Climate Change Adaptation in Southern Africa: Universalistic Science or Indigenous Knowledge or Hybrid

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Abstract

The aims of this chapter are to seek answer, through a document review, case studies, and thematic content analysis, to which direction Southern Africa should take in the face of climate change and to suggest a framework for adaptations by communities experiencing climatic events. Acknowledging that the fundamental set of ideas provided by indigenous knowledge (IK) works best at a small scale, the chapter argues for the need to seriously value IK-based response practices in the knowledge hybridization agenda. The worsening vulnerability potentiated by the increasing magnitude and severity of climate change impacts is a reminder that local-based indigenous response practices in Africa need to be complemented. Adaptation to climate change calls for real and surreal measures all being applied in combination. Across Africa, these measures have, at times, included the preservation of forest resources which increased carbon sinking and enhanced community resilience against climate change. Universalistic and orthodox sciences have punctuated and amplified these efforts by speaking of such initiatives as mitigation and adaptation through programs, e.g., Reducing Emissions from Deforestation and Forest Degradation (REDD+) and ecosystem-based adaptation (EbA). The merits of the two approaches have resulted in increasing call among scholars for the merging of these programs with IK. However, it remains to be fully understood how such a hybrid approach could be operationalized without treating the latter as an inferior element in climate science discourses.

Introduction

The complexity of climate change has attracted global attention and the various institutions worldwide to come up with adaptation and resilience methodologies and strategies (UNDP 2018). Throughout history, people and societies have successfully adjusted to and coped with climate change and extreme events. While climate change is a global issue, it is felt on a local scale (Silber 2013). This is because climate change affects many dimensions of development, including society, politics, science, economics, and moral and ethical questions (Henderson et al. 2017; Ogolla 2016). Local institutions are therefore at the frontline of adaptation as they attempt to factor in the local effects and how to mitigate these negative effects of climate change. This has resulted in the development of initiatives where climate change is factored into a variety of development plans on how to manage the increasingly extreme disasters and their associated risks, how to protect coastlines and deal with sea-level rise, how to best manage lands and forests, how to deal with and plan for reduced water availability, how to develop resilient crop varieties, and how to protect energy and public infrastructures (UNFCCC 2007; Carter et al. 2015; de Witt 2018). Carbon dioxide, the heat-trapping greenhouse gas (GHG) that is the main contributor to global warming, has high longevity as it can remain in the atmosphere for hundreds of years (Dabasso et al. 2014). Even if the global community manages to establish strategies that can successfully reduce GHG emissions into the atmosphere, climate change and global warming will still be experienced and affect future generations. Thus, climate change continues to be a persistent global issue (Bauer and Scholz 2010). In Southern Africa, the effects of climate change have been experienced at a large scale as the region lacks adequate technology and proper management of its resources (Thinda et al. 2020). In addition, the combination of other various aspects of the region, such as its geographical exposure that has low levels of human development, weak institutions, high levels of inequality, and high dependence on agriculture, makes the African people vulnerable to the effects of climate change, especially those in the Southern African region as it is warming up at a faster rate than the global average (Kupika et al. 2019).

Climate change adaptation is a complex process that requires efforts from different stakeholders. The various problems that currently overwhelm Africa, for example, poor governance, lack of technology, and prevalence of poverty, make it difficult to establish the best approaches to achieve climate change adaptation. Basically, there are two available options that can be employed by the governments, namely, indigenous knowledge systems (IKS) and universalistic science. The former refers to the tested and proven knowledge that is used by local communities from their many years of observing and experiencing environmental phenomena, whereas the latter includes sophisticated techniques and approaches that are often associated with Western technologies and advanced way of mainstreaming climate change (Chirisa et al. 2018). These two approaches have their individual merits.

