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Climate governance beyond the government: Indigenous knowledge systems in rural Zimbabwe's climate change adaptation

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Abstract

This paper assesses climate governance beyond the government, that is, climate governance alternatives that exist outside the context of government policy frameworks in rural Zimbabwe. Indigenous Knowledge Systems (IKS) are one of the alternatives available. Each community in developed, developing, and underdeveloped nations have their own indigenous knowledge systems because IKS are context specific. This encourages the effort to comprehend what indigenous knowledge systems are, and what they signify, on a fundamental level. Environmental disasters have always been a fact of life for African communities and smallholder farmers. Farmers are equipped with the knowledge necessary for coping with climate-related environmental shock and stress as a result of these encounters. The development of a comprehensive national response to climate change requires this information, according to several academic sources. Indigenous knowledge is a solid foundation and premise for climate change adaptation since indigenous people are well-versed in actual and potential solutions. Many scholars agree that few efforts have been made to incorporate IKS into formal climate change adaptation measures in terms of climate governance; therefore, it is necessary to incorporate IKS into the government policy framework on climate change.

Keywords: Africa; Climate Governance; Climate Change; Indigenous Knowledge Systems; IKS; Rural; Environmental Quality; Sustainability; Zimbabwe

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1. Introduction

Indigenous Knowledge Systems (IKS) are context-specific, which means that each community in developed, developing, and underdeveloped nations have their own indigenous knowledge systems (Nyong et al., 2007; Chanza, 2015). This motivates the effort to comprehend fundamentally what IKS are and what they imply. Indigenous knowledge systems are defined as the wisdom, knowledge, and practices of a given community's indigenous people; this information must have been acquired via experience or orally transmitted from generation to generation (Nhemachena, 2007). This knowledge only qualifies as indigenous if it has significantly contributed to the resolution of socio-environmental problems, including those relating to climate change and variability (Chanza, 2015). Indigenous people watch the activities occurring around them in a variety of ways, and in the event of environmental hazards, they use their knowledge of the environment and the other factors surrounding them to adapt to the threats. Recent studies have established that indigenous people who live near natural resources notice the surrounding activity and identify and adjust to any changes in various ways (Masoga and Shokane, 2017; Mugambiwa, 2018; Chanza and Gundu-Jakarasi, 2020).

The various meanings of specific birds, and the flowering of particular flora are correlated with the observed changes in communities (Nhemachena, 2007; Chanza 2015; Mugambiwa, 2017). These are indicators that communities use to ascertain that certain changes have occurred, and to anticipate certain environmental alterations that are, in most cases, related to climate change. Mugambiwa (2020) has established that indigenous people have utilized biodiversity as a buffer against variation, change, and catastrophe in the face of plague or any other type of environmental hazard. It has also been documented that, in order to adapt to the rapidly changing environmental conditions caused by excessive or low rainfall and drought, indigenous people in many parts of Africa cultivate crops with varying susceptibilities to drought and floods and frequently supplement these crops with hunting, fishing, and gathering wild plants (Nhemachena, 2007; Chanza, 2015). In this regard, indigenous knowledge is considered the basis for decision-making at the local level in rural areas. It has relevance not only for the culture in which it develops, but also for scientists and planners who want to improve conditions in rural areas (Mugambiwa and Rukema, 2019). This shows that indigenous knowledge is the foundation for effective participation in any type of community development.

Moreover, climate variability is believed to have a substantial impact on the success of agricultural production in rural Zimbabwe (Mugambiwa, 2020) Throughout the course of their history, communities on every continent have endured a variety of climate-related catastrophes. These natural disasters include droughts, floods, hail, thunderstorms, tsunamis, and powerful winds, which frequently result in the death of humans, animals, and crops (Oluoko-Odingo, 2010; Mugambiwa and Makhubele, 2021). These disasters should be comprehended and frequently prepared for so that societies are always in a safer position if they occur. Numerous environmental risks, including droughts and cyclones, have often been observed in Zimbabwe. According to recent reports, droughts in Zimbabwe have become increasingly regular and severe, with the 1992-1993 drought being the worst in recent memory due to the loss of 60 percent of the national cattle herd (Nyahunda and Tirivangasi, 2021a).

