

Assessing policy linkages and collaboration in response to climate change extreme weather events in Malawi. A case of the agriculture, environment, and health sectors

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Abstract

Background

Climate change has affected sectors that directly or indirectly influence the social determinants of health globally. In Malawi, the negative effects of climate change have been observed in the health, agriculture, and environment sectors. Floods destroy health facilities, exacerbate the spread of infectious diseases, and prolonged drought results in food insecurity and malnutrition. This study was conducted to assess linkages and mainstreaming of climate change themes in agriculture, environmental, and health sector policies in response to climate change extreme weather events in Malawi

Methods

Two methodological approaches were used in this study. At first, a review of the agriculture, environment, and health sector policy documents was conducted using a systematic approach to policy document review, READ (Ready, Extract, Analyse and Distil). In total, 44 policy documents were screened, and seven were included. Data were read, extracted, analysed, and distilled to assess policy linkages. Then, key informant interviews were conducted with policymakers at the national level and policy implementers at the district level for an in-depth understanding of policy linkages and implementation.

Results

In total, seven policy documents were included in the review, and thirteen key informant interviews were conducted. Four combined themes were generated from both the policy document review and key informant interviews. The emerging themes include policy development process, mainstreaming climate change themes, health-related response strategies, and policy linkages across sectors. Overall, the policy development process was similar across sectors, and climate change themes are present in all policies. Climate change themes have been mainstreamed, and all policies have health-related response strategies. The document analysis revealed cross-linkages between policies in agriculture and health, agriculture and the environment, while environmental policies are not linked to health. Policymakers were well conversant with policy linkages, unlike the implementers.

Conclusion

There is a positive policy response in addressing the effects of climate change across the three sectors. Only environmental sectors formulated climate change-specific policies, while the other sectors integrated climate change themes into policies formulated in response to other problems. Furthermore, all three sectors include health-related response strategies in their policies to promote social well-being among the population. Even though some sectoral policies have been cross-referenced, there are partial

sectoral policy linkages with implementation gaps and insufficient coordination, which require attention to ensure effective multisectoral response to climate change events.

Contributions to the Literature

- Presents one of the first focused syntheses of empirical evidence on policy linkages and collaboration among three sectors: agriculture, environment, and health in response to climate change-induced extreme weather events in Malawi.
- Identifies policy linkage and collaboration gaps in the policy development process, health-related response strategies, policy linkages and mainstreaming of climate change themes, and implementation coordination challenges across three sectors that are directly influencing social determinants of health in Malawi.
- Identifies a level of policy understanding that distinguishes between policymakers and implementers, showing that existing evidence predominantly reflects inadequate engagement between the national and district-level policy actors.
- Provides a replicable model and framework for analyzing policy linkages among sectors, supporting future planning, integration, and mainstreaming of national policies developed to address emerging health problems faced by the community.

Background

Climate change (CC) is affecting health outcomes negatively and requires an immediate policy response worldwide. It has affected many sectors that directly or indirectly influence the social determinants of health, including agriculture, veterinary, the environment, and health [1]. CC-related extreme weather, such as drought, reduces crop yields and food supply, leading to acute food shortages that increase malnutrition, wasting, and stunted growth among children [2, 3, 4]. On the other hand, CC alters the environment, creating opportunities for the emergence and re-emergence of new diseases that threaten many lives globally [5, 6, 7]. It is disrupting the ecosystem, influencing the spread of zoonotic diseases and altering the dynamics among host, pathogen, and vector populations, thereby increasing health risks for humans [8, 9]. Environmental alterations, such as temperature and humidity fluctuations, precipitation, drought, and floods, exacerbate the transmission of infectious diseases, vector-borne diseases, and parasitic infections, affecting both humans and animals [10]. The Intergovernmental Panel on Climate Change (IPCC) recognizes the interdependence among health-defining sectors, such as agriculture, the environment, health, and veterinary medicine, which requires a holistic approach and the integration of policy responses for comprehensive management [11].

Many CC-related health risks stem from multiple interacting factors, and effective responses should account for existing relationships between health and other relevant sectors [12]. Furthermore, for health systems to thrive and respond effectively to the effects of CC, it is vital to integrate related disciplines by

linking sectoral policies for better coordination [13]. CC response strategies, which focus on preventive and adaptive measures to mitigate their magnitude, timing, and public health risks, can be achieved through proper policy linkages and collaborative efforts during implementation [14]. This can be enhanced by applying systems thinking, which requires a holistic approach when addressing and managing a health problem [15]. In the case of CC response, systems thinking requires linking policies across all sectors that influence social determinants of health.

