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A Discussion of the Effectiveness, Availability, and Sustainability of the Current Community-Based and Institutional Adaptation Tactics in Response to Climate-Health issues in Rural Installation

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Abstract
Climate change presents major and complex dangers to the health of human beings especially in rural environments where livelihoods, infrastructure, and health systems are mostly climate sensitive. The rural communities are disproportionately affected by climate-related health problems that include diseases transmitted by vectors, diseases caused by water, malnutrition, and heat diseases. To counter this, the community-based and institutional adaptation strategies have been adopted to alleviate these risks. This paper reviews how well, how accessible and sustainable are current adaptation measures to deal with climate-health issues in rural arrangements with specific reference to the developing country experience like that of Zambia. Based on the applicable theoretical perspectives and empirical knowledge, the article summarizes the evidence on the results of adaptation, determines the most critical strengths, gaps, and emphasizes contextual variables that lead to success or failure. The results indicate that although community-based approaches increase local ownership and contextualization, they are usually restricted by lack of resources and technical capacity. The institutional strategies, which have a wider scope, are challenged by the factors of accessibility, governance and sustainability. The paper ends by giving policy-based recommendations that will help to enhance integrated, equitable and sustainable climate-health adaptation in the rural setting.

Keywords: Non-Governmental Organizations (NGOs), Community-Based Adaptation (CBA), Zambia

1. Introduction

Climate change has become one of the most important worldwide societal health issues in the 21st century. Higher temperatures, changing rainfall, extreme weather conditions and ecological disturbances have compromised health because rural settings are mostly reliant on natural resources and limited access to health services (WHO, 2021) [9]. Climate-health issues in rural sub-Saharan Africa, such as Zambia, arise due to the spread of malaria, diarrheal diseases caused by water shortage and flooding, food insecurity, and heat stress (Phiri *et al*., 2022) [7].

To these challenges, there have been various adaptations strategies that have been adopted at the community level and institutional level. CBA strategies focus on local knowledge, local involvement and local resiliency, whereas institutional adaptation strategies are often driven by governments, non-governmental organizations (NGOs), and development partners in terms of policies, programs and infrastructural investment (Adger *et al*., 2019) [1]. There are still questions about the efficiency, availability and sustainability of these policies in rural settings despite their increasing use.

The article is thus aimed at assessing the current community-based and institutional adaptation methods used to address climate-health issues in rural contexts. In particular, it explores the effectiveness of these strategies to be used in decreasing the health vulnerabilities, how well the rural population can utilize them, and their long-term sustainability. The analysis is especially applicable when reflecting on the rural Zambia where variability of climate has been the source of undermining the gains of the populace and development.

2. Theoretical Framework

The article is informed by Vulnerability and Resilience Framework, which is supplemented by Community-Based Adaptation(CBA) Theory. The conceptualization of climate-health outcomes within the Vulnerability and Resilience

Framework is grounded on the exposure, sensitivity, and adaptive capacity (IPCC, 2022) [3]. Because of poverty, poor infrastructure, and health amenities, rural populations can be very sensitive and exposed to climate risks, and, as such, adaptive capacity should be seen as a decisive factor of health outcomes.

The Community-Based Adaptation Theory highlights the importance of local communities as proactive agents to identify the risks, respond and adopt effective adaptation strategy based on indigenous knowledge and social capital (Reid *et al*., 2020) [8]. In this view, it is quite effective and sustainable that local adaptation strategies should be self-owned, culturally aligned and inclusive.

The Health Systems Strengthening Theory is also applicable at the institutional level. According to this theory, good governance, adequate funding, trained human resource, and strong service delivery constitute resilient health systems that are important in responding to health shock associated with climatic conditions (Kruk *et al*., 2018) [4]. Collectively, these theoretical lenses offer the overarching foundation of the assessment of the strategies of adaptation concerning their effectiveness, accessibility, and sustainability.

3. Literature Review

Climate change has steadily been identified in empirical research as a significant factor driving population health outcomes especially in rural environments of developing nations where the adaptive capacity is still low. The rural communities are the most affected due to the fact that their lives mostly rely on climate, the health infrastructure is underdeveloped, and poverty restricts their ability to deal with the problem (IPCC, 2022) [3]. There is a consistent pattern that empirical research indicates that climate variability and extreme weather events develop on underlying socio-economic vulnerabilities to increase the health risk to widen rural-urban health disparities (WHO, 2021) [9].