Prior to the widespread adoption of contemporary scientific methods, rural populations relied only on IKS, with some animals, birds, insects, and plants believed to be able to sense and respond to changes in atmospheric conditions. Over time, human cultural development has advanced and taken various levels and stages. The manner in which people employ their cultural beliefs to respond to adversity has also been used to

the environment in order to address climate-related concerns and assist communities in adapting to the multiple effects of climate change (Oluoko-Odingo, 2010). In addition, communities have made several advances, such as mastering the positions of stars, the sun, and the moon (Mugambiwa, 2017). Moreover, they reportedly comprehend wind speed and direction, cloud position, and lightning patterns. All these experiences are crucial for anticipating future environmental changes and shifts and explaining them within their cultural context. In this context, Ajibade and Shokemi (2003) indicates that the knowledge of past natural disasters and climate in Africa is part of the IKS-based experiences that have been transmitted orally from generation to generation. IKS is also used to characterize knowledge systems created over a very long period of time by groups opposed to scientific knowledge (Ajibade and Shokemi, 2003).

This paper reviews the situation with respect to IKS climate adaption in rural Zimbabwe, with general references and examples to clarify the concepts, interpretations, and practical applications in national climate change policy and strategies. The purpose of this paper is to summarize and synthesize the literature and resources available to confirm and document the importance of IKS in mitigating and understanding climate change and human rural adaptations. The objectives are: i) to align sustainable development strategies with IKS climate adaption strategies to develop community responses more effectively in Zimbabwe, and ii) to illustrate that IKS can support pest-control and natural-hazard mitigation processes more readily in combination with a conceptual approach.

1.1. Indigenous knowledge systems and climate change

The notion of IKS adds a cultural component to the discussion around the general perception of climate change and the assumed and real adaption techniques. Many experts, such as Ajibade and Shokemi (2003), regard the cultural dimension to be of utmost relevance to the development options on topics of national significance, as they are strongly tied to the indigenous people of Africa. This position argues that climate change, as one of the most important environmental concerns, should be addressed within the framework of cultures, with a variety of adaptation techniques based on culture in place. Ajibade and Shokem (2003) imply that local communities in Africa have established intricate systems for weather-related data collection, interpretation, and decision-making. For example, Ajibade and Shokemi (2003) reported that Nigerian farmers use their understanding of weather systems such as rainfall, thunderstorms, windstorms, and sunshine to plan for future weather conditions. Using IKS, they have adopted what is known as IKS weather forecasting, which is now an integral element of the farmers' disaster preparation and response system. In this sense, the distinction between traditional and Western systems is that meteorologists employ global models and satellite photos, but IKS obtains its knowledge, among other things, from animal and plant species' lived experiences.

Roncoli et al. (2001), asserts that senior male farmers are responsible for the formulation of seasonal rainfall hypotheses based on their observations of natural occurrences. In addition, community cultural and ritual professionals are used to derive forecasts from divination, visions, or dreams. This indicates that IKS has another aspect that does not solely focus on living experiences, but rather on the supernatural world, which translates to the function of the gods or ancestors and spirit mediums. In addition, Roncoli et al. (2001) found that not everyone has the ability to accurately predict the weather utilizing IKS based on either personal experience or supernatural skills. This suggests that select individuals in every society possess the supernatural abilities necessary to anticipate or foretell the changes that will occur or the method in which communities should prepare with regard to the types of crops they should plant (Mugambiwa, 2018). In

addition, it has been shown that the most often used indicators include the time and duration of low temperatures during the beginning of the dry season, the timing of fruiting on certain local trees, the water level in streams, the nesting behavior of birds and insect behavior (Roncoli et al., 2001).