The World Health Organization (WHO) defines policy linkage (PL) as the systematic promotion of mutually reinforcing policies across government departments to create synergies that achieve objectives addressing negative spillovers in other policy areas [16]. It involves linking and mainstreaming policies across different sectors and levels of government to achieve health goals and objectives [17]. Furthermore, it ensures that emerging public health issues are integrated into other sectors that influence health outcomes. Moreover, PL enables the mainstreaming of CC response strategies across governance levels and sectors, promoting an effective and efficient use of resources through multi-sectoral collaboration [18].

Malawi is among the Sub-Saharan African countries that have been affected by extreme weather events due to CC. The 2014 World Bank report indicates that the country is vulnerable to CC extreme events, such as dry spells, seasonal drought, intense rainfall, floods, and disease outbreaks [19]. The impact of CC is more pronounced in the agriculture, health, and environmental sectors, which directly affect the population's social and health status. For instance, between the years 2022 and 2023, the country experienced the worst cholera outbreak associated with CC, which claimed over 1,768 lives, representing a case fatality rate of 13.3% from 58,979 reported cases [20, 21]. In addition, during the 2024 rainy season, the country faced El Niño weather conditions characterized by late onset of rain and prolonged dry spells, which lowered food production, particularly in the southern and central regions of the country, subjecting many people to starvation and high malnutrition among the majority of children from poor families [22].

Recently, the Government of Malawi, through the Ministry of Health, adopted the One Health (OH) approach [23]. It focuses on a collaborative, multi-sectoral, and trans-disciplinary approach that aims to achieve optimal health outcomes by recognizing the interconnection between people, animals, plants, and their shared environment [23]. Furthermore, the OH emphasizes the health, veterinary, and environmental interactions and existing relationships, which are social determinants defining sectors for health [23]. In addition, it is worth noting that CC is among the challenges that the OH approach explicitly aims to address worldwide [24]. However, since the Malawi Government committed to the IPCC to reduce the effects of climate change [25] and adopted OH, no study has been conducted to explore the multi-sectoral policy linkages among the social determinants sectors of agriculture, health, and environment to minimize and respond to the effects of CC. Therefore, this study was conducted to assess the inter-sectoral policy linkages among the agriculture, health, and environment sectors. Specifically, the study explored policy development processes, climate change mainstreaming in the policies, health-related response strategies, and the implementation plans across the three sectors.

Methods

Study design

This was an exploratory, qualitative study design involving two approaches that applied systems thinking. At first, document review was conducted, followed by in-depth interviews with purposively selected key informants. Policy documents from the agriculture, environment, and health sectors were reviewed. These sectors were chosen because they provide functions that directly influence social determinants of health and have been affected by CC. In Malawi, the agriculture sector also encompasses veterinary as a department. This was then followed by interviews conducted with the Key Informants.

The study area settings

The study was conducted in Malawi, encompassing two districts, Blantyre and Phalombe, as well as at the national headquarters in Lilongwe. The two districts were chosen as they were heavily affected by Cyclone Freddy in 2023. The two districts are located in the southern region of Malawi. Blantyre is one of three major city districts, while Phalombe is a rural area.

Selection of policy documents

Lists of all policies were obtained from the ministries of agriculture, environment, and health, formulated between 2015 and 2025. This period was chosen because the Government of Malawi first committed to reducing greenhouse gas emissions and scaling up CC adaptation actions in 2015 [26]. To access the full document, we searched the websites of the targeted ministries and requested hard copies of policies that were not published online. Each policy was screened for the availability of CC health-related strategies and response plans.

The inclusion criteria were national health policies formulated between 2015 and 2025, with themes such as climate change, floods, droughts, cyclones, other extreme weather events, and health. All policies without climate change and health-related themes formulated before 2015 were excluded.

Data analysis framework

The policy document review was conducted using Dalglish et al. (2020) 's systematic approach to policy document review, the READ [27]. The word READ stands for (i) R-ready your materials, (ii) E-extract data, (iii) A-analyse data, and (iv) D-distill your findings.

