agriculture, water conservation, and disaster preparedness is critical for adaptation. Women are primarily responsible for seed selection, focusing on both traditional and exotic species, which increases agricultural diversity and resilience to climate variability (Acharya, 2024). This role ensures that crops are better suited to withstand erratic weather patterns, pests, and diseases. In many regions, women also lead household-level water harvesting techniques and soil conservation practices, directly influencing community resilience. In Nepal, women's groups have successfully managed community forests to combat soil erosion and ensure water availability, demonstrating their leadership in sustainable resource management (Agarwal, 2010). These initiatives not only mitigate climate impacts but also foster community solidarity and shared responsibility. For example, women-led cooperatives in Africa have adopted micro-irrigation systems that optimize water use, improving crop yields and household incomes under changing climate conditions.

However, systemic barriers such as limited access to financial services, land ownership, and technology constrain their full participation. For instance, less than 20% of women globally have secure land rights, reducing their ability to make long-term investments in adaptive practices. Similarly, lack of access to credit and insurance further limits their capacity to adopt climate-resilient technologies. Strengthening women's decision-making power through capacity-building initiatives and participatory governance is key to enhancing resilience (Misra, 2024).

Role of Men in Resilience Building and Adaptation

Men, especially those in rural areas, often bear the burden of providing financial stability to their families. The role of men in climate resilience and adaptation strategies is multifaceted, encompassing contributions across various sectors including agriculture, urban planning, and community engagement. Men, as key stakeholders, can drive initiatives that enhance adaptive capacities and promote sustainable practices. Their involvement is crucial in implementing strategies that address the impacts of climate change effectively. Men in professions such as architecture and urban design help to build climate resilient infrastructure (Anderson, 2020). For instance, male engineers and planners play key roles in designing flood-resistant buildings, green roofs, and energy-efficient urban systems that address long-term climate risks. In agriculture, men often lead in the adoption of large-scale mechanization and irrigation systems, which improve productivity under climate stress.

Their involvement in community planning stimulates public participation and integrates climate adaptation measures with urban development. Male-led local governance bodies often influence the allocation of resources for resilience-building projects, making their role in equitable decision-making crucial. Training programs for men in agricultural extension can improve their knowledge of climate risk management and sustainable practices like zero tillage and weather forecasting (Singh & Grover, 2013). Such training enhances their ability to predict and respond to climate risks, ensuring better preparedness for extreme weather events. Additionally, male farmers trained in agroforestry and crop diversification are pivotal in reducing greenhouse gas emissions and enhancing carbon sequestration.

Collaboration for Gender Inclusive Resilience and Adaptation

While men and women contribute uniquely to resilience-building, collaborative approaches that harness their complementary strengths are essential. The unique perspectives and skills of both genders, collaborative approaches often lead to innovative solutions. Women's knowledge of household-level resilience and men's expertise in large-scale adaptation measures complement each other. For example, joint male-female community initiatives in water management and disaster response have shown higher success rates than single-gender efforts. Community-level water management projects often benefit when men and women jointly participate in planning and execution. While men may lead in designing and constructing irrigation systems, women contribute by identifying optimal water use practices and ensuring equitable resource distribution. In India, water management practices in rural areas often involve both men and women in decision-making processes. While men might be more involved in the technical aspects of irrigation infrastructure, women are crucial in the day-to-day management, promoting water-saving practices, and ensuring fair distribution across household. In many regions of Sub-Saharan Africa, both men and women work together on water resource management. For instance, in Ethiopia, community members collaboratively design and maintain irrigation systems, with men leading construction efforts while women often contribute by organizing community meetings to discuss equitable water distribution and conservation techniques (World Bank, 2019). In countries like India, local farmer groups often work together on water management, where men may oversee the physical infrastructure, but women are central in organizing the community and teaching best practices for water conservation, promoting efficient irrigation techniques, and ensuring that all members of the community, regardless of gender, benefit equally from the system. Such partnerships promote efficiency and inclusivity, leading to better outcomes. Gender-inclusive collaboration fosters unity and reduces gender-based disparities in communities. For instance, men trained in sustainable irrigation techniques and women skilled in crop diversification can collaboratively implement agroecological systems that enhance resilience. Recognizing and addressing the intersectionality of gender roles, cultural norms, and resource access is vital for building inclusive and sustainable adaptive systems.