1.2. IKS climate change interpretation

Now that the use of IKS in climate change adaptation has been described, this study focuses on the idea of IKS climate change interpretation, which refers to the manner in which indigenous people understand the observed changes from an indigenous perspective. Ajani et al. (2013) show that the scientific and indigenous populations understand climate change differently. Mugambiwa (2020), found that farmers assess IKS climate change via a variety of approaches. These strategies include the interpretation of observable characteristics, such as rainfall amounts and river flow patterns, as well as many other significant components in the interpretation of meteorological occurrences. Accordingly, blossoming and mating patterns of plants and animals have been described as a part of this strategy. In several African indigenous groups, it has been suggested that climate change is a symbol of the wrath of the gods over issues with which they are not especially pleased, such as the failure of a larger portion of the community to observe specific cultural manifestations or practices (Mugambiwa, 2020).

Moreover, it has been established by a number of scholars that some animal species migrate over varying distances based on the prevalent rainfall patterns, and that some of these species are associated with the prevalent type of climate to the extent that indigenous people who have studied them over time are able to explain the migrations (Kiem et al., 2016; Mugambiwa, 2017). According to several researchers, the study of bird behavior can be conducted with a variety of methods. As an example, a common bird in Africa is the kingfisher, which has several sub-species. The West African forest Kingfisher bird and the Southern African kingfisher bird are related by the occurrence of severe rainfall during bird nesting and hatching stages. Indigenous people have examined this pattern over time and concluded that the nature of the bird's sound mimics the clattering of raindrops characteristic during a severe rainstorm (Mugambiwa, 2020). Noting that this knowledge is a privilege of the older members of the community shows that there is a need to emphasize the importance of the elderly in climate change governance, as they play a vital role in interpreting IKS issues. As such, one must recognize that the elderly serve as the conduit via which IKS is transmitted from one generation to the next. Their knowledge is of the utmost importance because it indicates what they have direct experience with.

2. Coping with the changing environment

Environmental catastrophes have always been a fact of life for communities and smallholder farmers in African communities (Mugambiwa, 2020). As a result of these encounters, farmers are equipped with the knowledge necessary for coping with climate-related environmental shock and stress (Oluoko-Odingo, 2010). According to many academics, this information is crucial to the development of a comprehensive national response to climate change. Indigenous knowledge forms the cornerstone and premise of climate change adaptation, as indigenous people are well-versed with positive solutions to environmental problems (Nyahunda and Tirivangasi, 2021b). Mugambiwa (2020) argues that strengthening and incorporating IKS into local level policies is of the utmost importance for the development process. Further, Mugambiwa (2020) has

hypothesized that IKS develops in areas where people have lived for an extended period of time and are integrated with their biophysical environment. People typically employ IKS-based knowledge regarding plant and animal species, among other topics. Knowledge of plant and animal species enables members of a community to comprehend their living environment to the extent that they can relate their behaviour to physiological changes.

In addition, Mugambiwa (2020) acknowledge that many communities can exhibit their richness in IKS through traditions such as rain-making rites. The authors claim that the diversity of IKS is exemplified by the fact that many of these processes are not uniform, indicating that they are diverse, but yield beneficial results that can be successfully used in climate change adaptation. In this regard, Mugambiwa (2020) concur that the processes vary significantly in different parts of the African continent, namely the eastern, southern, and northern regions, and that this alone offers a vast array of opportunities for in-depth studies that reveal how the various processes are executed and how they inform or influence adaptation strategies and national climate change policy.

If ideas are demonstrated to have been tried and tested, it can be argued that they will be readily embraced. As a result, the adoption of behaviors that are supposed to have been passed down from generation to generation in the name of IKS is expected to offer improved prospects in the fight against climate change (Mugambiwa, 2020). This implies that the practices that are most readily embraced by the general population are those that already exist. Mugambiwa (2020) conducted a study in Zimbabwe and found that local farmers were more ready to participate in the adaptation process when seasonal forecasts were combined with IKS. This was largely due to the fact that the procedure provided farmers with familiar techniques. Farmers participated in IKS processes involving natural mulching, the suppression of illnesses and harmful insects, and the retention of soil moisture. There was also widespread use of IKS-based plant products, which included agrochemicals, by small-scale farmers to combat pests that are typically known to attack food crops (Mugambiwa, 2020). Lastly, managed bush clearance as a means of minimizing soil erosion caused by runoff, the use of green manure, and the protection of riverbanks were among the most important IKS techniques utilized by the communities.