1. Ready your materials

Based on the study objectives, 44 policy documents were screened for eligibility, and those with CC themes were included for further screening. Seven out of the 44 policies were included in the final review: 3 from agriculture, 3 from health, and 1 from environment (Fig. 1). The included policies were read multiple times to understand the policy development process, mainstreaming of CC issues, response strategies, and linkages across the three sectors.

2. Extraction of data

An Excel spreadsheet was created with rows and columns categorized by policy name, implementing years, responsible ministry, development processes, CC mainstreaming issues, response strategies, and implementation linkage across sectors. The authors independently extracted data manually and compared the results. Overall agreement between the authors after review was at 96%, and the remaining 4% was resolved through discussion to reach consensus.

3. Analysis of data

The extracted data were synthesized and analysed, guided by the review's overarching main aim and objectives. The analysis approaches considered were content analysis, cross-mapping references, and policy linkage analysis. A descriptive content analysis [28] was conducted to understand patterns, themes, and intents surrounding the definitions of linkages and interaction, specifically CC and health linkages, as discussed in policy documents. Descriptive content analysis provided an in-depth understanding of how policies for these health-related sectors were linked and interacted during implementation. This process was carried out independently by the two authors, who compared and discussed the results for the final analysis.

4. Distil the findings

The review was completed after data were extracted from all selected policy documents. The reviewers independently completed the process, later discussed the final results, and reached a consensus.

Key informant interviews

A purposive sampling technique was used to select participants who were deemed to have adequate knowledge of policy formulation and implementation processes. With respect to the approach by Francis et al (2010), a minimum initial sample size of 14 participants was targeted [29]. However, after the thirteenth interview, no new ideas emerged from the respondents (data saturation point was reached). Informants were identified through personal and professional networks with the Ministries of Health, Agriculture, and Environment at the national and district levels. The snowballing technique was used during the interviews to identify the respondents by asking experts to nominate the next informant in the same sector.

Data analysis

The data analysis was conducted following the six steps of thematic analysis by Braun and Clarke (2006) [30]. The transcripts were read multiple times to become familiar with the data patterns. The main ideas were isolated to form initial codes. We developed a codebook based on the topics in the developed interview guide. The initial codes were sorted to identify themes and sub-themes. Furthermore, the identified themes were refined, defined, and named to provide the aspects of data each theme represented. The themes were grouped and categorized in line with the objectives to give the final results. Verbatim quotes from participants in each theme represent emerging issues that were selected, identified, and included in the final results [31]. To ensure study trustworthiness, transcription was conducted independently by the two authors, and they later worked together to refine and name the themes. To ensure credibility, preliminary findings were shared and validated with four key informants.

Ethics

This study received two ethics clearances. The first clearance was approved by the Biomedical Research Ethics Committee (BMREC) of the University of the Western Cape, reference No **BM24/9/6**. The second clearance was approved in Malawi by the National Health Sciences Research Ethics Committee, review No **4543**.

Results

Socio-demographic characteristics of the informants

A total of thirteen informants participated through face-to-face interviews (n = 4) and telephone interviews (n = 9). The distribution of the policymaker informants was agriculture (n = 2), environment (n = 2), and health (n = 3). The distribution of policy implementer informants was agriculture (n = 2), environment (n = 2), and health (n = 2) (Table 1).

Findings from document review

In total, seven policy documents were analysed: three from agriculture [32, 33, 34], one from the Environment [35], and three from health [36, 37, 38]. Through content analysis, and in line with the study objectives, four themes were developed from the analysed policies (Table 2).

1. Policy development process across sectors

The content analysis revealed that policy development and formulation across sectors followed a multi-stage process [32, 33, 34, 35, 36, 37, 38]. It starts with identifying the problems that the policy aims to address. This involved a wide consultation with stakeholders at all levels. The stakeholders involved were community members, implementing partners, politicians, members of the clergy, international donors, and organizations. However, the consultation process differed across sectors, with some employing a bottom-up approach and others a top-down approach. The consultations were conducted to

ensure that stakeholders' views were included and placed on the agenda. The analysis further revealed that policy formulation is an interactive process, as various stakeholders were invited to review the developed policies to ensure that all information gathered during consultations was captured. The development of the policies also included implementation plans and the formulation of monitoring and evaluation indicators.

