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African Indigenous Knowledge of Climate Change and Disaster Risk Management in Changing Climate

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Abstract

Climate change presents an unprecedented challenge to humanity. The changing climate threatens the very existence of humankind and the ways of life on Earth, including indigenous knowledge systems. The indigenous knowledge systems are threatened by climate change because they depend on natural factors such as trees, animals, and wind patterns, which can be affected by climate change. As the changing climate posits a significant challenge to the survival of species on earth, it begs the question 'Are indigenous knowledge systems still relevant in a changing climate? This paper examined the African indigenous knowledge of climate change and disaster risk management in the context of the changing climate. The research was conducted in Mozambique, Kenya, Ethiopia, Tunisia, Nigeria, Burkina Faso, and Cameroon. The seven countries represent the six climatic zones in Africa. Africa's climate is categorised into six climate zones. These are equatorial, humid tropical, tropical, Sahelian, Mediterranean, and Desert. Following an in-depth analysis, the research found that, by contrast, the African indigenous knowledge systems and practices have evolved with the changing climate as the African indigenous communities have developed some of the advanced adaptation options to build resilience to climate change and the changing disaster risk paradigm

Keywords: Humankind; Indigenous; Resilience; Demonisation

Abbreviations: SADC: Southern African Development Community; IGAD: Inter-Governmental Authority on Development; UNECA: United Nations Economic Commission for Africa; ECOWAS: Economic Community of West African States.

Introduction

Indigenous knowledge and practices for decision-making have gained significant momentum in both the global and African contexts. At the global level, the Paris Agreement on Climate Change 'recognises the need to strengthen knowledge, technologies, practices, and efforts of local communities and indigenous peoples to address and respond to climate change' [1], and further urges that adaptation measures should be based on and guided by the "best available science", including traditional knowledge, knowledge of indigenous peoples and local knowledge systems' [1]. Further, the Sendai Framework for Disaster Risk Reduction 2015-2030 recognises that indigenous peoples

can provide important contributions to the development and implementation of disaster risk reduction policies, strategies, programmes and plans [2].

Notwithstanding the acknowledgement, there is a limited application of indigenous knowledge systems in the implementation of policy frameworks related to climate change and disaster risk management. This paper interrogated the relevance of African indigenous knowledge systems and practices in response to the changing climate and disaster risk landscape and recommended actions that should be undertaken to reposition African indigenous knowledge and practices in a fast-changing and uncertain world.

Scientisation of Climate Change and Disaster Risk Reduction Knowledge

There is a general tendency to exclusion of indigenous knowledge systems and practices in climate change and disaster risk reduction efforts that promotes scientisation and demonisation of "laymen", who mostly understand the risk they face better than the "scientists" and bureaucrats sitting in high offices. Scientisation refers to the monopoly of knowledge by modern (western science) science as being the only source of rational knowledge (objective truth) and the apparent claim of infallibility of scientific knowledge [3]. In Beck's Risk Society Thesis, there were two stages of scientisation: primary and reflective scientisation. According to Beck, primary scientisation led to the destruction of people's ways of life, forcing them into 'reservations', for example, the Red Indians in the USA [3]. The second phase of scientisation is what Beck refers to as reflective scientisation. In this phase, science is faced and threatened by its products such as pollution, technological, and other manufactured risks [3].

Today scientific discourses tend to promote the scientisation of knowledge in apparent disregard for other local knowledge systems. By means of justifying the demonisation of indigenous people, most often, participation of indigenous communities in climate change discourses is based on "they are vulnerable to climate change" - further asserting that western-centric scientific reductionist view of climate change that undermines social and cultural perspectives on climate change [4]. The participation of local or indigenous communities should not be based on preconceived assumptions of "vulnerability", but as a strategy for ensuring a bottom-up approach, because the success of any national or regional and global policy depends on strong institutions at the community level [4]. Hence, it is counterproductive to rely on bureaucratic processes at national, regional and international levels, since disasters occur at the community level [4]. Therefore, understanding indigenous knowledge systems and practices for climate change and disaster risk management requires tailored research agenda that is framed from the 'perspective of locality rather than preconceived notions based on modernity' [5].

The changing climate, demography and urbanisation also mean that such indigenous risk management wisdom and philosophies may be rendered irrelevant [6]. In addition, the modernity processes underpinned by rapid urban growth and industrialisation and scientisation of knowledge, further introduce complex risks that threaten indigenous worldview and risk management practices [6]. Losing the indigenous or traditional knowledge of disaster risk management will be felt not only by the indigenous communities but by the whole of humanity [7].