While some proponents view IKS as primitive and less reliable (e.g., Briggs 2005; Widdowson and Howard 2008), others assert that universalistic science is often too complicated and costly for African communities, which will result in their failure to maintain such a sophisticated technology (Wallner 2005; Simpson 2010; Walsh 2011). This causes ambiguity with regard to choosing the best approach to be employed to achieve climate change adaptation. In the same vein, this chapter proposes a hybrid method that considers the integration of both IKS and universalistic science. Thus, how Southern Africa can best adapt to climate change is investigated by weighing the strengths and limitations of the two knowledge systems in the context of climate change responses in the region. Through a document review, case studies, and thematic content analysis, the study determines the direction that Southern Africa should take in the face of climate change. The area of interest is shown in Fig. 1, which consists of Angola, Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia, and Zimbabwe. It isolates specific themes to show how climate change responses have been pursued in the region. The chapter begins with a conceptual treatment of climate change adaptation in the frame of the distinctive knowledge forms (IKS and conventional knowledge systems) in the theory and practice of climate change responses. It then draws from existing scholars how these knowledge forms have characterized climate change

Fig. 1 The case study, Southern African Region. (Source: Extracted from google.com/maps © Map data AfriGIS (Pty) Ltd)

mitigation and adaptation in Southern Africa. The discussion highlights the strengths and limitations of these knowledge systems and concludes that a hybrid system could be the best approach for driving an effective adaptation agenda in the region.

Climate Change Response in Southern Africa

Although climate change will place additional stress on Southern Africa's resources, some authors argue that there is considerable adaptive potential (Karsenty et al. 2012; Wang and Corson 2015; Kupika et al. 2019). In order to promote a meaningful and sustainable development in the region, the probable impacts of global climate change need to be considered, as well as the best alternative that fits the regional context. In the science of climate change, the two approaches that guide climate change responses are mitigation and adaptation. Mitigation is concerned with stabilizing the levels of heat-trapping GHG and reducing its emissions into the atmosphere, whereas the focus of adaptation is on taking measures to respond to the observed or anticipated climate change impacts (Klein et al. 2005; IPCC 2014). Climate change has been the greatest threat to provision of infrastructure and facilities for human improvement in countries in the Global South. Thus, it calls for the need to develop mitigation and adaptation strategies that enhance the resilience of the region (Mugambiwa 2018; Kupika et al. 2019). The major goal in mitigation is to avoid human interference in the climatic system and balances, whereas adaptation is a practice where human and natural systems devise appropriate measures in response to climate change impacts. In Southern Africa, most of the mechanisms developed by rural communities are complex and mainly based on culture and IK in the production of subsistence crops (Green 2008; Mugambiwa 2018). Mugambiwa (2018) stresses that Southern Africa's priority is to adapt to the climate change already being experienced anticipated in the region.

In the employment of the mitigation and adaptation approaches, it is critical to identify specific strategies, where IKS has been used, mainly in conjugation with universalistic science to strengthen the response system. The United Nations-based programs, Reducing Emissions from Deforestation and Forest Degradation (REDD +) and the ecosystem-based adaptation (EbA), are worth mentioning. These have been largely introduced through universal science that advocates for the reduction of GHG emissions into the atmosphere. Arguably, the knowledge of local and indigenous people has been found to be effective in the reduction of GHG emissions into the atmosphere (Kupika et al. 2019). Indigenous knowledge is already viewed as pivotal in several fields, such as sustainable development, agro-forestry, traditional medicine, biodiversity conservation, soil science, ethno-veterinary science, applied anthropology, and natural resource management (Mafongoya and Ajayi 2017). Many scholars highlight the significant role that IK plays in climate science and in facilitating climate change adaptation (Nyong et al. 2007; Green and Raygorodetsky 2010; Speranza et al. 2010; Crona et al. 2013; Ford et al. 2016; Chanza and Mafongoya 2017; Reyes-Garcia et al. 2019).