2. Mainstreaming climate change across policies

Mainstreaming climate change into policy involves integrating emerging issues, such as adaptation and mitigation plans, into policy thematic areas, responding to their effects, and minimizing their impact. Although the majority of the policies analyzed (6 out of 7) [32, 33, 34, 36, 37, 38] were not specifically developed in response to climate change impacts, this review shows that climate change themes were included in the analyzed policies. The available policy priority areas were aligned with the main agendas of the three sectors, reflecting their commitment to address the challenges emerging from climate change. For instance, the National Agricultural Policy (NAP) [32] framed its climate change theme to reduce land degradation, soil fertility decline, and adverse effects among all categories of farmers, including youth, women, and vulnerable groups. On the other hand, the National Population Policy (NPP) [36] focuses on adaptation to the consequences of climate change as its main theme. At the same time, the National Environmental Health Policy (NEHP) [38] indicated air quality and climate change as its theme. The analysis also reveals that the policy goals and objectives were structured and aligned with the policy themes.

3. Climate change health-related response strategies across policies

Although some of the policies analyzed were from sectors other than health [32, 33, 34, 35], all policies reviewed contain strategies aimed at improving population health. The strategies were further grouped into two: direct and indirect health-related strategies. The direct health-related strategies were those whose outcomes, once implemented, will promote the health status of the communities [32, 37, 38]. For instance, NAP [32] has a strategy to increase nutrient intake for food diversification among household members. The NEHP [38] had a strategy focusing on reducing the impacts of public health emergencies and climate change effects on population health. This analysis revealed that indirect strategies were developed to influence the social determinants of health by promoting the population's social well-being [33, 34, 35, 36]. For instance, the National Health Policy (NPP) [36] has a climate change strategy to enhance mainstreaming and integration of climate change adaptation and resilience in sexual and reproductive health and rights, population, and development programming. National Climate Change Management Policy (NCCMP) [35] has a strategy that encourages women, girls, and other vulnerable groups to be involved in planning and implementing climate change adaptation interventions. Furthermore, the NEHP [38] health strategy aims to mitigate the adverse impacts of climate change and variability, thereby reducing air pollution and greenhouse gas emissions.

4. Linkages across policies

The content analysis of linkages (cross-referencing) across sectors revealed that some policies (6 out of 7) [32, 33, 34, 36, 37, 38] were linked to one another (Fig. 1). Only NCCMP [35] from the environment sector was not linked to health sector policies. NAP [32] indicated that the environment sector will be responsible for initiating equitable land pooling or consolidation of land parcels among community members, allowing smallholders to benefit from economies of scale through the agricultural mechanization and commercialization agenda. It also indicated that the health sector will promote initiatives to safeguard nutrition, targeting the vulnerable population. Analysis of NHP [37] revealed a linkage with the environmental sector to ensure the safety of employees and communities working and living within and around the mines and other environmentally hazardous areas. It is also linked to the agricultural sector to develop and implement policies and plans to ensure adequate, reliable, and nutritious food supply.

Findings from the key informants

Through in-depth interviews with KIs, four themes were generated. The themes were similar to those generated from the content analysis of the document review. These include the policy development process, mainstreaming climate change issues across policies, climate change health-related response strategies across policies, and implementation linkages across sectors at the district level.

1. Policy development process

Participants reported that policy formulation and development are initiated at the national level across all sectors analyzed. They indicated that it is influenced by the availability of data, which provides evidence on the magnitude of the problem. The KIs further reported that during the development and formulation of policy, districts are consulted for their inputs. These stakeholders include officers at district councils, traditional leaders, politicians, and non-governmental organizations found at the district level. A policymaker reported that:

“Ministry does initiate formulation of policies whenever required, and whenever the ministry plans to formulate a new policy, we always consult stakeholders for their inputs at the early stage of the policy formulation,” (Policymaker, informant # 2).

Participants reported that the decision to formulate policy is influenced by factors such as the availability of data that show the magnitude of the problem and its effects on population health. An informant reported:

“Normally, decisions to formulate policies are initiated after presentation of enough evidence through the availability of data that tells the magnitude and how the population has been affected,” (Policymaker, informant # 5).

However, the policy implementers were not sure about the policy formulation consultation process. They showed a lack of knowledge about whether it is a bottom-up or top-down approach. The key informant reported that:

"We are sometimes invited to a workshop for policy consultation, either within the district or outside the district, but it is difficult to tell if districts are the first ones to be considered for our inputs." (Policy implementer, informant # 6).

