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Research Article

Climate Change, Sustainability, and Reproductive Health: A Mixed-Methods Study

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Abstract

Background: Climate change increasingly threatens human health, especially in vulnerable regions like South Punjab, Pakistan. However, its effects on reproductive health and family planning remain underexplored. This study investigated how climate change shapes reproductive health behaviors and family planning decisions in Dera Ghazi Khan and Layyah districts after the 2022 floods.

Methods: Using a mixed-methods design, the study collected data from January to March 2023. Eighty-seven participants were purposively sampled. Quantitative surveys measured climate change awareness, contraceptive use, and reproductive intentions post-flood. Qualitative interviews explored cultural and social factors influencing family planning decisions. SPSS was used for quantitative analysis, and NVivo supported qualitative thematic analysis.

Results: While participants demonstrated moderate awareness of climate change's health impacts, few reported changing reproductive behavior. Only 28% adjusted contraceptive use or reproductive plans due to environmental concerns. Qualitative findings revealed key barriers, including strong cultural norms, a lack of eco-friendly contraceptive options, and limited provider counseling. Both districts highlighted the dominance of short-term survival concerns over long-term environmental considerations.

Conclusion: The findings highlight the urgent need to integrate climate resilience into reproductive health programs. Priorities include environmental education in family planning services, access to environmentally sustainable contraceptive methods, and community engagement. Broader policy reforms and cross-sector collaboration are essential to address the intertwined challenges of climate change, health, and sustainability.

Introduction

Climate change is increasingly recognized as one of the most profound challenges to human health, with disproportionate impacts on vulnerable populations in low- and middle-income countries [1]. In Pakistan, the catastrophic 2022 floods highlighted the fragility of health systems and the heightened risks to maternal and reproductive health in disaster-affected areas [2]. Among the most overlooked intersections in this context is the relationship between climate change, sustainability, and reproductive health, particularly how environmental disruptions shape family planning behaviors and access to services [3]. While the literature has examined climate-related health outcomes such as infectious diseases, malnutrition, and displacement [4,5], significantly less empirical research has exploredfar less empirical research has addressed how climate variability influences fertility intentions, contraceptive use, and reproductive decision-making.

South Punjab, particularly the districts of Dera Ghazi Khan and Layyah, represent some of the most climate-vulnerable regions of Pakistan. These districts have experienced recurrent flooding, notably in 2022, which displaced thousands of residents, disrupted health services, and severely undermined household livelihoods [6]. While immediate health concerns following such disasters are often centered around infectious diseases, injury, and malnutrition, the longer-term impacts on

sexual and reproductive health are often overlooked in both research and policy planning [7]. In particular, disruptions in access to contraceptive services, reduced autonomy in reproductive decision-making, and heightened vulnerability among women and girls have been observed globally in disaster contexts [8].

Existing research suggests that environmental insecurity, such as that caused by climate change, can shape fertility preferences and reproductive behavior, often leading to earlier childbearing, reduced birth spacing, or the suspension of contraceptive use in the face of uncertainty [9]. For example, Bongaarts and O'Neill [10] argued that environmental shocks may influence population dynamics not only through mortality but also by altering reproductive choices. Yet empirical studies exploring these linkages, especially in South Asia, remain scarce. In Pakistan, family planning programs have historically focused on biomedical and demographic targets, with limited attention to environmental sustainability or climate resilience. Integrating climate adaptation and sustainability considerations into reproductive health programs offers a promising but underexplored strategy for addressing interconnected challenges [11,12].

Moreover, qualitative studies have underscored that social norms, cultural beliefs, and gender dynamics play a critical role in shaping family planning decisions in resource-constrained settings [13]. In flood-affected regions like Dera Ghazi Khan and Layyah, women's reproductive agency is often constrained by patriarchal norms, economic precarity, and limited access to information or services [6]. Understanding how these local factors interact with climate-related stressors is essential for developing effective and contextually appropriate interventions.

Given these knowledge gaps, the present study employed a mixed methods design to comprehensively explore the intersection of climate change, sustainability, and reproductive health in Dera Ghazi Khan and Layyah. Conducted between January and March 2023, the study aimed to examine: (1) the level of awareness among reproductive-age individuals about climate change and its reproductive health implications; (2) the extent to which this awareness translates into family planning behaviors; and (3) the barriers and facilitators to integrating sustainability into reproductive health decision-making. By combining quantitative survey data with qualitative insights, this research provides a holistic understanding of how climate adaptation can be meaningfully integrated into reproductive health programming.