African Indigenous Knowledge of and Practice for Disaster Risk Management in the Changing Climate

Indigenous knowledge of and practices for managing disaster risk and climate change are context-specific across the world [8]. Similarly, in Africa, it may be invalid to assume a "one-size-fits-all" indigenous knowledge system and practices of climate change and disaster risk management across the continent.

Owing to varying geographical realities and diversities of African communities, a wide range of indigenous knowledge systems and practices in response to contextual risk management realities are being practised by different communities across the continent. Likewise, within a country, different communities sometimes adopt different knowledge of and practice for climate change and disaster risk management. However, there are also similarities across the continent regarding indigenous knowledge systems and practices for climate change adaptation and disaster risk management. The study identified different African knowledge systems that could be replicated in different parts of the continent. These can be used for empowerment and decision-making at all levels. In light of the peculiarities of the continent concerning climate and weather dynamics, the study recognized that there are specific and varied indigenous responses to climate and weather challenges in Africa. As such the research was undertaken in the six climate zones of the continent as per Koppen's climate classifications which are: equatorial, humid tropical, tropical, Sahelian, Mediterranean, and desert [9].

With a larger part of the continent lacking necessary observational stations for hazard monitoring [10], many

communities depend on their indigenous knowledge systems for decision-making. Even where there are adequate modern climate and weather services, there are also examples where indigenous knowledge systems have proven more effective than scientific forecasts [11].

In 2010, El Niño Southern Oscillation (ENSO) was forecasted by Kenyan Meteorological services, and communities were warned of the potential ENSO impacts. Upon receiving the warning, Samburu communities in Kenya disputed the forecast [11]. The Samburu use bird migrations and the intestines of animals to predict certain natural climate factors, including ENSO. As time passed by, the Samburu were proven right –there was no ENSO [6]. Beyond Africa's borders, indigenous people also challenged scientific observations elsewhere. In the Amazon, the star-gazing practice by the Andean potato farmers provided a mechanism for assessing levels of humidity in the upper atmosphere, which was proven to be an indicator for El Niño, yet local meteorological services could not determine the same. Following years of work that involved a collaboration between an anthropologist and a meteorologist, the Andean Potatoes farmers' observations were found to be reliable [12]. Similarly, in the Russian Arctic, an unusual change in weather and ecological responses such as later freezing in autumn, earlier thawing in spring, and warmer winter characterized by heavy rainfalls, was, according to local scientists, due to anthropogenic climate change [5].

However, indigenous nomadic Nenets reindeer herders argue that the weather changes did not represent any abnormal pattern [5]. In some Latin American and Caribbean communities, indigenous knowledge systems corresponded with observed changes in precipitation and temperatures as measured by local weather stations [7]. Similarly, indigenous knowledge proved to be more reliable than scientific observation in Artic Canada [13]. The Inuit people in Artic Canada observed unusual weather changes that were making it difficult for them to predict the weather, and upon reports, local scientists undertook a study to establish evidence of the unusual change in the weather. The study found no evidence that the weather had changed, as observed by the indigenous community. After receiving contradictory outcomes, a broadened scientific investigation was commissioned by the authorities and ultimately affirmed the Inuit's observations [13]. Similarly, in the African context, indigenous knowledge of and practice for disaster risk management in a changing climate shows similar evidence.

Study Area and Research Methodology

A total of eight (8) different indigenous communities in the six (6) climate zones were purposefully selected for the study to ascertain the relevance of indigenous knowledge systems and practices in responding to the changing climate and disaster risk management challenges across the different climate zones. The research was conducted in Mozambique, Kenya, Ethiopia, Tunisia, Nigeria, and Cameroon. These communities include the Anyuak and Nuer communities in the Gambella region of Ethiopia, Samburu and Masaai in Kenya, the Widikum community in Cameroon, the local community in Nampula in Mozambique, and the Sousse Community in Tunisia. Attempt to conduct interviews with communities in Nigeria was not successful. However, interviews with experts and civil societies in Nigeria were conducted. To ascertain the perspective of communities living in the Sahel, interviews were organised with the Boubou Dioulassou community in Burkina Faso. One hundred fourteen (114) respondents provided in-depth feedback to the study. Among the 114 respondents, 71 respondents were members of traditional/indigenous communities who participated in focus group discussions; and the remaining 43 respondents were experts that were involved in the implementation of climate change adaptation and disaster risk management programmes. The 43 respondents included twenty (20) experts from policy-level institutions that were selected from National Disaster Risk Management Authorities (7); Climate Change Adaptation institutions (5), Regional Economic Communities (3), African Union Commission (2), and UN Agencies (3); twenty (20) indigenous knowledge experts from a network of civil society organizations consisting of indigenous/community-based organisations (12), youth organisations (2), women organisations (3); and three (3) scientists (academic).