An impressive amount of literature associates climate change with the rebirth and spatial proliferation of the vector-borne diseases, in particular, malaria in rural Africa. Malaria is one of the most frequent morbidities and deaths in Zambia, and the patterns of transmission are highly affected by the variability of rainfalls, rising temperatures, and the humidity (Musonda and Chanda, 2021) [6]. Heightened rainfall forms stagnant water pools as a habitat of anopheles mosquitoes, and an increase in temperature reduces the incubation time of parasites and intensifies the transmission (Munyati *et al*., 2022). Similar evidence has been noted in neighbouring states like Malawi, Tanzania and Zimbabwe, where ecological changes related to the climate have modified malaria epidemiology in the countryside (Kibret *et al*., 2020; Mboera *et al*., 2021). These reports bring to light the fact that rural communities, especially subsistence farmers and those children under the age of five years are at greater risk of exposure because of the inadequate housing, inaccessible preventive devices and ineffective surveillance systems.

Other than malaria, climate change has also been empirically linked to a higher burden of waterborne and food-borne illnesses in the rural environment. Droughts decrease the availability of clean drinking water, making people resort to using unsafe water sources, and floods usually pollute the water sources with human and animal waste (Mulenga *et al*., 2020) [5]. Extreme rainfall and insufficient sanitation facilities have also contributed to the outbreaks of cholera, dysentery and diarrhoeal diseases in rural Zambia (Tembo and Simukonda, 2021). Similar findings are demonstrated by international studies that indicate that climate-induced flooding in rural areas in South Asia and Sub-Saharan Africa leads to a significant rise in the incidence of diarrhoeal disease among women and children, where the main burden of water collection and household hygiene is placed (Levy *et al*., 2021).

Nutritional outcomes and food security are other determinants of health in the rural settings that are influenced by climate variability. The empirical data of Zambia shows that frequent droughts and unforeseeable rainfall regimes have decreased crop production, which resulted in incessant food shortages and undernourishment among rural families (Mulenga *et al*., 2020 [5]; Sitko *et al*., 2021). Under nutrition causes a weakened immune system making people vulnerable to infections and compromising the growth and development of the child. These results are supported by studies conducted in Ethiopia, Mozambique and Kenya, which show that there are strong relationships between climate shocks, decline in agricultural productivity, and prevalence of stunting and wasting among rural populations (Hirvonen *et al*., 2020; Grace *et al*., 2022).

As a response to these climate-health issues, there is an increased literature on the application of community-based adaptation (CBA) to rural environments. Adaptation in communities is based on the principles of participatory that requires focus on local knowledge, social capital, and community ownership of the adaptation process (Reid *et al*., 2020) [8]. In rural Zambia, the strategies implemented by CBA have involved the creation of health volunteers at community level, encouragement of household water treatment, application of early warning systems in floods and droughts, and integration of climate-sensitive agricultural practices in order to enhance food security (Phiri *et al*., 2022) [7].

Empirical observations indicate that community health volunteers are very important to bridge the gaps between formal health systems and remote rural communities. They help in health education and disease surveillance, as well as in prevention methods like the use of mosquito nets and sanitation as these volunteers offer (Zulu *et al*., 2023) [10]. A study in Eastern and Northern Provinces of Zambia reveals that communities that have active volunteer networks are less likely to report poor health-seeking behaviour and low rates of adopting malaria prevention strategies (Musonda and Chanda, 2021) [6]. The same results are witnessed in rural Uganda and Ghana where community health workers have increased the detection and reaction to climate-sensitive illnesses earlier (Ochieng *et al*., 2021).

The second key pillar of community-based adaptation practices is improved water, sanitation and hygiene (WASH) practices. According to the literature, inexpensive solutions, including borehole protection, rainwater harvesting, and community-led total sanitation, have helped in the decrease of the cases of diarrhoeal diseases in the rural settings (Tembo and Simukonda, 2021). But the cost of maintenance, inadequate technical expertise, and institutional support may frequently put the sustainability of such interventions into question (Phiri *et al*., 2022) [7]. International studies also warn that, though community-led WASH programs are short-term success stories, success in the long run is reliant on sustained training, funding and

incorporation with local government systems (Cumming *et al*., 2019).