Policy frameworks and gender mainstreaming

Global Policy frameworks

UNFCCC Gender Action Plan (GAP)

The Gender Action Plan (GAP), adopted at COP23 in 2017 under the United Nations Framework Convention on Climate Change (UNFCCC), is a comprehensive approach to integrating gender considerations into the global climate action agenda (UNFCCC, 2019). The GAP provides a structured framework to ensure that gender equality is explicitly considered across climate-related policies and activities. It outlines five priority areas for action. Firstly, capacity-building and knowledge-sharing, which focuses on ensuring that women and men have equal access to information and training to adapt to and mitigate climate impacts. This includes equipping women with the tools and skills necessary to actively engage in climate decision-making processes. Secondly, gender balance in climate leadership and decision making, which focuses to promote gender balance in leadership positions within climate governance, ensuring that women are represented in decision-making bodies, negotiations, and policy formulation. Research has shown that greater female representation leads to more equitable and comprehensive solutions to climate issues. Thirdly, coherence between climate and gender policies, which calls for alignment between gender equality frameworks and climate action plans. It aims to remove any inconsistencies between these two domains, ensuring that policies and actions in one area do not undermine the goals of the other. Fourthly, gender responsive implementation of climate policies, which emphasizes that climate action must take into account the diverse roles, needs, and capacities of women and men. Gender responsive climate policies are designed to address the specific vulnerabilities and adaptive capacities of women, ensuring that both men and women benefit equally from climate-related interventions. Lastly, monitoring and reporting to track the effectiveness of gender-responsive climate policies, the GAP stresses the importance of collecting sex-disaggregated data and conducting gender analyses. This helps ensure that climate policies are truly inclusive and that the gendered dimensions of climate change are adequately addressed in future strategies.

The Paris agreement

The Paris agreement, adopted in 2015, is a landmark international treaty aimed at addressing climate change by limiting global warming to well below 2°C above pre-industrial levels. Gender equality is recognized as an integral part of achieving these climate goals, particularly in the context of adaptation. Article 7, paragraph 5 of the Paris agreement specifically calls for gender-responsive approaches in adaptation actions. It emphasizes the importance of ensuring that adaptation strategies promote equitable participation and representation of all groups, particularly women and other vulnerable populations.

The Paris agreement acknowledges that climate change impacts are disproportionately felt by women, especially in developing countries, and emphasizes that women's active participation is key to building resilience. This recognition reflects growing evidence that gender-responsive climate policies not only contribute to the empowerment of women but also enhance the overall effectiveness of climate adaptation and mitigation strategies. For example, women's leadership in climate resilience initiatives has been shown to improve community-level responses, increase sustainability, and reduce vulnerability to climate risks. Furthermore, the Paris Agreement encourages the integration of gender considerations into national climate plans, ensuring that climate actions are tailored to the needs and capacities of both men and women.

Sustainable Development Goals (SDGs)

The SDGs, adopted in 2015 as part of the 2030 Agenda for Sustainable Development, include explicit targets for gender equality and climate action. SDG 5 (Gender equality) aims to end gender-based discrimination, empower women and girls, and promote their participation in decision-making at all levels. Achieving gender equality is recognized as essential for addressing climate change, as women often play central roles in community-level adaptation and mitigation efforts. Empowering women through education, leadership opportunities, and access to resources can greatly enhance the effectiveness of climate resilience strategies.

SDG 13 (Climate action) aims to take urgent action to combat climate change and its impacts. One of the key components of SDG 13 is ensuring that climate actions integrate gender-responsive approaches, recognizing that the impacts of climate change are not gender-neutral. The targets under this goal emphasize the need for increased financial and technical support to enable gender-sensitive climate solutions. Moreover, achieving SDG 13 requires promoting gender equality in climate governance and ensuring that women's voices are heard in climate decision-making processes. The synergies between SDG 5 and SDG 13 reflect the understanding that progress in one area can significantly advance outcomes in the other. The interconnectedness of these SDGs is a recognition that gender equality and climate action are mutually reinforcing. Empowering women not only contributes to a fairer society but also leads to more effective and sustainable solutions to climate challenges.