The indigenous communities' focus group discussions were guided by indigenous methodology. Indigenous methodology is underpinned by the belief that knowledge is relational – meaning it is shared [14]. Thus, in an indigenous research setting, individualistic in-depth interviews are irrelevant. The study employed indigenous data collection methods such as talking circles, storytelling, songs, poetry, and spirituality. The initial plan was to organise each talking circle comprising thirteen (13) persons. However, due to COVID-19 protocols in some communities where COVID-19 restrictions were stringent, some circles were as low as three persons. The indigenous methodology was utilised because it used methods that are familiar to the target communities. Such an approach is described as decolonising because it employs indigenous methodologies to generate indigenous world views rather than imposing euro-centric methodologies that construe reality from a Western scientific point of view [8]. Using indigenous methods helped encourage openness and trust among the participants to engage in in-depth discussions.

The determination of the sample sizes for the talking circles, in-depth interviews, and close-ended questionnaires was consistent with existing best research practices. The

selection of the indigenous communities and their respective countries was informed by factors such as accessibility and cost efficiency, presence of diverse informants, climate zone, and vulnerability to disaster risks. The most vulnerable community to climate-sensitive disaster risks were selected. The vulnerability of the target community was determined as per the national risk profile, recent disaster risk reduction reports, and available indigenous knowledge.

Mozambique ranks as the second most vulnerable country to disaster risks in the Southern African Development Community (SADC) [15]. Mozambique also has diverse climate zones – equatorial and tropical. Mozambique was selected to ascertain the perspectives of African coastal communities on climate change and disaster risk management issues. The African Union's vulnerability assessment puts Kenya as the fourth vulnerable country to disaster risk in the Inter-Governmental Authority on Development (IGAD) region [15]. Kenya was also purposefully selected because it houses several international organisations. Importantly, the IGAD Disaster Risk Management Unit and the IGAD Climate Prediction and Application Centre (ICPAC) are based in Nairobi, the capital city of Kenya. Kenya, also, has several indigenous communities in its Savanah and arid regions that are vulnerable to climate variability and change, and who also possess rich indigenous knowledge to respond to extreme climate events.

Ethiopia, which is home to African Union, United Nations Economic Commission for Africa (UNECA), and several international and diplomatic entities was selected for the study. This study has a policy dimension. One of the study's aims is to advocate for the formalisation of indigenous knowledge in policy development and implementation. Given the diverse policy institutions based in Addis Ababa, Ethiopia, Ethiopia was purposefully selected for the study. In addition, Ethiopia has diverse climate zones – Sahelian, desert, and tropical. Accessibility and cost-efficiency put Ethiopia the most accessible because the researcher works and resides in the country.

Tunisia is the third most vulnerable country in North Africa. However, it was preferred over other Mediterranean countries due to its accessibility. The Tunisian Communities practise some of the continent's indigenous climate change adaptation solutions as part of their heritage.

Nigeria hosts the Economic Community of West African States (ECOWAS). In addition, it is among the first eight most vulnerable countries of the fifteen ECOWAS member states [15]. It has diverse climate zones – Sahelian, tropical, humid tropical, and equatorial. Due to the inability to conduct interviews with a community in Nigeria, a focus group was organised with the Boubou Dioulassou in Burkina Faso to ascertain the perspectives of communities in the Sahel climate region.

Cameroon is situated in one of Africa's tropical rainforest zones (tropical climate) and on the Atlantic coast (humid tropical). One community in southern Cameroon was selected to assess the relevance of the indigenous knowledge systems in responding to the climate change realities in communities residing in one of Africa's largest tropical forests, the Congo Forest.