3. Integrating IKS in climate change adaptation

In Africa, the concept of integrating climate change adaptation through IKS is not new. Natural disasters such as droughts and floods have long been a part of the African landscape, and over the years, Africans have adapted in a variety of ways to their consequences (Brooks and Adger, 2005). Consequently, communities in many African nations have been able to adapt to the changing environment and have also gained the required skills quickly to adapt to climate change and other natural calamities unrelated to climate change (Oluoko-Odingo, 2010). One of the primary reasons why communities in the majority of African countries have survived and overseen population growth is that they have successfully adapted to the changing environment within their cultures over time. It is important to note that these methods are consistently applied by the majority of African nations in order to adapt to the effects of climate change (Mugambiwa, 2020). Consequently, given the recorded means by which societies have persisted, one can argue that such information can be utilized in various academic and policy contexts.

4. Climate change IKS adaptation and sustainable development

The primary aim for utilizing IKS adaptation in rural communities is to help achieve sustainable development in rural communities. Many scholars concur that few efforts have been made to include IKS into formal climate change adaptation measures in terms of climate governance (Nhemachena; 2007; Mugambiwa and Rukema, 2019), and that climate change should not be addressed outside of the framework of sustainable development. Since many rural communities rely heavily on the natural environment, rural communities require measures to mitigate the consequences of a changing natural environment in order to achieve sustainable development. As a result, the incorporation of IKS into climate change policies can lead to the development of effective adaptation methods that are not only cost-effective but also participatory and sustainable. For example, they will not require additional funding to implement, and villagers will be willing to participate because the programs will be implemented within their cultural context. However, the usage of IKS should not be undertaken at the expense of scientific methodologies, but rather to supplement the current scientific global knowledge systems.

Moreover, Ajani et al. (2013) claim that the value of IKS has been recognized, and accounted for, in the design and implementation of sustainable development initiatives that incorporate it. On the other hand, it is apparent that very little has been done to include IKS in official climate change adaptation efforts. Therefore, based on the evidence, governments and academics are obligated to develop strategies to guarantee that IKS is incorporated into the broader academic spectrum (Williams and Hardison, 2013). Even though IKS has been passed down orally from generation to generation, its relevance should not be overstated. As IKS is regarded as the foundation of local-level decision-making in many rural communities on the African continent, it will be difficult for communities to function without it (Adger et al., 2012). It has also been demonstrated that IKS is transportable insofar as it provides relationships that connect individuals directly to their environments in order to help them adapt to climate change (Mugambiwa and Makhubele, 2021).

The preceding discussion illustrates some of the reasons why it is challenging to address climate change outside of the context of sustainable development. Climate change and sustainable development should not be separated, as sustainable development is the most effective means for communities to pose the adaptation and mitigation question. The process of incorporating IKS into climate change policies requires the creation of competitively successful, cost-efficient, and sustainable adaption solutions (Leonard et al., 2013). In this light, it may be stated that IKS provides communities with easy and user-friendly solutions for coping with, or adapting to, the effects of climate change in rural areas.

In addition, it has been established that local farmers in sub-Saharan Africa have developed numerous adaption measures throughout the years that have consistently allowed them to lower their sensitivity to climate change and unpredictability (Adger, 2012). The construction of early warning systems for the prediction of future events is a method that is consistently adopted in several African nations. Many rural communities are lauded for their ability to predict weather and climate because IKS enables them to comprehend current weather circumstances and predict future weather conditions and calamities (Mugambiwa, 2018). This indicates that farmers in most rural sub-Saharan African areas are proficient in predicting weather conditions. In essence, these farmers have constructed intricate IKS-based systems for gathering, predicting, and interpreting weather-related data and information (Adger, 2012). As a means of mitigating their sensitivity to the consequences of climate change, the farmers' employment of IKS-based

systems has been extraordinarily significant. This has been noted in Zimbabwe where farmers have resorted to farming traditional small grains as they are more adaptable to climate change (Muzerengi and Tirivangasi, 2019).