The policymaker further revealed the lack of nationwide consultation. The majority of them reported that during consultations, not all districts are involved, and the availability of funds dictates the process. They further mentioned that district representatives are sampled during consultations. An informant reported that:

"We just sample district representatives; for example, we can invite a traditional authority from district A, then from district B, we invite someone else, like a member of parliament. So not all are consulted, as we sample some districts to be consulted." (Policymaker, informant # 5).

2. Mainstreaming climate change across policies

Almost all KIs (11 out of 13) indicated that policies were not specifically formulated in response to the effects of extreme climate events. They reported that climate change issues were incorporated into the policies by considering the challenges faced. An informant reported that:

"Aaaah, the policies we have were not specifically developed for climate change challenges, but climate change issues were included as one of the challenges the policies try to address," (Policymaker, informant # 1).

Another key informant from the health sector emphasized that:

"We don't need a separate policy on climate change, but just include it in the already existing policies during review. What we are trying to do is to integrate services so that one package can have several interventions," (Policymaker, informant # 7).

Only one sector (Environment) formulated a policy in response to climate change challenges. This was done to guide the nation in managing environmental issues to reduce the impact of CC. According to our respondent, the Climate Change Management Policy is considered a blueprint and the first policy to be formulated in response to CC in the country. An informant reported that:

"We have a climate change policy that addresses a wide range of issues, and it guides different sectors on what to do. It is the first climate change-specific policy in Malawi," (Policymaker, informant # 3).

The policy implementers demonstrated adequate knowledge of the availability of CC themes in some of the policies. They reported that CC themes were added as part of the response to other problems the policies address. One of the policy implementers reported that:

"I am not sure how climate change issues were added to the policies, but what I am sure of is that we have policies that highlight climate change as a current challenge the country is facing." (Policy implementer, informant # 1).

Another policy implementer had this to say:

"We do not have a climate change-specific response policy, but climate change issues were added to some of the policies currently in force." (Policy implementer, informant # 4).

3. Climate change health-related response strategies across policies

There were mixed responses among policymakers and implementers about the availability of climate change health-related response strategies across sectors. The majority of policymakers (6 out of 7) were able to mention health-related policies in their respective policies, unlike policy implementers. A policymaker reported that:

"Yes, there is a health-related strategy on food selection, processing, and improving dietary practices, and increasing nutrient intake among community members as climate change affects food production at the household level." (Policymaker, informant # 5).

In a related response, another policymaker reported that:

"The policy focuses extensively on minimizing the adverse impact of climate change and variability by reducing air pollution in air-polluted communities so that diseases like TB are reduced," (Policymaker, informant # 2).

Interestingly, policy implementers were unable to mention health-related themes in policies, especially those from sectors other than health. They view the policies as aligned with sector-specific agendas. A policy implementer reported that:

"Ah, I am not sure if some strategies are health-related, but what I know is that the policy was formulated to reduce the effects of climate change on agricultural produce." (Policy implementer, informant # 3)

This assertion was also reported by another respondent who indicated that:

"According to my knowledge, our policies mainly focus on environmental issues because health has its own policies they are implementing to meet its objectives." (Policy implementer, informant # 1).

However, policy implementers in the health sector were able to mention health-related themes and strategies in health policies. A policy implementer reported that:

"I can say that although as a sector we do not have a climate change-specific health policy, some of the climate response strategies incorporated in some of the policies are directly aimed at protecting communities from health risks associated with climate change effects." (Policy implementer, informant # 2).

4. Implementation linkages across sectors at the district level

Another area that provided mixed responses was the implementation linkages across sectors at the district level. The policymakers indicated that every policy specifies the sectors or ministries responsible for implementing its activities. Despite this, policymakers were unsure about coordination mechanisms at the district level.

“When policy is formulated, the linkages are indicated in the policy, which shows departments or ministries that will help with the implementation of the policy at the district level,” (Policy maker, informant # 4)

Another policymaker reported:

“Yes, if you can analyse every government policy, you will see that there is always a clear link to other relevant policies, ministries and departments for easy implementation; however, the level of coordination at the district level is something we need to monitor,” (Policy maker, informant # 7).