Older coping mechanisms also play a significant role in the knowledge base on the rural climate-health adaptation appearing as long-standing coping systems where rural populations have historically sought to cope with climate variability and the health effects of climate variability such as food preservation, crop diversification, labour forms of community, and the use of indigenous environmental and weather forecasting knowledge to protect their livelihoods, food security, and health outcomes.

4. Findings

The assessment of the current community-based and institutional adaptation measures demonstrates both positive and situation-specific results in managing the climate-health issues in the rural areas. As the results show, although adaptation measures have produced quantifiable benefits in some aspects, the overall effectiveness, accessibility, and sustainability of adaptation measures are limited by the factors of structure, economy, and governance. These are the results of more global trends in the rural health adaptation literature, especially in low and middle-income states like Zambia where climate vulnerability and poverty are combined with poor infrastructure and institutional capacity.

Community-based adaptation strategies prove to be especially powerful in raising awareness about health risks associated with climate change and encouraging preventive health behaviours at the family and community level in terms of their effectiveness, in turn. Evidence based on rural districts in Zambia show that the community-based programs like malaria prevention campaigns, environmental sanitation, and participatory water management- have led to the decreases in the disease incidence and the health-seeking behaviour (Musonda & Chanda, 2021; Phiri *et al*., 2022) [6, 7]. What makes these strategies effective is the fact that it is based on the local knowledge systems and execution of the same by the use of the trusted community structures, such as traditional leaders, community health volunteers, and local committees. These participatory strategies also increase the community contentment and adherence, which is important in behavioural change at the rural level.

Community-based malaria control programs illustrate a good example of this efficiency. Research indicates that in regions where populations participate in the distribution of mosquito nets, the management of the environment, and health education, the prevalence of malaria is reduced at a greater rate than in regions where such intervention is externally developed (Musonda and Chanda, 2021) [6]. On the same note, community-based water sources and sanitation programs have also been linked to the decreased outbreak of diarrhoeal diseases after a flood or dry season (Tembo and Simukonda, 2021). These results align with the existing evidence of the international community that community engagement can increase the relevance and adoption of climate-health-intervention, especially in rural areas that lack formal health coverage (Reid *et al*., 2020; WHO, 2021) [8, 9].

Even so, in spite of these good results there is unequal effectiveness of community-based strategies and in many cases, they are small. The biggest obstacle is financial constraint since most of the initiatives depend on short-term donor funding or project-specific funding that does not enable expansion and sustainability (Phiri *et al*., 2022) [7]. A lack of efficiency is also fostered by technical constraints, especially in such fields where specialized skills are needed (like climate forecasting, water infrastructure, and disease monitoring). Consequently, although this has led to the realization of physical health gains in some communities, other communities are very susceptible because of uneven implementation and unequal distribution of resources in rural areas.

The strategies of institutional adaptation have mixed results as compared to their intended purposes. On the policy level, the incorporation of climate in the national health and development systems has enhanced the visibility of the climate-health nexus and advanced the planning processes (Government of Zambia, 2021) [2]. The meteorological-linked disease surveillance systems have improved early warning of malaria and cholera outbreaks in some districts, and subsequently respond quicker to events of extreme weather patterns (Zulu *et al*., 2023) [10]. Incremental changes of service delivery have also been achieved through investments in rural health posts, mobile outreach services, and emergency preparedness.

However, there is still little translation of the institutional commitments in meaningful health outcomes at the rural community level. Some of the studies identify implementation gaps due to insufficient funding, lack of skilled health staff, and poor sectorial coordination including health, water, agriculture and environment (Kruk *et al*., 2018; Zulu *et al*., 2023) [4, 10]. Such difficulties diminish the effectiveness of institutional strategies in practice especially in remote rural regions where the effects of climatic change are the worst felt. The same is observed in international literature, where top-down methods of adaptation are frequently unable to reach the desired results because the local context and capabilities are not taken into account adequately (Bene *et al*., 2018).

