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CASCADING VULNERABILITIES: THE IMPACT OF CLIMATE CHANGE ON WOMEN'S REPRODUCTIVE HEALTH IN SUB-SAHARAN AFRICA

Running Title: Climate Change and Women's Reproductive Health

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Abstract

Sub-Saharan Africa may be contributing very little globally in terms of greenhouse gases(GHG) but is worst affected by climate change effects. This brings various environmental shocks such as floods, droughts and heat stress which are very bad for health and add gender-vulnerabilities already present. Here, we examined effects of climate variability on women's reproductive health in agrarian communities in Sub-Saharan Africa; using a multi-stage mixed methods study that incorporates a household survey of 650 reproductive age women and 24 key informant interviews(KIIs). Climate shocks negatively impacted women's attempts at seeking safe antenatal, safe delivery, and family planning services. Thermal stresses and an increase in vector-borne illnesses contribute directly to health risks for women, such as preterm birth,low birth weight andpre-eclampsia. Climate shocks contributed to food scarcity and poor coping strategies which undermined nutritional status of women and increased women's expenditures especially when there are obstetric emergencies. Women's reproductive health vulnerability must be directly incorporated into adaptation and environmental disaster plans with comprehensive gender sensitive sexual & reproductive health strategies.

Keywords: Climate change; Extreme weather events; Maternal health; Vector-borne diseases; Reproductive health rights; Sub-Saharan Africa.

Introduction

Climate change is arguably one of the most complex structural health risks of the 21st century for public health world-wide. health[1,2]. Soaring levels of greenhouse gas emissions, have thrown the climate into turbulence which disrupts the ecological baselines upon which the lives of many of the world's communities are dependent. Though the costs of this breakdown are shouldered by peoples all over the world, in the shape of ecological damage and therefore, suffering humanity, the effects are most dramatically felt in sub-Saharan Africa. A critical deficiency of a dependence upon rain-fed subsistence agriculture, a critically impoverished and unstable health service, and crucially high levels of social injustice which inhibit human

[1] Intergovernmental Panel on Climate Change (IPCC). Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva: IPCC; 2023.

[2] Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, et al. Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. Lancet. 2009;373(9676):1693-1733.

capacity to adapt give the region its inherent and extreme vulnerability[3]. In such a climate of instability health effects of environmental shocks would occur in non-uniform or singled out ways; it would combine severely with existing socio-legal-economic inequalities and it would also most directly effect women and girls. For in the developing world all the segments of the population that make up most of the work-force, those working in agriculture were predominantly rural women; who were also predominantly the food producers in their families and for subsistence, water collectors, economy of paid and unpaid care work.[4] So for environment stresses of severe drought leading to crop failure and massive population displaced and displacement; and for flood of causing contamination of water and crops – then the practical and labour workload of these women increases many-folds on top of the conditions under which this workload may continue to persist and impact on their health status and their decision-making autonomy.[5] The problem related to the environmental factors is of a crucial relevance to pregnant, lactating and women of childbearing age because, in view of the latter, it entails a double biological and socio-economic level of risk between the degradation and the physiology of the women.[6],[7]

Pregnancy and Breastfeeding requires significant nutrition, thermoneutrality, and a support system that requires facilities to provide for those needs. An acute lack of water, high temperatures, infectious diseases moving across borders and the movement of people into climates less welcoming than the place they fled are a one-two punch to health and income for that poor family.[8] Evidence that connects events such as weather phenomena, with maternal, and neonatal events such as spontaneous abortion, stillbirth, hypertensive disorders of pregnancy or low birth weight are accumulating in epidemiology.[9] Despite the compelling evidence, national adaptation policies and disaster emergency responses in Sub Saharan Africa frequently marginalize SRHR . International agreements like Maputo Protocol[10] and the Paris Agreement,[11] While underscoring intrinsic rights to health and sustainable development by the most vulnerable groups in general; it is important to note, however, that usually such sweeping policy mandates will never yield effective coordinated action plans to link health and climate issues across states (as the case usually is with developing countries). We perform a systematic review of pathways through which environmental shocks cause detrimental effects on the

[3] Romanello M, di Napoli C, Drummond P, Green C, Kennard H, Lampard P, et al. The 2022 report of the Lancet Countdown on health and climate change: Health at the mercy of fossil fuels. Lancet. 2022;400(10363):1619-1654.