Importantly, this study contributes to a growing but still limited body of literature advocating for planetary health frameworks, which recognize the interconnectedness of human health and environmental systems [14]. It also responds to recent calls for more interdisciplinary research linking climate change and Sexual and Reproductive Health Rights (SRHR) in the Global South [15]. By situating family planning within broader sustainability and adaptation goals, this research advances both academic debates and practical policymaking.

The present study seeks to address a critical gap in the empirical literature by exploring how residents of two highly climate-affected districts in South Punjab navigate the complex relationship between climate change and reproductive health. The insights generated here aim to inform the design of more resilient, equitable, and sustainable reproductive health interventions that acknowledge individual-level needs and the broader environmental and structural forces shaping reproductive lives.

Methodology

The present study employed a mixed methods design to comprehensively explore the intersection of climate change, sustainability, and reproductive health, with a particular emphasis on the integration of family planning into climate adaptation strategies. This design was chosen to capture both the breadth of quantitative patterns and the depth of qualitative insights, thereby providing a holistic understanding of the research objectives. The study was conducted between January and March 2023 in two flood-affected districts of South Punjab, Pakistan: Dera Ghazi Khan (D.G. Khan) and Layyah. These districts were severely impacted by the 2022 floods, experiencing extensive damage to infrastructure, disruption of health services, and displacement of communities, making them ideal sites for investigating the study's objectives.

A total sample of 87 participants was included, based on available demographic data and logistical feasibility, post-disaster. The sample comprised both male and female respondents of reproductive age, as well as key informants such as health workers and community leaders. A purposive sampling technique was employed to ensure representation across different age groups, socioeconomic backgrounds, and levels of access to health services. The inclusion criteria required participants to be residents of the selected districts, aged between 18 and 49, and willing to provide informed consent. Exclusion criteria included individuals under 18 years of age, those with severe health conditions preventing participation, and those who had migrated to the area after the floods.

Quantitative data were collected using a structured questionnaire that included demographic information, knowledge, and perceptions of climate change, access to reproductive health services, and family planning practices. The questionnaire was adapted from previously validated instruments and aligned with international guidelines on reproductive health and climate adaptation [16]. For the qualitative component, in-depth interviews and focus group discussions were conducted using a semi-structured guide designed to explore individual experiences, community

challenges, and adaptive strategies related to reproductive health in the post-flood context. The qualitative questionnaire was adapted following recommendations from the WHO's *Reproductive Health Indicators Guidelines* [17], ensuring cultural sensitivity and relevance to the post-disaster setting.

Ethical approval was obtained from the relevant institutional review board, and all participants provided informed consent. Quantitative data were analyzed using descriptive and inferential statistics, while qualitative data were transcribed, coded, and analyzed thematically to identify recurrent patterns and emergent themes. Triangulation of quantitative and qualitative findings was employed to enhance the validity and richness of the study's insights.

Results

The study included a total of 87 participants (45 from D.G. Khan and 42 from Layyah), comprising married women of reproductive age, men, healthcare providers, and local government representatives. The quantitative survey data and qualitative interviews were collected between January and March 2023, capturing the post-flood context in these highly affected areas.

Quantitative findings (Table 1)

Notably, 72% of respondents reported experiencing disruptions to healthcare services due to the 2022 floods, and 66% reported difficulty accessing family planning services during this period. Awareness of climate change was moderate (58% overall), but only 21% reported that environmental concerns influenced their reproductive decisions (Figure 1).

Table 2 illustrates notable shifts in contraceptive use among 87 individuals before and after a flood, revealing a general decline in modern contraceptive methods and a rise in non-use or reliance on traditional practices. The use of oral contraceptives dropped from 25% pre-flood to 18% post-flood, injectables decreased from 14% to 10%, and implants/IUDs from 8% to 6%, suggesting limited access to clinical services or supplies in the aftermath of the disaster. In contrast, the use of traditional methods increased from 12% to 16%, and the proportion of individuals using no contraception at all rose significantly from 41% to 50%. These patterns reflect how natural disasters can disrupt healthcare infrastructure, reduce access to reproductive health services, and compel individuals to shift toward less effective or no contraceptive practices, underscoring the importance of integrating reproductive health continuity into disaster preparedness and response plans.

Table 1: Demographic characteristics of participants.