While the policy implementer acknowledges working with other sectors, they demonstrated a lack of knowledge regarding policy linkages. They further reported a lack of guidelines, which leads to improper coordination when collaborating with other sectors. The policy implementers cited the time of Cyclone Freddy 2023 when they were working together, but reported improper coordination among sectors due to a lack of guidelines.

“We sometimes work with other sectors, especially during disaster response, such as when Cyclone Freddy hit the country; however, coordination due to a lack of guidelines.” (Policy implementer, informant # 6).

Another policy implementer reported that:

“I am not entirely sure about the linkages among different policies. What I know is that we sometimes collaborate as a council.” (Policy implementer, informant 1).

Furthermore, some policy implementers mentioned a lack of guidelines as a barrier to proper coordination at the district level. A respondent reported:

“Yaaa, I can give an example of the time of Cyclone Freddy response, there was a team composed of individuals from different educational backgrounds, health, agriculture, education, and others working together, but there were no guidelines to be followed, so everyone was just doing what he/she knew best.” (Policy implementer, informant # 5).

Discussion

This study provides insight into policy linkages across sectors in response to CC extreme weather events and the CC theme mainstreaming among the agriculture, environment, and health sectors in Malawi. Furthermore, it puts the impact of CC extreme weather events at the center of policy considerations. The current study showed that several policy responses have been implemented to improve population health by minimizing the effects of CC in the country. The content analysis of policies revealed the inclusion of CC priority areas, health strategies, response goals, and cross-referencing of policies. The

findings of the two methodological approaches used are similar. Overall, the lack of sectoral linkage guidelines at the district level affects policy implementation.

Both document analysis and KIIs revealed that the policy development process across all sectors analysed follows a similar approach. It is initiated at the central level, influenced by the magnitude of the problems as evidenced by available data. The process also involves stakeholder consultations at various levels across the country to get and include their views. The involvement of various stakeholders has been reported to influence several areas of policy context, including social, political, and economic factors, which require special attention during policy development and implementation [39, 40]. It is argued that a policy development process that neglects context leads to ineffective choices and suboptimal outcomes during implementation, making it difficult to reach consensus on values and interests among various stakeholders [41]. In this case, the development and implementation period requires meaningful stakeholder engagement to address existing barriers [42]. In addition, this study has revealed inadequate stakeholder consultation, as participating districts and participants are sometimes sampled, limiting the inclusion of information and inputs from a diverse number of stakeholders. Similarly, a qualitative study by Masefield et al. (2021) on stakeholder engagement in Malawi concerning the health policy process reported barriers, including tokenistic involvement, stakeholder hierarchy, mutual distrust, preferred stakeholders, and inadequate stakeholder engagement [43]. The lack of stakeholder involvement and consultation during policy development affects implementation, as some stakeholders feel sidelined and irrelevant, and their inputs are limited.

The document analysis has further revealed that CC change issues have been mainstreamed in the reviewed policies across the three sectors, even though not all policies were specifically formulated in response to its impact. All the reviewed documents have CC priority areas aimed at adapting, mitigating, and protecting the population from their effects. According to the Intergovernmental Panel on Climate Change (IPCC), mainstreaming is the systematic inclusion of CC themes in sectoral policies and practices at all levels, to reduce harm and help to build resilient societies [44]. The analysed document policies contain CC objectives and strategies, providing evidence of mainstreaming of responses towards extreme weather events [45, 46]. On the other hand, the mainstreaming of CC in policies highlights positive responses towards the global agreement to address its impacts [47]. It further indicates the government's commitment to addressing the effects of CC on three sectors using a holistic approach [48, 49]. However, mainstreaming alone is not enough, as it relies on well-articulated plans to be followed during implementation to yield better results [50]. In addition, the plans can be easily achieved through institutionalization of CC challenges and increased acceptance among policymakers and implementers [50]. Furthermore, the CC mainstreaming areas require sufficient funding for effective implementation [51]. To achieve this, additional funds to supplement existing resources in national budgets or donor-supported programs must be identified through sustainable means [51].