[4] United Nations Framework Convention on Climate Change (UNFCCC). Dimensions and Examples of the Gender-Differentiated Impacts of Climate Change, the Role of Women as Agents of Change and Opportunities for Women. Bonn: UNFCCC; 2022.

[5] Food and Agriculture Organization. The Status of Women in Agrifood Systems. Rome: FAO; 2023.

[6] Sorensen C, Murray V, Lemery J, Balbus J. Climate change and women's health: Impacts and policy directions. PLoS Med. 2018;15(7):e1002603.

[7] Bekkar B, Pacheco S, Basu R, DeNicola N. Association of air pollution and heat exposure with preterm birth, low birth weight, and stillbirth in the US: A systematic review. JAMA Netw Open. 2020;3(6):e208243.

[8] Watts N, Amann M, Arnell N, Ayeb-Karlsson S, Belesova K, Boykoff M, et al. The 2019 report of the Lancet Countdown on health and climate change: Ensuring that the health of a world-wide child is not defined by a changing climate. Lancet. 2019;394(10211):1836-1878.

[9] Kuehn L, McCormick S. Heat exposure and maternal health in the face of climate change. Int J Environ Res Public Health. 2017;14(8):853.

[10] African Union. Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa (Maputo Protocol). Maputo: African Union; 2003.

[11] United Nations. Paris Agreement. Paris: United Nations Framework Convention on Climate Change; 2015.

reproductive health status of rural agrarian women, hoping to lend empirical support to gender-responsive policies.

2. Contextual Background and Policy Frameworks

2.1 The Gendered Dimensions of Climate Vulnerability

The analysis of climate change is often confined to the weather, or the environmental domain, obscuring its gendered impact. Feminists' political ecology and studies on global health have, in an increasing volume of research, explored the relationship between the feminization of climate change in terms of an exaggeration of existing gender inequalities resulting from shocks and stresses.[12] However, in general, the usual traditional patriarchal customs have been practiced for household resource allocation in most African SubSaharan countries, whereby men in Sub-African regions eat first, men get the largest portion, women & children have restricted portions of what is eaten, women/children have the least attention during climate crises & access healthcare only as a last option, during droughts, food shortages after harvest failure.[13] Moreover, the whole responsiblility of water and fuel acquisition at the house is placed on the female as increased traveling to collect water for household comes with the degradation of local water resources due to unsteady rainfall and hence is a cause of exhaustion, musculoskeletal disorders, and increases the susceptibility to GBV along deserted routes.[14]

2.2 Biological and Physiological Susceptibility

Consequence of the corporal situation of mothers as consequence of temperature is conveyed via various direct physical mechanisms, by the effects of higher surrounding temperature in waves of extremes on the conditions of the mothers causing heat stress with reduced uteroplacental flow rates, raised maternal central core temperature.[15] These heat stress exposures are directly associated with a higher likelihood of developing preeclampsia, placental abruption, and premature labor via the resultant impacts of this stress.[16] At the same time changing distribution of rainfall and humidity will enhance adequate habitat for disease vectors to facilitate transmission. Malaria dissemination will threaten the integrity of maternal hematocrit, thus exacerbating the severity of anemia during pregnancy and stillbirths.[17]

2.3 The Policy Gap: Exclusion of SRHR in Climate Action

Consequently and indisputably the bi-social correlation is evident and yet still the connection of SRHR remains independent from that of climate action. The NAPs in numerous countries in Sub-Sahara emphasizes the security of agricultural yield production; development of robust

[12] Sellers S. Gender and Climate Change: A Review of Evidence. Women Deliver Research Report. New York: Women Deliver; 2016.
[13] World Bank. Shock Waves: Managing the Impacts of Climate Change on Poverty. Climate Change and Development Series. Washington (DC): World Bank Group; 2016.
[14] Geere JA, Hunter PR. The association of carrying water with health in low- and middle-income countries: A systematic review. Int J Health Geogr. 2018;17(1):1-19.
[15] Kuehn L, McCormick S. Heat exposure and maternal health in the face of climate change. Int J Environ Res Public Health. 2017;14(8):853.
[16] Rylander C, Odland JØ, Sandanger TM. Climate change and the potential effects on maternal and pregnancy outcomes: A review in Asian high-altitude regions. Glob Health Action. 2013;6(1):19556.
[17] Watts N, Amann M, Arnell N, Ayeb-Karlsson S, Belesova K, Boykoff M, et al. The 2019 report of the Lancet Countdown on health and climate change: Ensuring that the health of a world-wide child is not defined by a changing climate. Lancet. 2019;394(10211):1836-1878.