Knowledge Driving Climate Change Responses in Southern Africa

The different forms of knowledge, used either individually or jointly, characterize the climate change responses in Southern Africa to achieve climate change adaptation. The definition of IK is very complex and distinguishes sciences from other knowledge traditions (Mugambiwa 2018). There is no universal knowledge to which science is privy and to which all other knowledge traditions must defer. Knowledge is produced with relevance to specific contexts and questions, including Newtonian physics and Palikur astronomy (Perez et al. 2007). Indigenous knowledge is known as local or traditional knowledge and is defined as the beliefs and intellectual behaviors of indigenous societies, or local information about the relationship between humans and their environment (Mafongoya and Ajayi 2017). This knowledge is accumulated, developed, and transmitted through local community experiences and know-how across generations. Therefore, one can argue that IK is based on the cultural beliefs of a community and that it is orally transferred from one generation to another (Casper 2007; Bryan et al. 2011; Baudron 2011). Thus, there exists a binary divide between universalistic science and IK (Appignanesi 2018). Western science is seen to be systematic, objective, open, and dependent on a detached center of rationality and intelligence. From a radical perspective,

Table 1 Major differences between IK and universalistic science

Major differences	Western/formal science	IK
Mode of transmission	Written, formally documented	Oral, repetitive
Substantive differences	To construct general explanations; is removed from people`s daily lives	Concerned with immediate and concrete necessities of people`s daily livelihoods
Methodological and epistemological differences	It is open, systematic, objective, and analytical. It advances by building rigorously on prior achievements	It is closed, non-systematic, and holistic rather than analytical. It advances on the basis of new experiences, not on the basis of deductive logic
Contextual differences	It is divorced from epistemic framework in search for universal validity	It exists in a local context anchored to a particular social group, in a particular setting, at a particular time

Adopted from: Mafongoya and Ajayi (2017)

universalistic science is understood to represent modernity, whereas IK is perceived as a traditional and backward way of life (Briggs 2005; Bauer and Scholz 2010). Clearly, these knowledge forms seem to be divergent and have been differently criticized. The cleavage between Western science and indigenous science is explored by Briggs (2005). Briggs (2005) argues that the use of IK is riddled with problems and challenges as it focuses on the (arte)factual, stating that this knowledge form has been romanticized. Wallner (2005) contends that Western science can become "very immoral" and "very dangerous" as it lacks subjectivity. From an African perspective, however, several scholars argue that IKS has been a sustainable factor in development of physical artefacts in space like infrastructure provisioning as it has minimized damage to the environment by allowing people to live in harmony with nature for generations (Kupika et al. 2019). Table 1 compares IK and universalistic science.

Local knowledge about ecosystems has been used in different parts of the world in an effort to respond to climate change. Universalism is defined as the epistemological and philosophical orientations taken by scientists of claims about the world or a particular issue in question (Green 2008). Western science is centralized and associated with the machinery of state, and its bearers believe in its superiority. The differences between IK and Western scientific knowledge are best described in the following grounds:

- Substantive grounds: there are differences in the subject matter between IK and Western knowledge.
- Methodological and epistemological grounds: the forms of knowledge employ different methods to investigate reality.
- Contextual grounds: IK is more deeply rooted in its environment (Mugambiwa 2018).

Therefore, it is undeniable that both Western science and IKS play significant roles in promoting sustainable development through mitigation and adaptation measures. The full conceptualization of IK can greatly contribute to the strengthening of the resilience of poor societies or marginal areas in Southern Africa. One of the best approaches to employ for climate change adaptation in poor regions is the ecosystem-based approach (Chanza and de Wit 2016; SSSI 2018; USAID 2018). In Zimbabwe, this is crucial especially to small-scale farmers as they are more prone to the effects of climate change. It is predicted that billions of people, particularly those in developing countries, face water and food shortage as well as greater risks to health and life as a result of climate change (Shava et al. 2009; Shames et al. 2012; Wang and Corson 2015). Thus, fully assessing the benefits of both science and IK in the face of climate change in Southern Africa is crucial. In an effort to adapt to climate change, there are conceptual issues that need to be considered. This chapter considers four factors that may possibly provide insights into the adaptation approach that may be employed in Southern Africa. The conceptual issues of vulnerability, EbA, REDD+, and resilience are discussed in the following sections.