Both document analysis and KIIs revealed that CC health-related response strategies are included in policies across all three sectors. If implemented, the strategies can improve the population's health directly or indirectly by positively influencing social determinants of health. For instance, inclusion of

water, sanitation, and hygiene in CC response strategies can help to address the spread of diarrheal diseases, such as cholera [52]. At the same time, some strategies can be formulated to reduce disease vector multiplication during floods, while others may be formulated to address malnutrition among children during drought [53, 54]. Inclusion of CC response strategies in sectors other than health is vital, as another study conducted in Bangladesh and Malawi on the health impacts of CC on smallholder farmers reported several effects, including communicable diseases, mental health issues, occupational health concerns, and safety risks, which require multi-sectoral collaboration to be addressed [55]. Therefore, it is essential to note that non-health sectors are incorporating health-related strategies in their policies in response to the effects of CC on population health. This study assumes that enhancing the implementation of these strategies could not only reduce the impact of CC but also improve population health. The findings further provide evidence on the availability of multisectoral interventions to reduce the impact of CC on health system performance. The effectiveness of multisectoral interventions has also been reported in a systematic review of multisectoral interventions and health system performance [56]. However, its effectiveness depends on the availability of standardized procedures and guidelines.

We further analysed implementation linkages across sectors at the district level. Our findings revealed mixed reactions from both policymakers and implementers. Policymakers reported that policies are linked across relevant sectors, while implementers had insufficient knowledge of linkages. We assume that policymakers have demonstrated good knowledge of policy linkage because of their dominance in policy formulation processes, from development, consultations, and implementation, making them more conversant with the policies. On the other hand, policy implementers have insufficient knowledge as they are at the receiving end of policies, making it difficult for them to understand policy linkages at the district level. Likewise, lack of knowledge among policy implementers was reported in another study on farmers' knowledge of environmental policy in the Ayeyarwady River basin in Myanmar [57]. In addition, a lack of knowledge of policy linkages among implementers limits multi-sectoral collaboration and a unified response against CC [58]. In this case, the study assumes limited implementation of policy objectives, as better policy knowledge linkages among implementers have been reported to promote a stable, unified purpose and increase the likelihood of meeting policy objectives [58].

The reviewed policy documents revealed cross-referencing among agriculture, health, and environment. Furthermore, there was no cross-referencing between policies from the environment and health sectors. In essence, all policies analyzed were supposed to cross-reference one another, as they all influence the social determinants of health. Likewise, a South African study reported similar findings, as the environmental sector did not give reference to health policies [59]. We assume that a lack of cross-referencing of policies reduces sector coordination and collaboration when responding to CC events.

Strengths and weaknesses

The use of two methodological approaches to understand the policy linkage provided comprehensive, valid, and nuanced information required to achieve the study objectives, and cross-checking of

information. In addition, the inclusion of policymakers at the national level and implementers at the district level strengthened our findings, as the results obtained provide a true reflection of how issues are perceived at different levels. The findings from the analyzed policy documents are not all-encompassing as they offer a limited perspective and do not reflect actual actions, events, and behaviors that occur in practice during implementation. Another weakness of the document analysis was that we may have missed some strategic documents that were not available online, and even those who provided lists or shared hard copies of the policies might have inadvertently omitted some.

Conclusion

In conclusion, climate change themes have been integrated and mainstreamed in sectoral policies for the three analyzed sectors (agriculture, environment, and health). The three sectors have health-related response strategies in their policies aiming at promoting public health. Even though some sectoral policies have been cross-referenced, there are partial sectoral policy linkages with implementation gaps and insufficient coordination. Overall, the three sectors have shown noticeable interest and commitment by ensuring that climate change does not cause catastrophic impacts on population health, which could derail development. We recommend that prompt efforts should be made to ensure that policy implementers are aware of policy linkages and cross-referencing for better coordination. Future sectoral climate change policies must be linked and cross-referenced with clear roles and responsibilities for each sector. Efforts must be made to identify sustainable funding for climate change activities.

Declarations

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Author contributions

CSC conceptualized the design, data acquisition, analysis, and interpretation. ML supervised study design, analysis, and results interpretation processes. CSC drafted the first manuscript, and ML revised it. All the authors read and approved the final manuscript.

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Availability of data and materials

The data supporting this study's findings are available on request from the corresponding authors, CSC, upon reasonable request. However, the data are not publicly available because they contain information

that could compromise research participant privacy/consent.

Ethics approval and consent to participate

This study received two ethics clearances. The first clearance was approved by the Biomedical Research Ethics Committee (BMREC) of the University of the Western Cape, reference No **BM24/9/6**. The second clearance was approved in Malawi by the National Health Sciences Research Ethics Committee, review No **4543**. Informed consent was obtained from all participants involved in the study. This study adhered to the Declaration of Helsinki ethical principles for Medical Research Involving Human Participants.