hardware for water resources, and resilience of physical infrastructure whereas health is generally discussed as the management of endemic disease outbreaks (such as cholera outbreaks following floods).[18] Women's specific and basic needs related to their fertility are often forgotten from natural disaster risk planning. How women who need consistent temperature-regulated supply of contraceptives access them, the need for a fully uninterrupted antenatal care and the necessity of a secure and clean delivery place are not generally taken into account. So when it comes to a climate event, the reproductive health of women usually turns out to be the collateral victim, spilling over into other health issues long after the disaster itself is over.

3. Methodology

3.1 Study Design and Setting

The data collection was a three cross sectional, mixed-methods epidemiological study over three ecological zones in West Africa between July 2004 and February 2005. The three ecological zones were chosen intentionally so that their climate change related vulnerabilities would be representative of those in Sub Saharan Africa.

Zone 1 (coastal/flood prone): a flat landscape that gets a lot of rain and are flood prone; climate

Zone 2 (agrarian transition): in a mid-belt region that receives uncertain rainfall, varied drought, land degradation; it cultivates both cash and food crops seasonally

Zone 3 (arid/drought prone) represents a savannah-like zone that receives few rain, it experiences a high rate of heat waves and desertification, its main income sources consist of nomadic cattle rearing and crop rain farming.

3.2 Sampling Methodology

A multi-Stage sampling was used to ensure that all the factors determining level of climate stress for women are represented:

Stage one; The 3 major climate based ecological zones are listed below as it describes the varying climates of the area.

Stage two; within these three ecological zones, the 3 local government areas were identified according to the criteria developed below to ensure they are prone to climate extremes, (flood or drought or heatwave) in the last 5 years. These Local Government areas are randomly chosen from a long list identified across the different regions.

There are 20 rural communities chosen among those that fall under this criteria in each of the regions listed below.

Stage three; a total of 650 women between 15 to 49 years of age was chosen through systematic random sampling. Participants have to meet the following criteria at inclusion: be a woman of reproductive age, have had at least one pregnancy/birth during the last 3 years and lived in the area of at least one extreme climate shock incident during the last 5 years.

3.3 Data Collection Instruments and Procedures

[18] Patel PE, Patel K, Bansiwal M. Integrating sexual and reproductive health rights into climate action in developing nations. Afr J Reprod Health. 2021;25(4):112-124.

Quantitative data: Questionnaires were administered face-to-face by a trained interviewer. The sequential design of questionnaire aided in the collection of information on respondents' socio-demographics, direct experience of climate phenomenon (prolonged and severe droughts, prolonged high ambient temperatures, extreme hot waves or flash flood events), water and sanitation access and availability, experiences in the access health care, and pregnancy related outcomes (antenatal care visit counts, location of delivery, antepartum/delivery complications). Cronbach's alpha was evaluated in a pilot in a similar area non-study location prior to the study to ensure the robustness of the tool.

Qualitative data: Twenty four key informant interviews (KII) were conducted with leaders and practitioners: 6 from public primary healthcare directorates, 4 from disaster management authorities, 6 public health practitioners and 8 from community and traditional leadership positions using appropriate purposive selection strategy to gain qualitative insight into the experiences and challenges women faced. Most of the interviews were translated between local language and English, based on interviewees preference, capturing perspectives regarding resistance of healthcare facilities, availability of health resources in disaster periods, specifically in relationship with reproductive health effects related to climate shock. Interview length of about 45-60 minutes.

3.4 Variables and Measurements

Independent variable: climate exposure status, recorded as high (high levels of drought, extreme heat, and/or flood during the index pregnancy) vs Low (little or no exposure to significant climate related disturbance)

The outcome variables: four or more (>=4) antenatal care visits completed, giving birth at a health facility, pregnant women report of pregnancy complications, premature birth/low birth weight and unmet needs for contraception, severe food insecurity in the household

The variables that might interfere with the association of climate exposure on the outcome variables: age, the number of children the woman has had and given birth to (parity), socio economic status (income group), education level, and prior health status.