Sendai framework for disaster risk reduction

The Sendai framework for Disaster Risk Reduction (DRR), adopted in 2015, is a critical global strategy aimed at reducing disaster risk and building resilience in the face of natural hazards, including those exacerbated by climate change. The framework recognizes the importance of gender in disaster risk management and emphasizes the need for gender-sensitive strategies that actively involve women in the leadership and decision-making processes of disaster preparedness, response, and recovery. The Sendai framework calls for the integration of gender into DRR policies, recognizing that women often face greater vulnerabilities during and after climate-induced disasters due to social, economic, and political inequalities. Women's leadership in disaster management has been shown to improve response times, ensure more inclusive recovery processes, and strengthen community resilience. The Sendai framework seeks to ensure that both women and men benefit equally from disaster risk reduction efforts. The framework stresses the importance of collecting gender-disaggregated data in order to assess the differential impacts of disasters on women and men. This data is essential for designing tailored disaster response and recovery strategies that address the unique needs of all individuals, especially those from marginalized and vulnerable communities.

Gender responsive climate strategies in Nepal

Nepal's Local Adaptation Plans for Action (LAPA) framework provides a practical example of gender integration in local climate adaptation strategies.

Nepal's approach ensures that women are not only beneficiaries of climate adaptation actions but are also central to the planning and decision-making processes. LAPA empowers women by actively involving them in community-based adaptation initiatives, such as water resource management, forest conservation, and disaster risk reduction. These initiatives demonstrate that when women are included in climate adaptation planning, there are tangible improvements in both the efficiency of interventions and the empowerment of women. Nepal's LAPA framework provides a model for integrating gender into climate change adaptation strategies at the grassroots level, ensuring that women's knowledge, roles, and needs are reflected in policy and action. By recognizing the critical role that women play in managing natural resources and coping with climate impacts, the framework promotes sustainable and resilient solutions that benefit entire communities.

Challenges to Gender Mainstreaming in Climate Policy

Limited representation

In many rural and traditional communities, patriarchal structures continue to limit women's access to positions of power and decision-making. These societal norms often result in the marginalization of women in political and climate governance processes, leading to a lack of their perspectives in the formulation of policies and strategies (Nyahunda et al., 2020). Limited representation of women in climate policy-making processes not only undermines the inclusiveness of climate action but also perpetuates gender inequalities. This exclusion reduces the diversity of viewpoints in climate decisions, ultimately hindering the development of more holistic, inclusive, and effective policies. The gender imbalance in leadership roles within climate governance is a major barrier to ensuring that policies are equitable and address the specific needs of women, particularly those in vulnerable communities (Nyahunda et al., 2020).

Resource inequality

Gender-based inequalities in access to resources such as land, finance, and technology significantly limit women's ability to participate fully in climate resilience efforts. In many developing countries, land ownership and access to productive resources are primarily controlled by men, leaving women with little or no control over assets crucial for climate adaptation. This gendered distribution of resources undermines women's capacity to engage in sustainable agricultural practices or invest in climate-resilient infrastructure. Moreover, women often face barriers to accessing financial services, which limits their ability to invest in climate-smart technologies or adopt sustainable practices (Dev & Manalo, 2023). Women are at greater risk from climate change impacts and are often excluded from climate adaptation and mitigation planning without access to these critical resources. Closing this resource gap is essential for empowering women and ensuring that they can contribute equally to climate resilience initiatives.

Data gaps

One of the key barriers to gender-responsive climate policy is the lack of reliable, sex-disaggregated data and gender-specific research. The absence of such data makes it difficult to assess the differentiated impacts of climate change on men and women and limits the development of targeted, effective interventions. Many climate policies are designed without understanding how men and women are impacted differently by climate change, leading to a one-size-fits-all approach that fails to address the unique needs of each gender. Implementing systematic methods for collecting, analyzing, and reporting sex-disaggregated data is crucial to understanding gendered vulnerabilities and to crafting policies that are truly inclusive. Furthermore, gender-specific research is needed to identify how social, cultural, and economic factors shape men's and women's capacity to adapt to climate change. Bridging this data gap would enhance policymakers' ability to design gender-sensitive climate strategies and improve the effectiveness of climate actions (Weber et al., 2021).