5. Water and land resources usage as indigenous adaptation measures

The implications of climate change and variability in sub-Saharan Africa on agricultural and land use, ecosystem, human settlements, health, and water resources are anticipated to be substantial (Luseno et al., 2003; Ajani et al, 2013). Considering this, it is projected that communities in sub-Saharan Africa will strengthen their adaptability. Climate change is expected to have a considerable impact on agriculture, water consumption, and land use, both in terms of the quantity of agricultural products produced and the location or area of production. Since most of the agriculture in Sub-Saharan Africa is rain-fed, it is projected that climate change will have a considerable impact on agricultural production. Temperature increases and a decrease in precipitation are a second concern that will undoubtedly impact populations (Mogotsi et al, 2011). It is also crucial to stress that the effects of climate change would not only be felt on the agricultural or productive side, but also through the displacement of individuals and families, as it is expected that people will be compelled to relocate to marginal lands.

Water supplies are another significant factor that will be significantly impacted by climate change (Moeletsi et al., 2013). The availability and quality of water are significantly impacted by climate change, which can result in either less precipitation or cyclones that create drought. In the event of decreased precipitation, there will be less water available for agricultural activities, and in the event of flooding, the quality of available water is likely to be reduced. With lower water quality, crops will be damaged, leading to hunger and food insecurity. Both effects may have significant consequences on agricultural activity, given that rural communities depend largely on agriculture for their subsistence economy. The importance of water for agriculture in semi-arid tropical areas has also been confirmed, despite the fact that rainfall forecasts are reported to be unpredictable. In this regard, scientists agree that climate change will decrease the availability and storage of water, while rising temperatures will decrease the quantity and quality of water required to irrigate crops (Mogotsi et al. 2011; Moeletsi et al. 2013). Water availability is of essential importance in terms of crop productivity and sustainable development.

Numerous agriculture-related adaption solutions have favorable effects on water resources and management (Nkoana et al., 2018). This is of the utmost importance because there is no form of agriculture that does not require water resources, and farmers make a variety of measures to supplement water resources in the case that climate change strains water resources (Anguelovski et al., 2014). In this regard, it is important to note that the majority of water-related adaptation techniques include the many types of irrigation in which people engage. These methods include drawing water from rivers, wells, or boreholes. However, despite the various forms of irrigation employed by humans, they all serve the same function, which is to supply additional water sources (Cooper et al., 2016). It has also been stated that enhanced agriculture and grazing management plays a significant influence in water storage and infiltration, resulting in greater water availability in the soil and increasing the water balance of the ecosystem (Huxman et al., 2005). This process then plays a significant role in the application of manure and, more generally, in other methods that maintain or increase soil organic matter.

Moreover, conservation agriculture is claimed to be significant in reducing soil evaporation in arid settings (Nkomwa et al., 2014). This is a result of the cumulative water loss that occurs through runoff and evaporation, which leaves crops with less than half of the rainfall. It has also been demonstrated that terraces and contour ridge farming have enormous effects on water, allowing for the storage of precipitation and the drainage of excess runoff (Nkoana et al., 2017). In areas where water management is focused at lowering water tables for crop production, there will be a risk of exposing soil organic matter and promoting considerable soil carbon losses. According to the views presented by experts, much of the concern over water supplies in agriculture arises from a deficiency of moisture required to ensure optimal crop or pasture production (Ajani et al., 2013).