Key Findings

Considering the changing climate, the research investigated the relevance of existing indigenous knowledge and practices for climate change and disaster risk management in responding to the changing climate and disaster risk paradigm. Firstly, the indigenous knowledge of and practices for climate change adaptation and disaster risk reduction is discussed, and secondly, the relevance of the knowledge and practices in the changing climate enjoys attention. The study revealed considerable African risk management wisdom and philosophies. There was a consensus across various African indigenous communities that their climate was changing, as well as acknowledgement of the challenges and related impacts of the changing climate. Communities in Tunisia observed that the weather was out of the "Mezzan" [16]. In Kenya, the Masaai observed more droughts than rainfalls [17], whereas the Widikum Community in Cameroon experienced extreme rains or extreme dryness [18]. Existing solutions to climate hazards are being adopted in response to erratic weather patterns across the continent. Communities in Tunisia developed El mejel to manage the consequences of unbalanced weather [16]. In South Sudan and the Gambella region of Ethiopia, Kulang's resilience model is seen as one of the practical and sustainable solutions to managing alternating climate hazards, specifically droughts and floods [19].

African Indigenous Knowledge for Climate Change Adaptation and Disaster Risk Management: As briefly captioned above, the study revealed African indigenous knowledge and practices, and philosophies being widely implemented across the continent. The most noticeable African indigenous risk management wisdom and philosophies will be discussed.

Jessours and El mejel: In Tunisia, Jessours and El mejel are remarkable climate change adaptation practices. Jessours are networks of canals connected to divert flood water to central water storage facilities or small dams for use during dry seasons [16]. The jessours are double-edged swords in

controlling flooding and mitigating the impacts of droughts. The use of the jessours in Semi-arid Tunisia does not only prevent runoffs, but they have resulted in enhancing soil fertility and ecosystem health [20]. In areas where jessours are practised, despite aridity, olive production performed exceedingly well beyond its ecological limit [20]. Other positive impacts of the jessours' practice were the emergence of the city of Zaghouan several decades ago, which was built around the water body formed through jessours from Mount Zaghouan, making the area known as agricultural belt producing varieties of crops [16]. Smaller in scale than Jessours, El mejel is widely practised in Tunisia and provides a small-scale water supply to families. The indigenous system uses rainwater from rooftops and channels the water to small water ponds for domestic use. Both El mejel and Jessours are methods that are mainly used in arid regions and areas facing scarce water supply. However, these methods can be relevant and applicable in other African climate regions.

Kulang's Resilience Model: Kulang (an indigent to modern-day South Sudan) invented a model that is locally referred to as Kulang's Resilience Model, to adapt to the risk of alternating climate hazards, usually drought and flood. The model reduces the risk of drought and floods turning into a disaster in two ways. First, when a flood or drought is anticipated, Kulang would sell away his cattle before a hazard could strike and use the cash to procure other food items such as grains during emergency and rebuy cattle later when conditions are favourable [19]. The second component of Kulang Resilience Model includes the adoption of no-regret de-risking strategies such as planting two farms on different terrains – higher ground and lower ground. The latter is a key strategy being employed by many communities in the remotest part of the Gambella region to cope with uncertainties. Among the indigenous Nuer communities living in the Gambella Region in western Ethiopia and the Upper Nile Region of South Sudan, Kulang's resilience model provides a coping mechanism for climate stresses [19].

Emergency Stockpile: In preparation for disasters, communities across the continent have developed food preservation mechanisms such as Ouula in Tunisia and dry Kob in South Sudan or the Gambella region of Ethiopia. The kob is a local food made out of cereals that can be kept for an extended period as an emergency stock. In Tunisia, food such as couscous and dry chilly are stored to cushion communities from disaster impacts or times of food stress, a practice commonly known as Ouula and largely practised in northern Tunisia. Kob or Akob is akin to Couscous, but a larger version of it. It is usually made from steamed balls of sorghum or maize flour. In wetlands, such as part of Ethiopia's Gambella region and Sudd region in South Sudan, communities preserve dry kob purposely as part of contingency planning and preparedness for food stresses, emanating from the failure of food production due to droughts, floods or conflict.

Indigenous Building Technologies: African communities living in extreme climates adopt construction methods with buildings' roofs made of a mixture of sand, hay, and yeast to protect against damages from heavy rains, but also to provide heat balance - both during extreme heat or cold. This technology is commonly practised in semi-arid, arid, and desert terrains in Africa. In other parts of the continent, roofs are built with wood and grass. According to the respondents in Eswatine, the conventional wisdom behind the design of houses built of wood and grass is that the construction allows smoke to pass through the roof, prevents heat and heavy rainfalls and is also earthquake tolerant as the foundations of such buildings are made out of stones that allow the building to "breathe" and prevent any damage from underground movements. Other coping mechanisms for severe flooding in the Sudd region include the construction of local boats.