One of the factors that become a limiting issue is accessibility particularly when it comes to institutionally driven strategies of adaptation. The geographical challenges that rural populations most often encounter include long distances to health centers, inappropriate road networks, and a lack of transport because of which rural populations do not always have access to climate-resilient health services in a timely manner (Zulu *et al*., 2023) [10]. Such physical barriers are enhanced by financial limits such as the user charges, cost of transport, and opportunity costs of time off farming or informal jobs. As a result, they can become virtually unavailable even in the presence of institutional services to the neediest households.

The barriers are also informational, thereby restricting access. Climate-health programmes, early warning mechanisms, and messages about the health of the people are not universally distributed in a format that is not only readable by the rural less-learned population but also accessible to digital devices (WHO, 2021) [9]. Research in Zambia suggests that community messages about flooding or epidemic outbreaks do not always reach remote communities in time to be useful in preventing those (Phiri *et al*., 2022) [7]. These results are correlated with other studies conducted at the international level, which indicate that the lack of proper communication channels can diminish the equity and effectiveness of institutional strategies of adaptation to rural communities (Levy *et al*., 2021).

There is also a spatial inequity in climate-related infrastructure investments which have accessibility implications. The upgrades of health facilities, water supply and sanitation facilities are often concentrated in urban or peri-urban areas where the cost of implementation is lower and the political visibility is greater (Zulu *et al*., 2023) [10]. Such urban bias enhances the marginalization of the rural and restricts the scope of the institutional adaptation. Although mobile clinics and outreach services are trying to close such gaps, they are still inadequate compared to the magnitude of the climate-health issues affecting the rural population.

Adaptation strategies at a community level are usually more convenient to the rural dwellers as they are integrated into community social and geographical background. Community meetings, household visits by volunteers, locally managed water and sanitation activities are some of the activities which ensure that people do not have to travel long distances and spend money. Nonetheless, the results show that the accessibility in communities is not homogeneous. The adaptation initiatives are affected by social and cultural considerations where disadvantaged groups, such as women, elderly, persons with disabilities, and female-headed households, tend to be hindered in joining and making decisions (Tembo and Simukonda, 2021). Utilizing gender norms, e.g. women may have fewer resources and options to make adaptations, even though it would be their primary concern in terms of health and managing water in the household.

Concerning sustainability, community-based adaptation strategies manifest a comparatively high potential in long-term continuity because of local ownership, social solidarity and the use of local knowledge structures. Whenever communities feel that the interventions are relevant and rewarding, they would continue to embrace practices that include sanitation improvements, diversification farming and arrangements of communal labour despite external aid being withdrawn (Phiri *et al*., 2022) [7]. In this respect, social capital is of the crucial importance, because collective action helps communities to mobilize resources and assist vulnerable individuals in times of climate crisis and improves physical and mental health outcomes.

Nevertheless, the sustainability is jeopardized when community based efforts are over-reliant on external resources like charitable funding, technical apparatus or other financial compensation to volunteers. The termination of foreign aid is likely to result in the failure of the monitoring systems, infrastructure maintenance, and incentive of the community health actors (Reid *et al*., 2020) [8]. In addition to this, the growing rate and severity of climate shocks can exceed the conventional coping resources, and more robust institutional support is necessary to maintain community resilience (IPCC, 2022) [3].

The institutional adaptation strategies are more sustainable in theory since they are integrated in formal governance frameworks and in the systems of the publicly funded health. As a matter of fact, though, sustainability is compromised by discontinuity of policy, constant change in political priorities, overdependence on donor funding (Kruk *et al*., 2018) [4]. The climate-health programs are not usually carried as an integrated project but may be part and parcel of the regular routine health system planning and budgeting programs, and are therefore subject to budgetary cycles and administrative transitions. Poor inter-sectorial coordination also constrains sustainability because a successful climate-health response means that various sectors should be able to work together in a sustained way.

In general, the evidence suggests that although both community-based and institutional adaptation techniques are effective in solving the climate-health issue in rural areas, they are limited in their effectiveness, availability, and sustainability due to systemic constraints and systemic inequalities. Community based strategies are superior in terms of their contextual relevance and accessibility, but institutional strategies offer the much needed scale and policy support. Their integration however is lacking and this makes their combined effect less effective. Solidifying the synergies between community and institutional adaptation strategies reinforced by stable funding, inclusive governance and integrated planning is critical towards improving the resilience of the rural to climatic health risks in Zambia and other related situations.