Variable	D.G. Khan (n = 45)	Layyah (n = 42)	Total (n = 87)
Mean age (years)	30.8 ± 6.1	29.4 ± 5.9	30.1 ± 6.0
Education (≥ primary)	60%	55%	57.5%
Employed (any income)	28%	24%	26%
No. of children	3.4 ± 1.8	3.7 ± 1.5	3.6 ± 1.7

n = 87

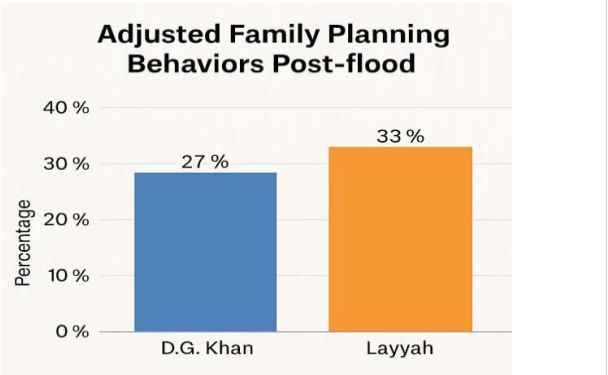

Figure 1: Changes in family planning behaviors post-2022 flood.

Table 2: Use of contraceptive methods before and after flood.

Method	Pre-flood (%)	Post-flood (%)
Oral contraceptives	25%	18%
Injectables	14%	10%
Implants/IUDs	8%	6%
Traditional methods	12%	16%
No method	41%	50%

n = 87

Qualitative findings

Three major themes emerged from the interviews:

1. **Climate change and health vulnerabilities**: Participants reported heightened concerns about food security, waterborne diseases, and reproductive health complications post-flood. Several women noted delays in receiving prenatal care or contraception. One female respondent from Layyah shared:

"After the flood, the clinic was closed for weeks — I had to wait almost two months to receive my family planning injection."

2. **Barriers to eco-sensitive reproductive choices**: Cultural norms, limited healthcare outreach, and lack of knowledge about environmentally friendly contraceptive options were consistent across both districts.

3. **Adaptation strategies and resilience**: Some women reported spacing pregnancies longer due to household economic strain, and a few health workers described innovative local efforts, such as mobile clinics and community health sessions, to address unmet needs.

Quantitative-qualitative integration

The mixed-methods approach revealed that while quantitative data showed only modest shifts in contraceptive use, qualitative data captured deeper adaptive responses shaped by local flood impacts. Although only 19% of women reported formal contraception use post-flood, interviews suggested that informal strategies (like prolonged abstinence) were more widespread.

Discussion

This study provides valuable insights into the relationship between climate change, sustainability, and reproductive health, an intersection that has received increasing attention but remains underexplored in empirical research. Our findings reveal that although awareness of climate change and its health impacts is growing among reproductive-age individuals, this awareness does not consistently influence family planning decisions. Participants demonstrated a moderate understanding of how environmental degradation, resource scarcity, and climate events can affect reproductive outcomes, yet few reported adjusting their reproductive intentions or contraceptive choices based on these concerns. This echoes earlier research indicating a disconnect between environmental awareness and behavior change in health-related contexts [10].

The qualitative data added significant depth by uncovering key barriers to integrating sustainability into family planning decisions. Cultural norms, limited access to environmentally sustainable contraceptive methods, and insufficient provider counseling on environmental issues emerged as consistent themes. Importantly, this study was conducted in D.G. Khan and Layyah, two districts in South Punjab that were severely impacted by the 2022 floods. The post-disaster recovery phase shaped participants' immediate priorities, with many focusing on rebuilding livelihoods, restoring health service access, and securing basic needs. This context helps explain why, despite climate change awareness, individuals did not consistently adapt their reproductive behavior to reflect environmental concerns. Prior research similarly highlights how populations in crisis-affected settings often prioritize short-term survival over long-term environmental considerations [7,18].

The study highlights a critical research gap regarding the integration of climate adaptation into reproductive health programming. While considerable attention has been paid to the direct health impacts of climate change, such as increased vector-borne diseases and heat-related mortality, there is comparatively little research on indirect effects on fertility preferences, birth spacing, and contraceptive use [9,19]. Our findings align with growing body of evidence suggesting that environmental uncertainty shapes reproductive intentions, particularly in resource-constrained and disaster-affected settings. However, formal health systems often overlook these linkages, leaving families without adequate support or guidance [13].

The practical implications of this work are significant. Family planning programs in climate-vulnerable areas like D.G. Khan and Layyah should incorporate environmental education into counseling strategies, allowing clients to weigh sustainability alongside personal and familial health needs [11]. Furthermore, policy initiatives must support the development and distribution of environmentally friendly contraceptive technologies, which can help reduce the ecological footprint of reproductive health services [3]. Urgent interdisciplinary collaboration is needed between environmental and health sectors to design integrated interventions that address both human and planetary health [12].

Our findings also underscore the importance of addressing gender dynamics and reproductive justice in climate adaptation efforts. Women in low- and middle-income countries, including flood-affected districts like D.G. Khan and Layyah, often bear disproportionate burdens of both climate impacts and reproductive labor, yet they have limited voice in decision-making processes. Empowering women through education, access to sustainable reproductive options, and inclusion in policy design is therefore essential for building resilient and equitable communities [8].