Vulnerability Concept

In relation to climate change, vulnerability is the degree to which a system is susceptible to, and unable to cope with, the adverse effects of climate change, including climate variability and extremes (UNFCCC 2007; IPCC 2014; Mavhura 2019). Climatic stress is already causing much pressure on the African region, making it highly vulnerable to the impacts of climate change (UNFCCC 2007; Bauer and Scholz 2010; Mugambiwa 2018). In Southern Africa, the poor predominantly depends on natural resource-based livelihoods, which are climate-sensitive. This makes them mostly vulnerable to poverty as they have minimum capacity to economically manage and cope with the damage caused by natural disasters or incremental degradation (Swinkels et al. 2019). Africa is well known to have diverse climates that are considered to be the most variable in the world on seasonal and decadal time scales. This makes the region's societies and ecosystems most prone to climatic events largely in the form of frequent floods and droughts (UNDP 2018). Africa's vulnerability to climate change also opens up room for its exposure to famine and widespread disruption of socioeconomic well-being as well as climate-sensitive diseases, such as diarrhea, malaria, and tuberculosis.

Ecosystem-Based Adaptation Concept

Adaptation to climate change is associated with adjusting to expected or actual climate. The goal of adaptation is to reduce the vulnerability of the environment, regions, or societies to the harmful and dire effects of climate change (Green 2008). It also involves making the most of any potential beneficial opportunities associated with climate change. Ecosystem-based adaptation therefore refers to the management of ecosystems to enhance ecological structures and functions essential for ecosystems and the people to adapt to multiple changes, including climate change (Kupika et al. 2019). This approach has the potential to contribute multiple benefits through the reduction of vulnerability to climate change as well as contribute to socioeconomic development and conservation (Mafongoya and Ajayi 2017) Ecosystem-based approaches include the maintenance of safety nets as a mechanism that best serves as a coping strategy during scarcity periods to enhance livelihood security. Some approaches implored under EbA include the following:

- Restoration of ecosystems that can reduce the exposure of human settlements to extreme weather events or climate change, e.g., combining the "building with nature" techniques with hard-engineering infrastructure to restore mangrove coastlines that reduce the risks of flood, erosion, and saline intrusion and support adaptation to sea-level rise (Bauer and Scholz 2010).
- Integration of sustainable ecosystem management practices into broad landscape-level planning processes. For example, integrated watershed management in peri-urban areas, which has proven to enhance water regulation to support the supply of water for drinking and hydroelectricity generation in cities.
- Payment for ecosystem services to diversify income generation and build adaptive capacity, for example, conserving a shoreline mangrove and coral reef system to maintain economies based on ecotourism, recreational activities, and fisheries.
- Climate mitigation by maintaining or enhancing carbon stocks with safeguards in place to support adaptation, for example, collective management of forested landscapes that promotes social learning to conserve forest function and structure, biodiversity and habitat connectivity, and climate-smart agriculture with agroforestry systems.

At the center of this approach lies the recognition of nonlinear feedbacks between social and ecological processes. Ecosystem-based approaches can be applied to all types of ecosystems and at different scales from local to global (NASA's Global Climate Change n.d.). Chanza and de Wit (2016) suggest that EbA should be best articulated at the local level where it can promote adaptation governance through IK. They also argue that the concept provides multiple benefits to society and the environment as it contributes to reducing vulnerability and increasing resilience to both climate and non-climate risks. Many cases in Africa have also shown that EbA approaches involving local people using their IKS can promote climate proofing and emission reduction (Hachileka 2010; Lo 2016; van Niekerk et al. 2017).

REDD+ Concept

The UN-based REDD+ program is an incentive-based tool that bases its work on public and private agents' self-interest in conservation strategies and the fact that they are well capable of calculating the opportunities as well as the costs associated with the reduction of GHG emissions into the atmosphere (Karsenty et al. 2012). The main concept of REDD+ is to make performance-based payments, which means that forest users and owners are paid to reduce GHGs emitted into the atmosphere (Angelsen 2009). Payments for environmental services gives the forest owners the opportunity to receive incentives to motivate them to manage forests better and also minimize the rate at which deforestation occurs (Baudron 2011). Therefore, the concept of REDD+ is a rewarding mechanism to actors involved in keeping and restoring forests as well as a mechanism with the main objective of reducing carbon emissions (Karsenty et al. 2012; Skutsch and Ba 2010).