Cultural barriers

Cultural norms and traditional gender roles remain significant barriers to gender mainstreaming in climate policy. In many societies, these traditional roles confine women to domestic responsibilities, while men are primarily seen as breadwinners or decision-makers in public life. These cultural expectations restrict women's ability to engage in public governance, including climate governance, and reinforce their exclusion from important decision-making spaces. Women are often perceived as less capable of handling leadership roles, including those related to climate action, due to these deeply ingrained social constructs (Suyito et al., 2024). Such cultural barriers not only perpetuate gender inequalities but also hinder the effectiveness of climate policies, as they fail to harness the full potential of both women and men in addressing climate challenges. Challenging these cultural norms and promoting gender equality in governance is essential for creating more inclusive and effective climate policies.

Policy Implications and Recommendations

Strengthening institutional commitment and overcoming barriers

Integrating gender-responsive policies in agriculture and food technology faces several challenges, primarily stemming from institutional resistance and a lack of understanding of the interconnected barriers and underlying causes of gender gaps. Bureaucratic inertia often slows the adaptation of existing structures to gender-inclusive approaches. Governments can counter this by creating dedicated gender units within agricultural ministries to ensure systematic integration of gender considerations into all policies and programs. Cross-sectoral collaboration among government agencies, civil society organizations, and academic institutions can further build momentum for change. It's crucial to clearly document these gender-responsive policies and establish methods to measure progress and impact after implementation. For example, Rwanda's Gender Monitoring Office (GMO) successfully institutionalized gender considerations in its agricultural policies by ensuring compliance with gender-responsive budgeting, holding ministries accountable, and providing technical guidance, a model that can be adapted by other countries (Habtezion, 2016).

Ensuring sustainable funding mechanisms

Lack of dedicated funding for gender-responsive policies is another significant obstacle which can cause well-intentioned policies to fail. Governments should introduce gender-responsive budgeting, specifically allocating agricultural funding to support women's empowerment initiatives. Engaging international donors and financial institutions is also crucial to provide long-term funding for gender-focused programs. It is also important to improve women’s participation in leadership roles to build sustainable agri-food systems and ensure that governments foster political representation and increase opportunities for women. Uganda's implementation of gender-responsive budgeting in its agriculture sector, which allocates financial resources for training programs, access to credit, and land ownership rights for women farmers, has led to increased productivity and empowerment of female agricultural workers (Habtezion, 2016).

Prioritization of policy strategies

Policymakers should prioritize interventions based on their effectiveness and feasibility, specifically considering gender-transformative approaches (GTAs) that tackle the fundamental sources of inequality (Habtezion, 2016). GTAs move beyond individual self-improvement, aiming to transform power dynamics and promote gender equality (Poulsen, 2018). These approaches address discriminatory social norms, customs, values, and exclusionary practices, as well as formal laws, policies, procedures, and services. Key policy strategies include securing land tenure for women through legal reforms and land redistribution programs (The World Bank, 2014). Expanding microfinance programs tailored to women in agriculture, and developing vocational training programs focused on modern agricultural techniques, agribusiness management, and digital literacy is crucial (FAO et al., 2020). Support for women's cooperatives, access to local and global markets, promotion of gender-sensitive agricultural technologies, and accounting for the gender gap in Climate-Smart Agriculture (CSA) practices are also crucial (Paudyal et al., 2019). Interventions such as building agency, changing relations, and transforming structures can lead to more equitable relationships and sustainable outcomes.

Addressing cultural barriers to gender mainstreaming

Addressing cultural barriers is crucial for successful gender mainstreaming in agriculture and food production, as cultural norms frequently limit women's involvement (Hernandez et al., 2023). Policymakers must actively engage local communities through targeted awareness campaigns and participatory approaches. Partnering with community leaders and enlisting gender champions can be instrumental in shifting perceptions and fostering the acceptance of gender-inclusive policies. Deep-rooted preconceptions in many societies often position women as supplementary workers, limiting their access to essential agricultural resources. Discriminative social norms, laws, and regulations further restrict women's ability to fully contribute to rural development. Cultural barriers can also lead to women being excluded from decision-making processes and leadership roles in local and central government organizations. Engaging with community leaders and gender champions helps to address these inequalities by promoting the understanding that gender equality benefits the entire community (United Nations Women, 2024). Awareness campaigns can challenge traditional stereotypes and highlight the economic and social benefits of women's empowerment in agriculture. Participatory approaches ensure that policies are tailored to local contexts and address the specific needs and challenges faced by women in those communities. The Self-Employed Women’s Association (SEWA) in India serves as a successful example of empowering rural women by providing access to markets, credit, and legal support, leading to significant improvements in their livelihoods (Colovic & Mehrotra, 2020). Governments can replicate such models to ensure cultural acceptance of gender-responsive policies, adapting them to the specific cultural contexts and needs of different regions. By addressing cultural barriers and promoting gender equality, policymakers can unlock the full potential of women in agriculture, leading to more sustainable and equitable outcomes.