5. Conclusion

The research measured the efficacy, access, and maintenance of present community-based and institutional adaptation solutions applied in reaction to climate-health issues in the rural land. The results prove that even today climate change can be described as a threat to rural health systems, livelihoods and wellbeing with multidimensional and severe effects due to socio-economic vulnerability being overlapped by inadequate infrastructure and low adaptive capacity, especially in the context of the developing countries like Zambia. Community-based and institutional adaptation strategies are vital in addressing these challenges, but their findings are skewed and limited by the structural and governmental constraints.

The adaptation strategies based in communities have been demonstrated to be especially useful in increasing the awareness of the health impact of climate risks, preventing health behaviours, and improving local resilience. Their basis on indigenous knowledge systems, social networks, and participatory processes make them more acceptable and relevant in the rural communities. Community-led malaria prevention, sanitation enhancement, climate- smart agriculture, and traditional coping practices are among the initiatives that are of significance in mitigating disease incidence as well as enhancing food and water security. Nevertheless, the success of these strategies is usually local, small-scale because of financial limitations, technical limits and reliance on foreign donor funding.

The national policies, the disease surveillance systems, development of health infrastructure, and social protection programmes are the key strategies of institutional adaptation that can offer the necessary systemic support in response to the climate-health risks. Such measures have increased the policy awareness of climate-health interactions and enhanced preparedness and response to some rural districts. However, their reality at the community level is often compromised with the weaknesses of accessibility, insufficient funding, poor inter-sector coordination, and urban bias of resources distribution. Consequently, this has left a large number of rural populations out of climate-resilient health services and infrastructures.

The issue of accessibility has become a common problem in both forms of adaptation. Rural populations are held back by geographic isolation, poverty, lack of transport networks and dissemination of information which limits the capacity of

rural communities to access institutional programmes. Although in most cases community-based strategies are more available, intra-community disparities on gender, age, disability, and social-economic status still determine individuals who perceive and gain access to adaptation programs. Such inequalities erode the notion of inclusive adaptation and limit the resilience in general.

Community-based strategies demonstrate promising results in terms of sustainability because they are owned locally and can be socially cohesive, but they are susceptible to the loss of external assistance, as well as the aggravation of climate extremities. The so-called institutional strategies, which are theoretically more long-lasting, are undermined by the dependence on the donors, policy inconsistency, and lack of integration into the regular planning of the health system. In general, the results highlight the fact that both community-based and institutional strategies cannot be used separately. Localized solutions that would involve integrating of local knowledge and engagement with high-level institutional endorsement, consistent funding, and coordinated governance are the only methods that can make the use of rural areas effective, accessible, and sustainable to climate-health adaptation. It is necessary that these synergies are strengthened to protect rural health and development against the increasing climate change.

6. Recommendations

Strengthening community-based and institutional adaptation strategies: Integration between community-based and institutional adaptation strategies can be strengthened by engaging community in the process of planning and co-designing climate-health interventions.

- Heavy domestic investments and investments in climate-health adaptation to decrease the dependence on the short-term donor funding and improve the sustainability.
- Increase and spread climate resistant health facilities in rural communities such as health posts, water and sanitation facilities fairly.
- Increase the ability of building capacity to community health volunteers by ensuring continuous training, supervision and provision of relevant incentives.
- The improvement of the climate-health information systems through the integration of indigenous knowledge and scientific early warning systems in rural settings is recommended.
- Improve accessibility obstacles through enhancing rural transport systems, mobile health outreach initiatives and locally-based interventions.
- All climate-health adaptation programmes are mainstreamed with respect to gender issues, disability, and social inclusion to make the benefits equitable.
- "Inter-sectorial coordination between health, water, agriculture, environment, and social protection sectors on the national and local levels should be strengthened.
- Institutionalize climate health adaptation among normal health system planning, budgeting and monitoring systems.
- Facilitate the community ownership and accountability systems to improve the long-term sustainability and resilience of the adaptation programs.

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