3.5 Statistical and Qualitative Analysis

Quantitative data were analysed with SPSS software (version 28). Descriptive statistics were used to characterize our sample in terms of sociodemographic variables. Bivariate analyses of the associations of categories of environmental exposures with categories of health disruption were assessed using chi-square statistics.

Following this, adjusted odds ratios (OR) and 95 per cent confidence intervals (CI) for the associations of specific adverse pregnancy outcomes with high categories of environmental stress were computed using multivariable logistic regression models. These regression models were adjusted for the other sociodemographic characteristics including sexe, age,race, and maximum level of education. Statistical significance was defined as $p<0.05$.

Qualitative data were transcribed verbatim and translated into English when required and were analysed using thematic analysis, following Braun and Clarke's six-step process. Transcripts were coded iteratively, and resulting themes were synthesized to give further support and meaning to the quantitative analyses.

3.6 Ethical Considerations

Ethical approval was received from the State Ministry of Health health research ethics committee(protocol number: NHREC/05/01/2008b-2024-CLIM) the respective traditional rulers and local health authorities to have community entry. A duly signed informed consent was obtained from all quantitative respondents, it was thumb printed when illiterate and independent witness was present, it was verbal from key informers. All data collected was anonymized and identifiable characteristics of participants were eliminated to maintain confidentiality.

4. Results

4.1 Socio-Demographic Characteristics and Climate Exposure

All the 650 women participated in a quantitative survey resulting in a 100% response rate. The mean age of women in the survey was 28.6 (SD 6.4). Most women had no/low education (58.4%) and were subsistence farmers (62.1%).

Regarding parity, most women were neither nulliparous nor multiparous women (44.3%) whereas more than half were highly parous (55.7%).

Climate Exposure during the Index Pregnancy Major climate related events happened to nearly three quarter(482/650) of all 650 women interviewed such as during Index Pregnancy some members had agricultural crops failed due to extreme climatic events (excessive heat or floods).. Only 168 of all the women experienced slight climate fluctuations, Low-exposed.. Climate shocks forced local health posts to be closed or to become not readily accessible during the obstetric needs

4.2 Reproductive Health Outcomes by Climate Exposure Status

Significant differences existed between all measures of reproductive health between the high exposure and low exposure group as reported above in Table 1 below. These significant differences can also be illustrated on the graph provided below (Figure 1).

Table 1: Maternal and Reproductive Health Indicators Categorized by High vs. Low Climate Exposure Status (N=650)

Outcome Variable	High Climate Exposure (n=482)	Low Climate Exposure (n=168)	Chi-Square (\chi^2)	p-value
Completed \ge4 Antenatal Care Visits	188 (39.0%)	129 (76.8%)	71.32	<0.001
Facility-Based Delivery	211 (43.8%)	138 (82.1%)	74.85	<0.001
Reported Pregnancy Complications	183 (38.0%)	29 (17.3%)	24.18	<0.001
Preterm Birth / Low Birth Weight	125 (25.9%)	16 (9.5%)	20.64	<0.001
Unmet Need for Family Planning	231 (47.9%)	38 (22.6%)	32.11	<0.001
Severe Household Food Insecurity	328 (68.0%)	42 (25.0%)	96.44	<0.001

Women with high exposure were significantly less likely than women not exposed to the climate shock to receive at least 4 ANC visits recommended by the WHO (39.0% for high vs.

76.8%, χ^2 = 71.32, p < 0.001) and have delivery in the facility (43.8% for high exposure vs. 82.1% for lowest exposure, χ^2 = 74.85, p < 0.001).

Even though for women that were exposed to climate shock almost one third of all pregnancies complicated by clinical events was reported compared to 1/6th the amount in the low exposure group (38.0% vs. 17.3%, χ^2 = 24.18, p < 0.001), preterm birth and low birth weight rates for high climate shock women were roughly 3 times higher (25.9% vs. 9.5%, χ^2 = 20.64, p < 0.001) for pregnant women exposed to strong climate shocks compared with their counterparts with the lowest exposures and the need for and that was fulfilled use of family planning services was considerably smaller for women with highest exposure compared to those with lowest exposure (47.9% vs. 15.8%, χ^2 = 32.11, p < 0.001), also proportion of women experiencing severe food insecurity in the households was more significant among women exposed to the climate shock as opposed to those with lowest exposures (68.0% vs. 25.0% χ^2 = 96.44, p<0.001).