Since 2020, the Sudd wetland has continued to witness devastating flooding. Communities had to live in boats for days as they were evacuating to safety. Every household that could afford the cost of purchasing a boat that is locally designed had one. What is significant is the use of boats as an adaptation measure to cope with the severe flooding exacerbated by climate change. In the past, boats were owned mainly by fishermen. The increasing ownership of boats by every household that affords it is a significant indicator of the ability of local communities to adapt to the changing climate [6]. Using boats for climate change adaptation and disaster risk reduction provides important lessons for modern-day climate change adaptation and disaster risk reduction. In the indigenous practice for boats as a means of reducing the risk, the most vulnerable segment of societies, for example, women, children, people living with disabilities, and the elderly are evacuated and provided protection. This gender dimension of indigenous disaster risk management can be a substantive research agenda of its own, however, it is an important lesson for contemporary adaptation and disaster risk reduction.

Indigenous Early Warning Systems: Across the continent, various indicators ranging from animals, plants, winds, and stars are used for warning of impending disaster events [6]. In Mozambique, the coconut fruit is a key warning sign for tropical storms. Also, other fruits such as mangos are used for the warning. When unripe coconut fruit starts to fall due to high winds, cyclones or other tropical depressions are imminent. Communities are then advised to evacuate to safety. Similarly, when fruits such as unripe mangoes start to fall in big numbers as a result of strong winds, storms are expected and communities take precautionary actions, including evacuation.

Similarly, the appearance of stars in a particular position or alignment with other celestial bodies such as the moon provides critical indicators for hazards' occurrence. Among the Borana in Kenya and Ethiopia, when the moon is aligned with the seven stars around March, it indicates drought and famine [19]. Similarly, when the morning stars appear in the west 70 days after their appearance from the east, it is an indication of a very bad drought [21]. In western Ethiopia's Gambella region, when the Nuer experiences "tarkew" (cold wind that moves from south to the north in April to May), the community experiences drought [19].

Indigenous Safety Nets: Indigenous social safety net solutions such as lending food or cattle are important adaptation measures widely practised across the continent. In Samburu, as in many African communities, poor households are lent cows to keep during food crises. The communities share food to cushion from crises till the worst times are over. The indigenous social safety net practices are, to some extent, akin to contemporary humanitarian assistance, albeit, with some differences.

Relevance of the African Indigenous Knowledge for Climate Change Adaptation and Disaster Risk Management in a Changing Climate: In answering the key research question – 'will the African indigenous knowledge of climate change adaptation and disaster risk management still be relevant in a changing climate'; strong views were expressed by the indigenous communities that their ancestral knowledge and practices for climate change and disaster risk management were still highly relevant to managing contemporary climate and disaster risks. Among the communities in Gambella that practise Kulang's Resilience Model, other coping mechanisms to climate stresses, such as diversification of livelihood options, have been adopted. In the Gambella region, the Nuer have increasingly adopted small ruminants to cope with frequent droughts. Other communities living in the Savanah climate, such as the Masaai in Kenya, have resorted to diversifying livelihood options. The Maasai livelihood is anchored in cattle rearing [22]. However, the Masaai have now engaged in agro-pastoralism and search for jobs in cities. This is in stark contrast to the pure pastoralism practices the Masaai are known for.

Notwithstanding the acknowledgement of the effectiveness of indigenous knowledge in responding to a changing climate and disaster risk paradigm, a wide range of respondents (89%), including some indigenous communities, and climate change and disaster risk experts, believed that indigenous wisdom and risk management philosophies were at the verge of disappearance, citing climate change and other development linked factors as being the drivers. Climate change was strongly argued by experts and policymakers as the major threat to the disappearance of indigenous knowledge systems and practices because indigenous knowledge depends on climate-sensitive indicators such as trees animals, and winds among others, which are vulnerable to climate change. In a similar vein, most indigenous communities that were interviewed expressed rather different views – the major threat to their way of life was scientisation and according to the field ethnography, exclusion of the indigenous practices and knowledge systems by the African governments in policy formulation and implementation. Some scientists (80% of academics and DRR/CCA experts) that were interviewed shared similar views expressed by the indigenous communities that the dominance and preference for a western-centric version of science and development, particularly, the massive destruction of ancestral territories were cited as major factors that have undermined and would continue to undermine, not only the indigenous knowledge systems but the prosperity and survival of the indigenous people themselves.