This issue is especially important in dryland agricultural systems (Abbas et al., 2016). Consequently, irrigation is regarded as the most common and direct method for farmers to alleviate water stress on crops and forage grasses. However, enhanced cropland management and grazing management are other feasible alternatives that can be utilized to improve soil water regimes. In semiarid regions of sub-Saharan Africa, Nkomwa et al. (2014) found that small-scale farmers utilize planting trenches to capture rainwater and repair degraded soil for millet and sorghum growth. This type of technology is known to boost nutrient availability and improve infiltration on sandy and loamy soils, resulting in considerable production gains and enhanced soil cover (Nkomwa et al., 2014). In the same areas, farmers also collect rainwater from rooftops and channel water from natural springs into storage tanks (Anguelovski et al., 2014). This ensures that they have a significant quantity of water conserved for future usage. This implies that when they encounter drought, the stored water will support them for a significantly longer amount of time, allowing them to continue agricultural activities.

Additionally, it has been determined that water is essential for the supplemental irrigation of vegetables and crops (Cooper et al., 2016). In some areas, when the weather becomes dry, such as in the case of a brief period of rain, the water infiltrates underground and is utilised by plants, allowing farmers to continue their farming tasks (Abbas et al., 2016). Also, it is believed that crops would likely reach maturity using the stored water. The experiences of farmers suggest that they will be able to harvest water from pits regardless of the number of days available to them throughout a season (Nkoana et al., 2018). The fact that these procedures are made possible by the combination of IKS and scientific approaches, both of which have the ability to increase agricultural output and sustain the farming system, is of the utmost importance.

6. Climate-proof crops adaptation

In addition to land-based climate adaptation, effective strategies include climate-proof crop adaptation. For example, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has created pearl millet hybrids that can withstand 40 degree Celsius temperatures and produce normal yields with low amounts of water (Abbas et al., 2016). This is what is known as climate-resistant agriculture. It is crucial to underline that these crops are of utmost relevance in terms of climate change adaptation. Similarly, the Kenyan Ministry of Agriculture has developed drought- and disease-resistant maize, sugarcane, and wheat cultivars with good yields (Nyariki et al., 2009). Even though this variety of crops differs from that produced by ICRISAT, the concept of climate-resistant crops remains the same. Other nations that have introduced the same crop include the dry and semiarid regions of Congo, Sudan, Tanzania, and Uganda. In this light, one may argue that

temperature-resistant crops are of essential relevance in terms of climate change adaptation (Oluo-Odingo, 2010). The process adds to the several other forms of adaptation described in this section.

6.1. Pest control methods

In many studies, pest control methods are not considered climate adaptation measures, but they play a significant role as climate adaptation measures given that many of the pests' farmers confront are a result of climate change (Nkoana, 2018). Even without the context of climate change, pests have long been one of the many obstacles farmers encounter in their daily operations. The incidence of pests is expected to increase in response to climate change, considering the multiple actual and anticipated effects of climate change. Therefore, the development of technologies to assist farmers in pest management is of the utmost importance. Because eradicating pests is of the utmost significance, both scientific and IKS techniques have been employed. Climate change poses several obstacles to the growth of pests, however, not all pests are a direct result of climate change. This indicates that there are both natural plant-related pests and pests caused by climate change. Given the circumstances surrounding pests, one may argue that their effects are identical in that they all have enormous influence on the productivity of agricultural produce, posing a formidable problem for farmers.

7. Conclusion

This study assessed climate governance alternatives that exist outside the context of government policy framework. Indigenous Knowledge Systems (IKS) are among the available alternatives and are context specific. This motivates efforts to comprehend what indigenous knowledge systems are, and what they signify, at a fundamental level. For African communities and smallholder farmers in Zimbabwe, environmental disasters have always been a way of life. As a result of these encounters, farmers are equipped with the knowledge necessary for coping with climate-related environmental shock and stress. Indigenous knowledge is nonetheless the basis and premise of climate change adaptation, as indigenous people are already familiar with these solutions. Many scholars concur that while few efforts have been made to integrate IKS into formal climate change adaptation measures in terms of climate governance, it is now necessary to make a stronger effort to integrate IKS into the government policy framework on climate change. This paper clarifies some reasons and examples of IKS in action in Zimbabwe and other parts of Africa to help accomplish this important goal.

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