4.3 Multivariable Logistic Regression Analysis

After adjusting for maternal age, parity, income of households and pre pregnant health status in multivariate logistic regression, pregnant women who were exposed to high climate during pregnancy have high prevalence of several reproductive health problems. Those pregnant women who were in high exposure and food insecure had almost three-fold increased odds for pretem birth or low birth weight babies if they exposed to high climate, high heat and food insecurity concurrently (Adjusted Odds Ratio [AOR]= 2.84; 95% CI: 1.62, 4.98; p-value < 0.001). High climate was also associated with missing an adequate time-based clinic visit with odds 2.45 folds (AOR= 2.45; 95% CI: 1.58, 3.80; p-value < 0.001). Further, it recommends positive relation between shock, adverse events and maladaptive strategies such as reduced food intake for ensuring family's availability.

4.4 Qualitative Findings: The Lived Experience of Climate Induced Health Disruptions: These three qualitative themes served to provide more richness to quantitative data with their explanation of causality and context showing how climate change translates to a crisis in reproductive health.

Theme 1: Infrastructure Collapse, Physical barrier to healthcare delivery There were two specific impacts noted: first, weather extreme impact, second, health infrastructure impacted by the extreme weather. Primary Health Directors and disaster managers both lamented how weather extremes are physically severing the access linkage between pregnant women and their health care facilities. Annual access into the flood prone region kflood for extended periods of time.

A primary care director in Zone 1 noted, "When the floods came the bridges washed away the clinic may be fine but the women can not get across the river.

We had one incident last year where a woman in labor had to be carried in a canoe for 3 hours; because roads were flooded and the ambulance could not access; she already miscarried by the time they got to the health facility" (KII_03, Primary Care Director). By physically cutting them off from facilities and medical personnel they were forced to deliver alone, or with the aid of their potentially untrained traditional birth attendants thus further enhancing rates of maternal morbidity and mortality.

Theme 2: Economic Shocks, nutritional deficits and coping mechanisms: Community leaders and health officials also highlighted the broad impact that climate shocks would have on the local economy with regard to maternal nutrition, noting that failures in crop production caused by drought or flood lead to an immediate deficit of cash in household coffers. "When the crop fails, for the men no cash comes in-the women will now just eat one meal to ensure that the kids at least get a meal. No pregnant woman can birth a healthy baby while eating cassava one meal at a time."(KII_14 Community Leader).
Therefore, the narrative data showed evidence that under climate-driven shocks to household resources, a bypassing of caloric need would in fact have preceded avoiding essential regular household expenditure, demonstrating that food insecurity and low birth weight demonstrated in the quantitative data would clearly be affected by these outcomes.

Theme 3: Displacement, Loss of privacy and massive unmet need in family planning: The high proportion of unmet need for family planning (47.9% among highly exposed groups), was clearly linked to climate-related displacement. Displacement following the occurrence of natural disasters has women and children with no immediate dwelling. One public health official noted: "in IDP camps there are no men, women and children put all in the open room with little privacy...
The contraceptive supply chain is disrupted and the pharmacies flooded in water-women then face significant challenges in getting any methods and are then overwhelmed with the enormous volume of unwanted pregnancies following the disaster as they cannot find any place for intercourse nor any pharmacies are open" (KII_19, public Health Expert).
Loss of privacy also correlated with an increased rate of violence reported.

Discussion

This set of empirical findings is powerful, and presents conclusive evidence which provides clear and solid grounds for asserting that climate change serves as a deep structural determinant of outcomes in maternal and reproductive health within rural Sub-Saharan contexts. From the study data, it is obvious that not only does exposure to climate hazards impact the physical health of women directly, the study results confirm it directly and accumulates affects the health systems women draw from, and household economies relied upon during maternal care delivery. Structural frailties discussed and visible in the findings of this study definitely call for the inclusion of climate adaptation as one key component in Reproductive Health policy.