Implementation roadmap

A phased approach is recommended to ensure the successful implementation of gender-responsive climate policies. In the short term (1–2 years), the focus should be on establishing gender monitoring bodies, conducting baseline assessments, and initiating pilot projects (UNFCCC, 2024). The establishment of gender monitoring bodies can ensure that gender considerations are integrated into all climate-related policies and programs. Baseline assessments are crucial for understanding the existing gender dynamics and identifying specific challenges and opportunities (UNFCCC, 2024). Pilot projects can provide valuable insights into the effectiveness of different interventions and inform the design of larger-scale programs. During the medium term (3–5 years), successful interventions should be scaled up, institutional integration should be ensured, and gender-responsive budgeting should be implemented. Scaling up successful interventions will help to maximize their impact and reach a larger number of beneficiaries. Ensuring institutional integration will ensure that gender considerations are mainstreamed across all government departments and agencies. Gender-responsive budgeting will ensure that resources are allocated in a way that addresses the specific needs and priorities of both women and men. In the long term (5+ years), gender policies should be fully institutionalized, integrated into national frameworks, and sustained through continuous evaluation (UNFCCC, 2024). Institutionalizing gender policies will ensure that they are durable and resistant to political changes. Integrating gender policies into national frameworks will ensure that they are aligned with broader development goals. Continuous evaluation is essential for tracking progress, identifying challenges, and making necessary adjustments to ensure that gender policies remain effective over time.

Strategies for Effective Gender Mainstreaming

Capacity building

Capacity building plays a critical role in enabling women to effectively participate in climate action and decision-making processes. Educational programs that emphasize climate science, policy, and leadership skills for women are crucial in empowering them to become active contributors in climate governance (Wray et al., 2023). Such capacity-building initiatives should focus on providing women with the knowledge and skills necessary to lead climate adaptation projects, engage in policy development, and advocate for gender-responsive climate actions. Training programs should target various sectors such as agriculture, disaster risk management, renewable energy, and urban planning, which are all directly impacted by climate change. It is also important to ensure that women are equipped with digital literacy skills to access and analyze climate data and information, which can enhance their participation in climate-related decision-making. We can enable them to play an instrumental role in shaping climate resilience strategies and promoting sustainable development by strengthening the capacity of women.

Inclusive policies

Inclusive policies are essential for addressing the structural barriers that prevent women from fully participating in climate action. Governments must incorporate gender considerations into all aspects of climate policies, particularly in fiscal policies, to ensure that budgeting processes reflect the needs and demands of marginalized populations, including women (Rigoni & Stracquadaini, 2022). Gender Responsive Budgeting (GRB) is a key tool in this process, as it allocates resources in ways that directly address the different needs of men and women, especially in relation to climate adaptation and mitigation. This approach ensures that financial investments are made to support women's participation in climate change efforts, as well as to reduce gender inequalities in access to resources. Inclusive policies should also promote gender equality in all sectors of climate action, such as agriculture, water management, and energy, and ensure that women's voices are included in all levels of decision-making.

Funding mechanisms

Gender-responsive climate financing is crucial for addressing gender inequities in climate action and ensuring that women are included in climate projects as active agents of change (Adams et al., 2014). Climate financing mechanisms must be designed to prioritize gender-specific needs and provide adequate resources to empower women in their roles as leaders in climate resilience efforts. This includes funding for women-led projects, access to credit for women to invest in climate-smart technologies, and financial support for capacity-building initiatives. Gender-sensitive climate finance must also ensure that women, particularly those in rural areas, have access to credit, land tenure, and technology, which are critical for their participation in climate action. Furthermore, innovative financing mechanisms such as microfinance programs, climate insurance, and social protection schemes tailored to women's needs can help address financial barriers and empower women in the face of climate change.