Most of the respondents (97 %) called for the need to expedite policy actions that should urgently halt what the indigenous communities referred to as 'hostility' towards indigenous knowledge and practices that are essential to the survival of humanity and species on earth, and embrace indigenous wisdom and risk management philosophies that are relevant to the contemporary risk management challenges. In expressing their views, the respondents (77%) acknowledged and strongly believed there was a strength in integrating relevant indigenous knowledge and practices with scientific knowledge. In contrast, 23% of the respondents argue that indigenous knowledge systems are difficult to integrate with modern science as both knowledge systems use different tools and methodologies in the generation of knowledge. The opponents of the integration of indigenous and scientific knowledge strongly argue that both knowledge systems should co-exist and complement each other's shortfalls. The proponents further argued that where indigenous knowledge is proven superior to the Western version of science, the latter should be disbanded.

Discussions of the Findings: Indigenous Knowledge and Practices for Changing Climate

Indigenous knowledge of and practices for climate change and disaster risk management is largely dependent on noticing natural manifestations, such as in trees and animals. This dependency makes indigenous knowledge highly vulnerable to climate change and variability. As a result of changing climate, some trees or animals that trigger early warning and other vital information that the indigenous communities use for decision-making may also go extinct and further affect the reliability of indigenous knowledge

observations. Similarly, due to a changing climate, some trees may flower earlier or later than at normal times. Whereas the various African communities may find it difficult to predict certain hazards, there are widespread examples of their ability to adjust to the changing climate. For example, many rural communities have continued to adopt new livelihood options even without "experts" telling them what to do, e.g. from crop farming to fishing, pastoralism to crop farming, large to small ruminants, fishing, inter alia. As discussed during the focus group discussions, indigenous communities over the years could abandon certain crops in favour of new ones. These are remarkable examples of how climate change has already impacted indigenous knowledge and how the indigenous knowledge of and practices for climate change and disaster risk management have evolved with the changing climate. Indigenous knowledge is never static, it adapts to the changing environment and demography [23].

Whereas indigenous knowledge systems have indeed been proven to be relevant in responding to the changing climate, they too are also affected by climate change. While indigenous knowledge may be affected by climate change, scientific knowledge may also suffer the same fate. However, without disputing potential negative impacts on indigenous knowledge systems to predict and cope with climate hazards, contemporary realities indicate that they are still used today by communities for decision-making. In light of the low coverage of the continent by modern scientific hydro-meteorological services [10], the larger part of the continent, which are mostly rural centres, depends on indigenous knowledge systems for decision-making on planting, seasonal migration, harvest, hunting, fishing among others.

In Africa, indigenous solutions such as El mejel are highly relevant. This indigenous practice is cost-effective and can guarantee access to water for families until the next season [16]. Other practices, such as the jessours, are more cost-effective than modern irrigation systems that use river or underground water. Modern irrigation systems are instead threatened by climate change and water stresses due to the lowering of water levels due to changing climate and climate variability [10]. In adapting to the changing water level, modern farmers in Sudan had to introduce two-pump systems. In this system, the first pump pumps water from the Nile to a canal, and another pump is introduced to pump water from the canal to the farms. This system has resulted in increased labour costs and the cost of technology as the water stresses mean that to irrigate farms adequately, farmers must purchase more than one pump. Consequently, the high cost of pumping water has to be factored into the prices of produce, leading to high prices of commodities and a high cost of living [24]. Also, the farming systems are susceptible to both flooding and droughts. During droughts, the water level diminishes, and this affects the water supply to the farms. Similarly, during flooding, crop production is affected [25]. This example of a modern irrigation system in Sudan shows that climate change also affects scientific solutions. Hence, arguing that climate change will affect the indigenous knowledge systems the most is invalid [7].

Many indigenous practices tend to perform better than modern scientific solutions. For example, the jessours provide solutions to both droughts and floods. During flooding, the flood water is diverted to the canals that are connected to a central water storage facility. Similarly, during droughts, water from canals is used for irrigation. In light of changing climate and increased frequency of droughts and floods alternating with each other, there is a need to examine the comparative advantages each knowledge contributes to adaptation and disaster risk reduction. Other indigenous knowledge systems, such as indigenous social safety nets, are important adaptation and disaster risk reduction measures essential in responding to the changing climate. In indigenous social safety practice, the community would lend the most vulnerable segment of their community cattle or food to enable them to rebuild their homes and cultivate their farms. There are three important aspects of these social safety net practices. First, it reduces the exposure and vulnerability of the affected by strengthening their resilience and promoting collective social protection mechanisms. This is different from putting the affected people in displaced camps, which tends to create a sense of isolation and lowering self-esteem. Such approaches quicken recovery and build long-term resilience and strengthen community resolve to be one another's keepers.