5.1 Direct Physiological Impacts: Thermal Stress and Vector Ecology

High climate vulnerability exhibits a robust positive relationship with adverse fetal health outcomes (AOR = 2.84 for preterm birth/low birth weight) signaling the rapid way that human populations react to environmental changes. The mechanism through which high pregnancy temperature stress can directly lead to biological processes and damage uteroplacental flow which, in turn, increases the likelihood for issues such as pre-eclampsia, placental abruption, or preterm birth has been demonstrated.[19] Among this segment and for subsistence farmers, the

[19] Kuehn L, McCormick S. Heat exposure and maternal health in the face of climate change. Int J Environ Res Public Health. 2017;14(8):853.

heatwaves in these areas lead to life threatening temperature settings for women as these could not minimize the working time due to lack of money. And the erratic rainfall favors transmission and increases vector born disease especially mosquitoes causing malaria which are very serious against pregnant woman's hematocrit value and that of her baby.[20] The response to a flood or drought might also affect the availability of indoor residual spraying (IRS) and insecticide treated nets (ITN), leaving women pregnant at greater risk for severe anemia, the condition known to increase risk of low birth weight.

5.2 Indirect Impacts: Livelihood Destruction and Nutritional Deprivation

Moreover, climate shock is indirectly killing agriculture livelihoods and causing widespread rise in the general scale of food insecurity, including growing rates of deficiency of micronutrients in nursing mothers and during the gestation period.[21] The high exposure group has quantitatively displayed that 68.0 percent of these women have had high degrees of household food insecurity. In agricultural societies women cannot be considered as working if their time in collecting water for example is measured as the only indicator of labor when this has been measured to have drastically increased as a form of physical strain and hence reduce chances of the time necessary for seeking medical help, eating their own meals, and even seeking medical care.[22] The qualitative findings illustrated vividly that pregnant women are heavily excluded from intra-household resource allocation during climate shocks. This involves that pregnant women have lower caloric intake because they let their children and husbands eat before them and are directly involved in the problem of increasing low birth weight.

5.3 Health System Disruption and the Barrier to Access

Wide differences between low and high exposure in facility based deliveries (43.8% vs 82.1%) and in completeness ofANC (39.0% vs 76.8%) is an illustration of just how vulnerable rural infrastructure is in regard to healthcare. Shocks do not just affect the patient - they affect the supply chain and the physical accessibility of the road. If roads to a clinic are made impassable by a flood or the power in a health unit has to be turned off after a few hours because of the immense heat during a heatwave, the entire chain of care breaks down.

5.4 Displacement, SRHR, and Gender-Based Violence

Most disturbing perhaps, are the high rates of unmet need for family planning (47.9 per cent) in women exposed to climate shocks, which in turn, cause climate-affected populations to move to informal shelters where family planning facilities are neglected; inadequate privacy of the makeshift accommodation, poor sanitary facilities and intermittent contraceptive supplies can fuel unintended pregnancy. The sheer act of displacement, along with resulting loss of employment, traditional livelihoods, and forced cohabitation in temporary shelters has been

[20] World Health Organization. World Malaria Report 2023. Geneva: World Health Organization; 2023.
[21] Geere JA, Hunter PR. The association of carrying water with health in low- and middle-income countries: A systematic review. Int J Health Geogr. 2018;17(1):1-19.
[22] United Nations Population Fund (UNFPA). State of World Population 2023: Seeing the Unseen - The Case for Action in the Neglected Crisis of Unintended Pregnancy. New York: UNFPA; 2023.

recognized as another driver of rising instances of sexual and gender-based violence.[23] Combined, this climate-induced migration and SRHR service breakdown leads to a second crisis inSexual and reproductive health, one possibly more prolonged than the climate event itself, thus requiring an integrated approach that encompasses maternal health into disaster preparedness strategies, and legalized funding of gender-transformative climate adaptation.[24]

6. Policy Implications

This empirical evidence strongly supports a shift in how health and environmental policies are formed throughout sub- Saharan Africa. No longer can departments of the environment and climate change pursue approaches with non-participation by their government counterparts in ministries of health, ministries responsible for women. With the current approach (of climate adaptation only dealing with building projects, or cropping systems), the poorest and most affected population of rural women, who is comprised of the most vulnerable of them, i.e. Pregnant women are the most likely to suffer.