The concept of REDD+ has been implemented at a global level through the United Nations Development Program (UNDP) as a strategy to reduce GHG emissions into the atmosphere while promoting economic development, especially in developing regions, such as Africa (UNDP 2018). Developing countries have a competitive advantage in the carbon market if they choose to conserve their forests rather than convert them for agricultural use (Gantsho and Karani 2007). The REDD + mechanism thus invests in providing incentives to projects that promote forest conservation and conversion, afforestation, and reforestation (Wang and Corson 2015; Leach and Scoones 2013; Shames et al. 2012). This has led to the introduction of carbon markets that have successfully paved way for developing countries to earn funds through forest conservation. The plus sign on REDD+ indicates how the concept is also dedicated to the enhancement of forest carbon stock which can also be referred to as forest rehabilitation and regeneration, carbon removal, negative emissions, negative degradation, or carbon uptake (Angelsen 2009). Chanza and de Wit (2016) reveal opportunities for the success of this initiative if local communities can use their IKS in forest conservation. In Kenya and Tanzania, for example, the success of REDD+ projects has been attributed to participatory planning where the knowledge of local citizens in technical analysis has helped in addressing the drivers of deforestation and forest degradation (Richards and Swan 2014).

Resilience Concept

There is no universally accepted definition of resilience. The vast and growing literature available on urban resilience demonstrates the complexity of the concept as a target, as well as the challenges of mainstreaming recommendations into the urban development practice (UN-HABITAT 2017). The concept of resilience originated from ecological studies, exploring the varied ability of ecosystems to absorb and adapt to external pressures (Dau Kuir-Ayius 2016). The Intergovernmental Panel on Climate Change (IPCC) (2014, p. 1772) defines it as “the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.” Understanding that human systems function as complex, interdependent, and integrated social-ecological systems is crucial to understanding how resilience-based planning, development, and management can protect life and assets as well as maintain the continuity of functions through any plausible shock or stress (Sekar et al. 2019; UN-HABITAT 2017; Dau Kuir-Ayius 2016). Thus, the Southern African region needs to develop resilient strategies that will assist them in coping with climate change (Doyon 2016; Dau Kuir-Ayius 2016; UN-HABITAT 2017; Kupika et al. 2019). Scholarship treating IK and climate change resilience is still developing (Bohensky and Maru 2011; DeAngelis 2013; Makate 2020). Despite the phenomenal growth in resilience literature, Bohensky and Maru (2011) express the lack of clarity and empirical evidence for the relationship between IK and resilience. Citing the utility of IK in agricultural projects, Makate (2020) argues that in establishing resilience to climate change, local communities should be seen as equal partners in the development process. The next section discusses the strengths and limitations of the existing climate change response practices in Southern African countries.

Experiences with Climate Change Responses in Southern Africa

The study found out that in its trajectory to curb the effects of climate change, Southern Africa is largely driven by modernity. However, due to the slower development of this region compared with the Western and European regions, it is difficult to implement technologically advanced measures owing to its limited manpower, poor resource management, and inadequate finances to make use of the science. Therefore, traditional knowledge and IK play a significant role in climate change adaptation in many rural communities (Green 2008; Mafongoya and Ajayi 2017; Kupika et al. 2019). However, due to modernity, it is now rare to find pure IKS practices that are not contaminated with the conventional construct of adaptation practices. Thus, it is important to fully understand indigenous-based practices that continue to shape the adaptation landscape in the African context and to assess the strengths and limitations of such strategies. This chapter argues that one way to complement the strengths of adaptation practices in the region is to complement the two forms of knowledge. Conscious of the blending gaps that have been highlighted in adaptation literature, the next sections also propose how the two knowledge systems can jointly work best.

In Southern Africa, there exists a diverse and unique group of cultures, including the Shona, Ndebele, Zulu, Tswana, Xhosa, Pedi, Tshangni, Venda, and Suthu, among many others (Mabogunje n.d.; Hanyani-Mlambo 2002). The main common aspect of all these African cultures is that they all started as hunters, gatherers, nomads, and pastoralists. Their traditions and way of living are still being practiced today, especially in marginal areas, for instance, in the Mbire District in Zimbabwe and the Khoisan in the Kalahari Desert of Botswana (Dube et al. 2014). In this regard, it can be safe to agree that traditional knowledge is also an ecological knowledge. It involves adaptation processes that have been handed down from generation to generation, and thus, they are useful in climate change adaptation (Dabasso et al. 2014).