Consent for publication

All participants consented to the publication of the study.

Competing interests

The authors declare that they have no competing interests.

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Tables

Tables 1 and 2 are available in the Supplementary Files section.

Figures

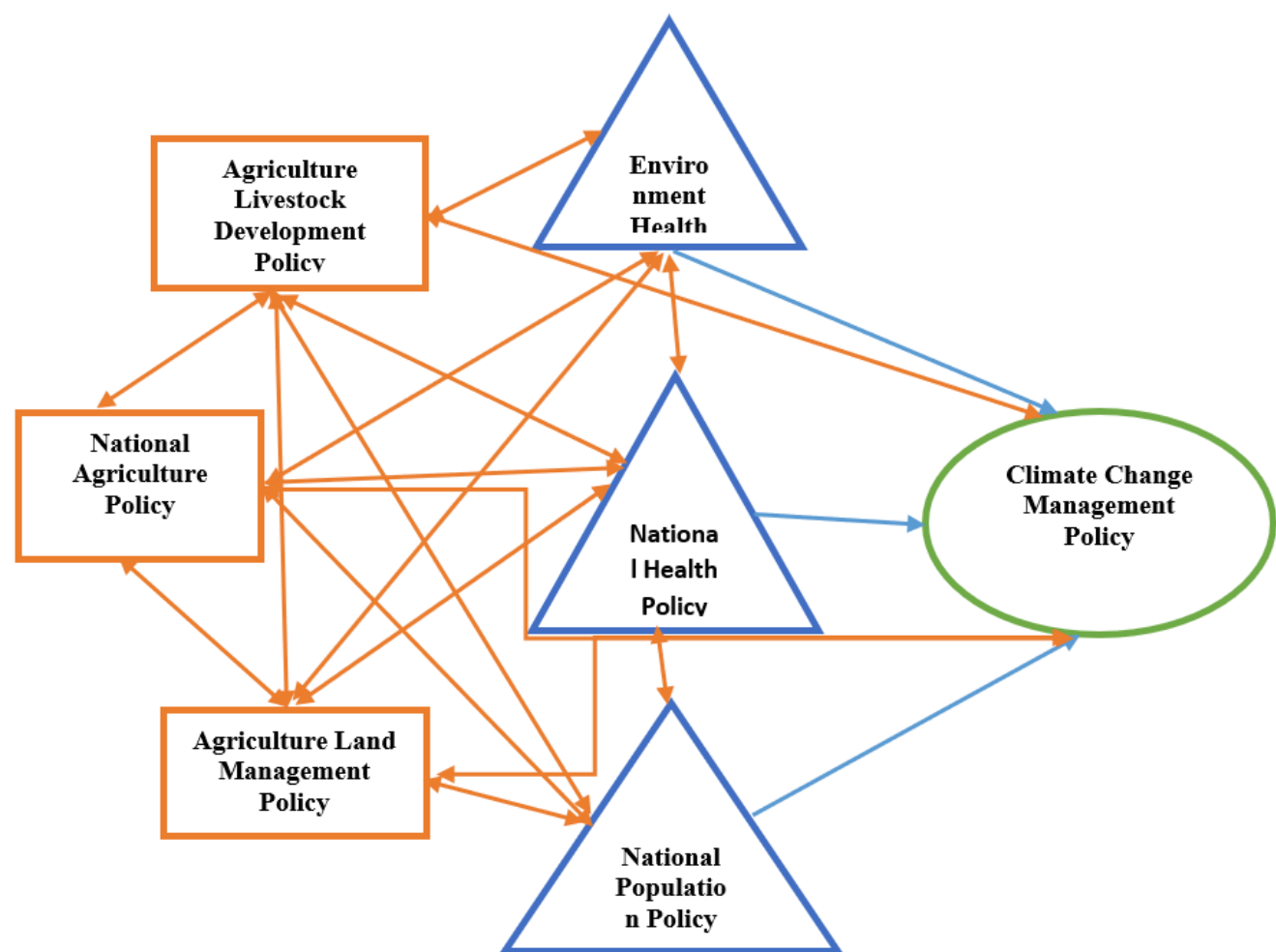


Figure 1

Policy linkage and cross-referencing

Rectangle = agriculture, triangle = health, and oval = environment

Supplementary Files

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