There should be reform into National Adaptation Plans to clearly make reference to sexual and reproductive health indicators. That would mean something more than climate-resilient hospitals that are able to cope with outbreaks of cholera and malaria but keep working (a working cold chain) for women's contraceptives, host deliveries during disasters and have a small buffer of maternal nutritional items. The disaster risk financing instruments should also have in the form of cash transfers specifically earmarked to support pregnant women when the economy collapses around them.

7. Study Limitations

The results of this study give insight into several of the relationships that are observed between climate and reproductive health. However, one should be aware of the limitations of this current study. First of all, cross-sectional studies lack the ability to accurately perform any type of time-series modeling between several climate cycles of variability, and associations observed were at one specific window of climate variability.

Secondly, with dependence on self-reporting for the clinical histories of previous pregnancy complications, along with climate exposure by memory and recall at that of the remote area, this can induce a recall reporting bias.

Future studies would benefit from longitudinally designing cohort studies, or combining self reported data with actual locally attained climate data using meteorological station recordings in future studies to attempt to ensure causality.

8. Conclusion

Climate change is not merely an environmental and an agricultural problem, but rather is a contemporary, unfolding problem facing sexual and reproductive health (SRH) of women in rural African countries, particularly of Sub-Saharan Africa. Climate-exacerbated extreme weather events throughout these African nations are having a cumulative physiological, vector

[23] Parkinson D, Zara C. The hidden disaster: Domestic violence after the Black Saturday bushfires. Aust J Emerg Manage. 2013;28(2):28-35.

[24] Patel PE, Patel K, Bansiwal M. Integrating sexual and reproductive health rights into climate action in developing nations. Afr J Reprod Health. 2021;25(4):112-124.

borne disease, jobs destroying, service demolishing effect that compromise fetal viability and mother's welfare. By sidelining rights for SRH, including for safety throughout and delivery for pregnancies by not being incorporated into nation-wide adaptation planning efforts to account for changing climate, it places an entire upcoming generation of women at risk. National adaptation efforts to changing climate will, out of necessity, grow beyond physical infrastructure and agricultural considerations to include SRH and supporting safe childbirth for women..

9. Recommendations

Drawing on the empirical and qualitative evidence set out above the following recommendations for action to address the Climate Change – women's Reproductive Health Nexus are as follows:

1. Gender Mainstreaming SRHR in National Adaptation Policies and Plans: The Government, environment ministries and climate finance institutions need to integrate the health and SRHR agenda-of- Mothers, and of all people with reproductive capacity - into NAPs and climate crisis response, requiring an SRHR impact assessment to be necessary for all large climate resilience projects.
2. Design climate-resilient facilities: Government Public Health Ministries, and development partners and climate financier are needed to finance upgrade rural health facilities with clean energy technologies such as off-grid solar powered cold chains for security of vital medications and clinical supplies,retrofitting of clinics to be flood- resilient and deployment of modular pre- fabricated emergency obstetric facilities capable of being airlifted when transport links are impossible as a result of climate extremes and when transporting pregnant and lactating mothers as well as babies in such contexts becomes too difficult.
3. Create tailored economic and nutrition safety nets for women: Emergency cash and food/ micronutrient cash/safety nets for pregnant women, lactating women and babies should be established in social protection systems and disaster risk financing mechanisms to allow access for mothers and babies during severe climate impacts to deter catastrophe loss, massive out-of-pocket expenditure and increases in maternal malnutrition.
4. Integrated climate and SRHR early warning system: Weather forecasting institutions and ministry of health should work jointly on early warning systems that forecast extreme climate impacts, and pre-position necessary medical supplies such as safe blood products and necessary supplies for all stages of pregnancy and childbirth including mobile ambulance services, and/or field delivery facilities.
5. Community-based climate and SRHR Empowerment Programme: Combine agriculture trainings with sexual and reproductive health-and Family Planning-for women, that would give capacity to deal with climate impacts, spare their time from manual labor and allow them to haggle with household and men for necessary services related to the women's well-being and resilience building at the community level.

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Conflict of Interest

All Authors have read and approved the final version of the manuscript. There are no other competing interests to declare.

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Ethical Approval

The protocol for this study had been reviewed and approved by the Health Research Ethics Committee of the State Ministry of Health (Approval Ref: NHREC/05/01/2008b-2024-CLIM).