The renewal of IK throughout generations has ensured the well-being of many Southern African people through ensuring food security, early warning systems, environmental conservation, and disaster risk management (Mawere 2010). Therefore, it can be deduced that the people rely on this traditional knowledge for social capital and food production as a way to ensure survival. The advent of universalistic science that has enabled the invention of technologies, machines, and concepts that are mostly unsustainable has led to IK being disregarded as it is considered as backward and old (Carmody 1998; Mugambiwa 2018).

Towards a Hybrid Knowledge Approach in Climate Change Adaptation

Climate change adaptation calls for more than just local experiences or scientific knowledge. Effective adaptation to climate change in Southern Africa requires the best knowledge regardless of where it is coming from (Shava et al. 2009). Hybrid knowledge from both sources is only possible through collaborative process, community participation, and involvement and interactions between the locals and scientists. It is also important to acknowledge that IK can provide solutions to food insecurity and poverty (Hussein and Suttie 2016). Appropriate and effective use of IK can promote a number of advantages that can match those of conventional science. These include environmental conservation and management of disasters in terms of prevention, mitigation, recovery, prediction or early warning, preparedness, and healing through traditional medicinal practices by producing traditional foods. In Kenya, the Maasai traders have relied on the benefits provided by the earth's resource, which has ensured a stable livelihood for centuries (Wang and Corson 2015).

As the world warms, traditional weather indicators may become less and less valuable. Individual species will adapt to the impacts of local climate change in idiosyncratic and unpredictable ways. Animals may change their behaviors or their ranges, whereas plants may begin flowering at different times. It is feared that these changes might render traditional knowledge less reliable. One way to strengthen the hybridization of IK and universalistic science in terms of climate change response is to revitalize or strengthen local institutions (Mararike 2011; Makate 2020). According to Makate (2020), the integration approach can work best only where climate adaptation practitioners build from existing local-based knowledge forms, rather than moving to replace them. When strengthened, local institutions can enhance the employment and scaling success of climate adaptation projects and innovations. Such efforts will improve information sharing, resource mobilization, stakeholder coordination, network establishment, and capacity building with local citizens as well as provide leadership and control of climate adaptation programs. The technological orientation of adaptation practice as seen through irrigation infrastructure in the agricultural sector, for instance, can be enhanced if local farmers are given sovereign rights over the traditional crop or animal varieties of their choice. Accordingly, it is reasonable to suggest that using the two knowledge forms individually will not provide solutions to the increasing threats of climate change in Southern Africa.

Conclusions and Recommendations

Given the sensitivity of the entire socioeconomic sectors and natural systems to the increasing climatic events, the Southern African region is expected to devise appropriate mitigation and adaptation practices. The region faces a quandary in terms of the trajectory that it should take in its development plan in the context of the existing and anticipated climate change threats. Climate change is starting to be factored into a variety of development plans on how to manage the increasingly extreme disasters faced by humanity and their associated risks, how to protect coastlines and deal with sea level rise, how to best manage land and forests, how to deal with and plan for reduced water availability, how to develop resilient crop varieties, and how to protect energy and public infrastructure. In other parts of the world, countries are working on building flood defenses, plan for heat waves and high temperatures, install water-permeable pavements to better deal with floods and stormwater, and improve water storage and use. However, in the absence of national or international climate policy direction, cities and local communities worldwide have focused on solving their own problems on climate change. The importance that communities in Southern Africa place on IKS in the face of climate change deserves recognition. However, due to changing seasons, IKS needs to be integrated with scientific methods as it cannot address the magnitude of the challenge alone. In the face of global climate change and its emerging challenges, unknowns, and uncertainties, it is important to base the decision-making for policies and actions on the best available knowledge. The multisectoral and cross-scale nature of climate change responses, such as REDD+ and ecosystem-based adaptation approaches, requires the integration of a range of disciplines, actors, and institutions interacting at different levels and influencing diverse decision networks.

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