While this study makes valuable contributions, several limitations must be acknowledged. The reliance on self-reported data may have introduced social desirability bias, potentially inflating levels of reported awareness or masking sensitive reproductive attitudes. Additionally, the non-probability sampling and small sample size (n = 87) limit the generalizability of the findings beyond the specific communities studied. Nonetheless, the mixed-methods design enriched the analysis by offering both breadth and depth of understanding [16].

Future research should expand on this work by exploring diverse populations, including rural and climate-vulnerable communities beyond South Punjab, and by employing longitudinal designs to assess how climate change perceptions influence reproductive trajectories over time. Comparative studies across countries and regions would help elucidate context-specific dynamics and inform scalable interventions [18]. Furthermore, research should investigate the role of health systems in supporting families during post-disaster recovery, ensuring that reproductive health needs are met even in the face of environmental crises.

This study reinforces the need to embed climate-responsive strategies within regional reproductive health programs, particularly in disaster-affected areas like D.G. Khan and Layyah. The disconnect between climate awareness and reproductive behavior highlights a gap in current health systems, which often lack the tools and messaging to guide climate-informed family planning. Policies should prioritize sustainability-focused counseling, access to eco-friendly contraceptives, and inclusive community engagement, especially with women. While findings are limited by non-probabilistic sampling, they align with global models such as Nepal's Female Community Health Volunteer (FCHV) program, which effectively integrates family planning with broader climate resilience strategies [20].

This study underscores the urgent need to integrate climate

change and sustainability considerations into reproductive health programs and policies, particularly in disaster-affected regions like D.G. Khan and Layyah. Addressing these interconnected challenges requires not only technological innovations but also social and behavioral change strategies that resonate with local communities. By doing so, we can promote more sustainable family planning practices that support both human well-being and environmental resilience.

These findings underscore the need for alignment with regional reproductive health policies in climate-vulnerable areas, such as integrating environmental sustainability into existing family planning programs (Figure 2).

Limitations

This study offers valuable insights into the intersection of climate change, sustainability, and reproductive health; however, several limitations must be considered. The research was conducted in only two districts of South Punjab with a relatively small sample size, and it employed non-probabilistic sampling methods, which significantly limit the generalizability of the findings to wider populations. The reliance on self-reported data introduces the possibility of social desirability bias, as participants may have overstated their awareness or environmentally responsible behaviors. Furthermore, although the mixed-methods design enriched the analysis, the limited number of in-depth interviews may not fully capture the diversity of reproductive experiences and climate-related perceptions within the broader community.

Due to the use of non-probabilistic sampling, the findings cannot be generalized to the broader population.

Recommendations

To enhance research, policy, and practice, future studies should include more diverse samples, especially from underrepresented communities, to better capture social and regional differences. Longitudinal research is needed to track how climate change perceptions influence reproductive intentions over time. Family planning programs should integrate environmental education, linking sustainability with reproductive health. Investment in eco-friendly contraceptive technologies is vital, expanding their accessibility and effectiveness to support informed choices. Interdisciplinary collaboration is crucial for addressing both health and environmental challenges. Finally, empowering women and marginalized groups with education and policy participation will foster more resilient communities.

Figure 2: Policy implications and strategic recommendations for integrating reproductive health and climate resilience

Conclusion

This study deepens our understanding of how environmental changes influence reproductive health attitudes and behaviors. While people are increasingly aware of climate change risks, this awareness has not yet led to major changes in family planning practices, partly due to persistent cultural and structural barriers. The findings highlight the need to integrate climate resilience and sustainability into reproductive health programs, moving beyond a narrow medical focus toward more holistic and socially responsive approaches. Addressing these challenges requires coordinated efforts that integrate technological innovation with social and behavioral strategies that resonate with local communities. By strengthening interdisciplinary collaboration and prioritizing the needs of women and vulnerable populations, we can build reproductive health systems that safeguard individual well-being while contributing to environmental sustainability and resilience in an era of global climate uncertainty.

Authors contribution

Author 1: Basic Research Idea, Literature work, Introduction, Data Collection, contributed to write Risk Assessment, contributed to write Adaptation Strategies and Policy response, proof reading.

Author 2: Basic Idea, Design, Methodological work, contributed to introduction and Literature work, contributed to data collection, Writing and Formatting, Risks assessment, Adaptation Strategies, and Policy Response

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Conflict of interest statement

The authors declare that there are no conflicts of interest regarding the publication of this paper. The research was conducted independently, and there are no financial or personal relationships with individuals or organizations that could have inappropriately influenced the content of this study.

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