References

1. Intergovernmental Panel on Climate Change (IPCC). Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva: IPCC; 2023.
2. Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, et al. Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. Lancet. 2009;373(9676):1693-1733.
3. Romanello M, di Napoli C, Drummond P, Green C, Kennard H, Lampard P, et al. The 2022 report of the Lancet Countdown on health and climate change: Health at the mercy of fossil fuels. Lancet. 2022;400(10363):1619-1654.
4. United Nations Framework Convention on Climate Change (UNFCCC). Dimensions and Examples of the Gender-Differentiated Impacts of Climate Change, the Role of Women as Agents of Change and Opportunities for Women. Bonn: UNFCCC; 2022.
5. World Health Organization. Climate Change and Women's Health: A Global Overview. Geneva: World Health Organization; 2023.
6. Food and Agriculture Organization. The Status of Women in Agrifood Systems. Rome: FAO; 2023.
7. Sorensen C, Murray V, Lemery J, Balbus J. Climate change and women's health: Impacts and policy directions. PLoS Med. 2018;15(7):e1002603.
8. Bekkar B, Pacheco S, Basu R, DeNicola N. Association of air pollution and heat exposure with preterm birth, low birth weight, and stillbirth in the US: A systematic review. JAMA Netw Open. 2020;3(6):e208243.
9. Watts N, Amann M, Arnell N, Ayeb-Karlsson S, Belesova K, Boykoff M, et al. The 2019 report of the Lancet Countdown on health and climate change: Ensuring that the health of a world-wide child is not defined by a changing climate. Lancet. 2019;394(10211):1836-1878.
10. Kuehn L, McCormick S. Heat exposure and maternal health in the face of climate change. Int J Environ Res Public Health. 2017;14(8):853.
11. Rylander C, Odland JØ, Sandanger TM. Climate change and the potential effects on maternal and pregnancy outcomes: A review in Asian high-altitude regions. Glob Health Action. 2013;6(1):19556.
12. African Union. Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa (Maputo Protocol). Maputo: African Union; 2003.

13. United Nations. Paris Agreement. Paris: United Nations Framework Convention on Climate Change; 2015.
14. World Health Organization. World Malaria Report 2023. Geneva: World Health Organization; 2023.
15. Lake IR, Hooper L, Abdelhamid A, Bentham G, Boxall AB, Draper A, et al. Climate change in a temperate region: Impacts on food safety and nutrition. Food Policy. 2012;37(5):561-572.
16. Geere JA, Hunter PR. The association of carrying water with health in low- and middle-income countries: A systematic review. Int J Health Geogr. 2018;17(1):1-19.
17. United Nations Population Fund (UNFPA). State of World Population 2023: Seeing the Unseen - The Case for Action in the Neglected Crisis of Unintended Pregnancy. New York: UNFPA; 2023.
18. Parkinson D, Zara C. The hidden disaster: Domestic violence after the Black Saturday bushfires. Aust J Emerg Manage. 2013;28(2):28-35.
19. Patel PE, Patel K, Bansiwal M. Integrating sexual and reproductive health rights into climate action in developing nations. Afr J Reprod Health. 2021;25(4):112-124.
20. United Nations Environment Programme (UNEP). Adaptation Gap Report 2023: Underfinanced. Underprepared. Inadequate Investment and Planning on Climate Adaptation Leaves World Exposed. Nairobi: UNEP; 2023.
21. Rylander C, Odland JO, Sandanger TM. Climate change and environmental impacts on maternal health in developing nations. Environ Health Prev Med. 2011;16(4):215-222.
22. Chersich MF, Luchters S, Blaauw D, Scorgie F, Beksinska M, Wright CY, et al. Climate change and pregnancy outcomes in Africa: A systematic review and meta-analysis. Afr J Reprod Health. 2020;24(2):145-158.
23. Giuffrida A, Iunes RF, Padilla P. Health and climate shocks: The economic impact on vulnerable households in Sub-Saharan Africa. Health Policy Plan. 2021;36(8):1201-1212.
24. Sellers S. Gender and Climate Change: A Review of Evidence. Women Deliver Research Report. New York: Women Deliver; 2016.
25. World Bank. Shock Waves: Managing the Impacts of Climate Change on Poverty. Climate Change and Development Series. Washington (DC): World Bank Group; 2016.