Secondly, communal assistance comes in handy during crises, a sharp contrast with external humanitarian and disaster aid that takes days, if not months, to arrive. Thirdly, the lending practised by communities to uplift the most vulnerable out of crises is interest-free. Unlike contemporary disaster risk financing mechanisms, many of which are financed through loans, this no-interest financing saves lives and reduces debts but also promotes a sense of belonging and solidarity. Under the future climate, lending as a way to finance disaster risk management interventions, particularly for the most vulnerable, would perpetuate poverty with the poor being perpetually indebted. Because, as witnessed in recent years, the space between one disaster event to another has significantly narrowed [15]. Yet, with climate change, extreme climate hazards are expected to become frequent, intense, and less predictable [26]. In the words of an indigenous Samburu elder -" every 10 years, there used to be severe drought. Now droughts are happening almost every year, and they are difficult to predict". This implies that the space between recoveries from one disaster to the next is limited. Taking loans to finance response and recovery, may be counterproductive under future risks and uncertainties.

Whereas indigenous safety nets are key for building resilience to growing risks, often driven by climate hazards, indigenous social safety nets are also threatened by the frequency of disaster events and climate change. Many African indigenous communities are already using extreme and negative coping mechanisms, such as cattle rustling, to respond to climate stresses. Such measures also exacerbate conflicts and further engender vulnerability. Notwithstanding the negative coping mechanisms arising from the heightened risks, there are remarkable examples that demonstrate that indigenous communities are already adapting to changing climate. In Kenya, some of the Samburu people have adopted camels instead of cattle because, as observed by the communities, cattle do not survive protracted droughts. Other communities have also resorted to adopting new food systems, such as poultry farming or keeping chickens. These are extraordinary practices of ongoing adaptation and resilience building.

In reflexive modernity, science reproduces risks, and yet, paradoxically, it assumes superiority and monopoly of knowledge to find solutions to risks that it produces itself [3]. The sciencisation of knowledge further disregards people's perspectives in climate change debates and disaster risk management discourses [23], including the ongoing discussions on climate change and disaster risk nexus. In today's risk management practices, the use of drones, models and other sophisticated technology mirrors the sciencisation. Whereas the use of artificial intelligence is key to understanding climate change and disaster risk complexities, it should not disregard people's perspectives and experiences that are proven effective on several occasions [6].

Repositioning African Indigenous Knowledge and Practices for Climate Change and Disaster Risk Management in Fast Changing and Uncertain World

Embracing and reviving indigenous science must be taken seriously – it may hold the key to addressing the complex neo-normal disaster risk paradigm facing modern-day societies. African governments must adopt a whole-of-society approach to ensure existing indigenous knowledge and know-how are studied and make necessary efforts to ameliorate, develop and better apply them to address risk management [27]. To restore and reposition African indigenous practices at the centre of climate change and disaster risk management discourses, the following recommendations can be made: (i) commissioning comprehensive assessment of indigenous knowledge of and practices for climate change and disaster risk management; (ii) develop an overarching framework for the application of indigenous knowledge of and practices for climate change and disaster risk management; (iii) develop simplified guidelines for the application of indigenous knowledge in policy decisions; (iv) review curricula to incorporate indigenous knowledge of and practices for climate change and disaster risk management; (iv) develop sustainable research agenda for indigenous knowledge of and practices for climate change and disaster risk management; (v) document best practices and facilitate intra-Africa indigenous knowledge experiences; and (vi) develop common Africa's position on indigenous knowledge and popularise them at all levels.

Conclusion

This study examined the relevance of African indigenous knowledge of and practices for climate change and disaster risk management in the changing climate. Contrary to arguments that ought to conclude that indigenous practices are made obsolete by climate change, many indigenous practices tend to perform better than modern scientific solutions.

However, indigenous knowledge systems are fast disappearing. Climate change was strongly argued by experts and policymakers as the major threat to the disappearance of indigenous knowledge systems and practices. However, for the indigenous communities, the major threat to their way of life, including their indigenous knowledge systems, is the development-induced destruction of the environment and disregard for their practices and knowledge systems by governments and scientists.