Participatory governance

One of the most effective strategies for gender mainstreaming in climate policy is increasing women's involvement in decision-making positions. Inclusive governance structures that prioritize gender equality leads to more responsive and context-sensitive climate plans, ensuring that policies are reflective of the unique experiences, knowledge, and needs of women. Increasing women's representation in climate-related decision-making bodies such as local climate committees, national climate change commissions, and international climate forums can help incorporate diverse perspectives into policy development and implementation (Kovaleva et al., 2023). Participatory governance ensures that women's lived experiences with climate change, including their roles in agriculture, water management, and disaster preparedness, are considered in the design of climate adaptation and mitigation strategies. Women's leadership in these areas also fosters greater community engagement, as they are more likely to build trust and support among local populations, particularly in rural and marginalized communities. Encouraging the active participation of women at all levels of governance also contributes to a more equitable distribution of resources, ensuring that climate adaptation strategies benefit both men and women.

Contradictions and Debates in Gender-Responsive Adaptation Strategies and Way Forward

Contradictions and debates

While the advocacy for gender-focused climate adaptation is widespread, a closer examination reveals several contradictions and debates surrounding its actual effectiveness. These nuances are critical to consider when designing and implementing policies aimed at enhancing resilience and promoting gender equality in the face of climate change. These debates include economic empowerment vs reinforcement of traditional roles, gender-responsive vs gender-neutral policies, indigenous knowledge vs modern technology.

On one hand, initiatives like microfinance programs and cash transfers are celebrated for their potential to economically empower women (LI-BIRD, 2014). These programs can enhance women's agency, enabling them to invest in their livelihoods, improve household well-being, and build financial independence. Studies have shown that women are more likely to reinvest income in their families' health, education, and nutrition compared to men, amplifying the positive impacts of these interventions. However, critics argue that many of these programs inadvertently reinforce traditional gender roles, adding to women's already heavy workload without fundamentally challenging the structural inequalities they face (UNFCCC, 2015). For example, programs often assume that women are primarily responsible for caregiving, placing the burden of managing household finances and childcare squarely on their shoulders. This can lead to increased stress, limited time for other productive activities, and a perpetuation of traditional gender divisions of labor. The case of disaster relief programs in Bangladesh exemplifies this contradiction (Daze, 2019). While these programs provide much-needed financial aid to women in the aftermath of climate-related disasters, they often fail to address the underlying structural barriers that make women particularly vulnerable, such as unequal land ownership rights. Without secure land tenure, women are less able to access credit, invest in sustainable agricultural practices, and build long-term resilience to climate change. In such cases, economic empowerment initiatives may provide short-term relief but do little to address the root causes of vulnerability.

There is a broad consensus that gender-responsive policies are essential for effective climate adaptation, recognizing that women and men experience the impacts of climate change differently and have distinct needs and capacities. However, some scholars caution against over-targeting women in adaptation programs, arguing that this can inadvertently alienate men and undermine overall community resilience (UNFCCC, 2015). Evidence from India suggests that when adaptation funding is exclusively directed toward women, men may perceive this as a threat to their traditional roles and status, leading to resistance or disengagement from climate action (Daze, 2019). This can manifest as a lack of support for women's initiatives, increased household conflict, or even outright sabotage of adaptation efforts. In such cases, a focus solely on women's empowerment may inadvertently create new forms of inequality and reduce overall community resilience. This raises the important question of whether gender policies should integrate men more actively instead of focusing solely on women's empowerment. Some argue that engaging men as allies in promoting gender equality can lead to more sustainable and equitable outcomes. This may involve challenging traditional norms and stereotypes, promoting men's involvement in caregiving, and creating opportunities for men and women to work together on climate adaptation initiatives.

Women in many regions possess a wealth of traditional ecological knowledge that is invaluable for climate adaptation. This knowledge, often passed down through generations, encompasses practices such as seed-saving, soil conservation, water management, and natural resource management (Otzelberger, 2011). These practices are often well-suited to local environmental conditions and can enhance the resilience of communities to climate change. However, climate policies often prioritize technological solutions such as precision agriculture, climate-smart irrigation, and drought-resistant crops, sidelining traditional knowledge systems (Li-Bird, 2014). While these technologies can undoubtedly play a role in enhancing climate resilience, they may not always be accessible or appropriate for all communities, particularly those with limited resources or access to infrastructure. The case of female farmers in Peru practicing agroecology illustrates this disconnect. These women have developed and implemented sustainable farming practices that have improved food security and enhanced biodiversity in their communities. However, they often lack access to scientific climate data and technological resources that could further enhance their adaptation efforts. This creates a gap between local adaptation practices and state-led interventions, potentially limiting the effectiveness of both (UNDP, 2016). A more integrated approach is needed that recognizes the value of both indigenous knowledge and modern technology, combining the strengths of each to develop climate adaptation strategies that are both effective and equitable. This requires engaging local communities in the design and implementation of climate policies, respecting their knowledge and expertise, and providing them with access to the resources and technologies they need to adapt to climate change.