Besides climate change and the scientisation, the lack of documentation of indigenous practices threatens their viability. There is a need to document them and have a central repository across the continent to allow for comparison and exchange learning among the communities and for better analysis and applications, not only at that geographical level but also applicability across the continent. Ultimately, by mapping and understanding the different indigenous perspectives, there may be common approaches to be promoted in response to the transboundary risk that is increasingly characterising the neo-normal disaster risk paradigm on the continent.

References

1. United Nations (2015) Paris Agreement.

2. United Nations (2015) Sendai Framework for Disaster Risk Reduction 2015-2030.

3. Beck U (1992) Risk Society: Towards a modernity 1st (Edn.), Sage Publication, Germany, pp: 272.

4. Friis-Hansen E (2017) Decentralised Governance of Adaptation to Climate Change in Africa. Wallingford: CABI. Africa, pp: 162.

5. Forbes BC, Stammler F (2009) Arctic climate change discourse: the contrasting politics of research agendas in the West and Russia. Polar Research 28(1): 28-42.

6. Field-interviews-DRM Experts (2021) African Indigenous Perspective on Climate Change and Disaster Risk Nexus.

7. Kronik J, Verner D (2010) Indigenous peoples and climate change in Latin America and the Caribbean, Washington DC: The International Bank for Reconstruction and Development/World Bank, Latin America.

8. Shizha E, Emeagwali GT (2020) African Indigenous Knowledge and the Sciences: Journeys into thePpast and Present, SensePublishers, Rotterdam, Africa, pp: 220.

9. Kottek M, Grieser J, Beck C, Rudolf B, Rubel F (2006) World Map of the Köppen-Geiger climate classification updated. Meteorologische Zeitschrif 15(3): 259-263.

10. African Union (2021) State of Multi-Hazard Early Warning Systems

11. FieldData-Samburu (2021) Afican Inidgenous Perspectives on Climate Change and Disaster Risk Nexus.

12. Orlove B, Chiang JCH, Cane MA (2002) Ethnoclimatology in the Andes. American Scientist 90(5): 428-435.

13. Weatherhead E, Gearheard S, Barry RG (2010) Changes in weather persistence: Insight from Inuit knowledge. Global Environmental Change 20: 523-528.

14. Chilisa B (2012) Indigenous research methodologies, Sage Publications, Thousand Oaks, California, USA.

15. African Union (2020) Bi-ennial Report on the Programme of Action for the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 in Africa.

16. FieldData-Jammal-Tunisia (2021) African Indigenous Perspectives on Climate Change and Disaster Risk Nexus: Inteviews with 13 Communities elders and Imam in Sousse, Tunisia.

17. FieldData-Maasai (2021) African Indigenous Persctives on Climate Change and Disaster Risk Nexus: FGD with 13 Maasai Indigenous Group in Kenya.

18. FieldData-Widikum-Cameroon (2021) African Indigenous Perspective on Climate Change and Disaster Risk Nexus: FDG with 7 elders from Widikum Community in Cameroon.

19. FieldData-Gambella (2021) Africa Indigenous Perspectives on CLimate Change and Diaster Risk Nexus.

20. Calianno M, Fallot JM, Fraj TB, Ouezdou HB, Reynard E (2020) Benefits of Water-Harvesting Systems (Jessour) on Soil Water Retention in Southeast Tunisia. Water 12(1): 295.

21. Radeny M, Desalegn A, Mubiru D, Kyazze F, Mahoo H, et al. (2019) Indigenous knowledge for seasonal weather and climate forecasting across East Africa. Climatic Change 156: 509-526.

22. Gold S (2019) 5 Fascinating Facts about the Maasai People, Africa.

23. Nakashima D, Kruptnick I, Rubis JT (2018) Indigenous Knowledge for Climate Change Assessment and Adaptation, Cambridge University Press, France.

24. African Union (2021) Sudan Peer Review.

25. NRSFA (2020) Nile River State's Farmers Association (NRSFA) Representative, Sudan [Interview] (6 December 2020)

26. Field CB, Barros V, Stocker TF, Qin D, Dokken DJ (2012) Managing the risks of extreme events and disasters to advance Climate Change Adaptation, IPCC.

27. Surminski S, Tanner T (2016) Realising the 'Triple Dividends of Resilience': A New Business Case for Disaster Risk Management. London.