Way forward

A comprehensive and effective approach to gender-responsive adaptation strategies require moving beyond one-size-fits-all solutions to embrace context-specific, inclusive, and integrated interventions. It begins with conducting thorough local assessments to understand the unique gender dynamics, cultural norms, and power structures within communities. Such assessments should uncover the root causes of vulnerability and inequality, informing the development of tailored adaptation programs that directly address local needs. Participatory design is crucial, ensuring that women, men, and marginalized groups are actively involved in shaping and implementing adaptation strategies, with their voices and perspectives guiding decision-making. Additionally, it is essential to move beyond short-term economic empowerment by addressing structural barriers that perpetuate inequality, such as discriminatory laws, unequal land rights, and limited access to education and healthcare. Promoting women's leadership at all levels, from community organizations to national agencies, is vital to ensuring their perspectives shape climate-related decisions. Programs should also challenge harmful gender norms and stereotypes, encouraging women to break free from traditional roles and expectations.

Engaging men as allies is equally important in fostering equitable outcomes (Li et al., 2023). Adaptation programs should promote shared responsibility in caregiving and household tasks, traditionally viewed as women's duties. Encouraging men to reflect on and challenge harmful masculinities can foster more equitable behaviors and relationships. Collaborative initiatives involving both men and women in climate adaptation efforts can promote mutual respect and shared ownership of solutions. Furthermore, integrating indigenous knowledge with modern technology can enhance adaptation strategies. Recognizing the value of traditional ecological knowledge and ensuring communities have access to technology and training can create more effective, locally grounded solutions. Platforms for knowledge exchange among scientists, policymakers, and local communities can facilitate collaboration and innovation (Cvitanovic et al., 2015). Lastly, robust monitoring and evaluation mechanisms are essential for tracking progress and ensuring accountability. Developing gender-sensitive indicators helps measure the direct and indirect impacts of adaptation programs on women and men. Regular evaluations can assess effectiveness, identify unintended consequences, and inform necessary adjustments. Using a mixed-methods approach, combining quantitative and qualitative data collection, provides a comprehensive understanding of outcomes and challenges. The path forward requires a shift from solely focusing on women's empowerment to addressing broader structural inequalities, engaging men as allies, and integrating indigenous knowledge and modern technology. Grounded in local contexts and participatory design, this nuanced and holistic approach can drive more equitable, sustainable, and effective climate adaptation outcomes for all.

Conclusion

The impacts of climate change are inherently gendered, deeply intertwined with existing social, economic, and cultural inequalities. Women and men in rural areas experience distinct vulnerabilities and adaptive challenges, shaped by their respective roles, responsibilities, and access to resources. Women, often tasked with collecting water, gathering fuel, and producing food, bear a disproportionate burden due to their limited access to land, financial resources, and decision-making power. This disparity restricts their capacity to adapt effectively to climate change. On the other hand, men, particularly those in climate-sensitive industries, face significant challenges such as job losses, which can lead to shifts in their roles within the household and communities, and may result in increased migration as a coping strategy. These gendered dynamics underscore the urgent need for gender-responsive climate strategies that both address the unique vulnerabilities of each gender and capitalize on their adaptive capacities. It is essential to implement inclusive policies that promote capacity-building and integrate indigenous knowledge to effectively address these challenges. These strategies can transform gender disparities into strengths, enhancing the collective adaptive capacity of communities. Achieving this requires dismantling systemic barriers that hinder women's participation in decision-making processes, ensuring equitable access to resources, and promoting cross-sectoral collaboration among governments, civil society, and the private sector. Ultimately, by addressing the gendered impacts of climate change and fostering inclusive governance, we can build more sustainable, resilient communities that leave no one behind. Gender equality and climate resilience are not mutually exclusive; they are mutually reinforcing goals that can drive more effective and equitable climate action for all.

Declarations

Data availability

No data was used for the research described in the article.

Conflict of interest

The author declares no conflict of interest.

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