International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Assessing the role of Indigenous ecological knowledge for climate change forecasting among rural farming communities in Malawi: A Case Study of Phalombe, Salima and Nkhatabay Districts

Dr. Ausward W Zidana Jere

PhD in Agriculture
auswardzidana @gmail.com

ABSTRACT :

Rural farming communities in Malawi continue to rely on place based ecological knowledge to explain seasonal variations and prepare for weather related risks. This study examines how indigenous knowledge systems (IKS) provide locally relevant mechanisms for climate prediction in Phalombe, Salima and Nkhata Bay districts. A qualitative case study approach was employed, focusing on focus group discussions, key informant interviews and secondary literature to document indicators used in predicting droughts, dry spells and floods. The findings show that communities observe environmental cues, including the behavior of birds, insects, cloud patterns, winds, and plant phenology, to predict seasonal performance and guide agricultural decisions. Despite changing climate conditions reducing the reliability of some indicators, the IKS remains an accessible and reliable forecasting tool that enhances climate resilience. The study recommends integrating IKS with scientific early warning systems to strengthen local adaptation planning in Malawi.

Keywords: Indigenous knowledge, climate forecasting, rural resilience, Malawi, ecological indicators

1. Introduction

Climate variability and climate-induced hazards have become increasingly disruptive to rural livelihoods in Malawi, where agriculture is predominantly rain-fed and vulnerable to environmental change (Government of Malawi [GoM], 2023). Smallholder farmers, who make up more than 70% of the national workforce, experience extreme weather events such as prolonged dry spells, cyclones and flash floods that compromise food production and income sources (FAO, 2024; World Bank, 2023). Although scientific meteorological systems provide seasonal forecasts, many rural populations struggle to interpret or access these services in user-friendly formats (Makwija et al., 2022).

Indigenous knowledge systems (IKS) have been recognized for their enduring relevance as community driven climate information sources embedded in cultural experience, historical climate observations and environmental signals (Mistry and Berardi, 2016; Dube and Moyo, 2021). In Malawi, rural farmers have long interpreted natural indicators to predict the onset, intensity, and duration of rainfall, advising key decisions such as land preparation, early harvest, and flood preparedness. However, climate change is altering environmental patterns, reducing the accuracy of some indicators (Leal Filho et al., 2022). Therefore, strengthening the synergy between IKS and scientific climate services remains central to advancing Malawi's national resilience strategy and community-based adaptation initiatives (GoM, 2023).

This study examines how IKS contribute to climate prediction and adaptive decision making among rural communities, drawing lessons for local resilience building.

2. Conceptual and empirical foundations of Indigenous Knowledge Systems in climate change prediction with a contextualization of Malawi.

Indigenous knowledge systems (IKS) are locally rooted sets of observations, practices, beliefs and rules developed over generations through long interactions with the environment; They include ecological indicators (phenology, animal behavior), ritual knowledge, resource-management practices, and social institutions that shape local responses to environmental change (for example, planting rules, soil conservation, water harvesting) (Mafongoya, 2017). IKS are viewed not as a set of facts but as dynamic, contextual knowledge embedded in language, social relations, and cultural practice

(Mafongoya, 2017).

IKS are also understood as knowledge systems developed from long-term interaction with the environment, transmitted through generations, and embedded within cultural values and communal memory (Chanza and de Wit, 2016).

Conceptually, IKS in climate contexts are framed by three complementary approaches: (1) epistemological pluralism, thus, recognizing IKS as a legitimate knowledge system alongside climate science; (2) Resilience and adaptive capacity, thereby considering IKS as part of community adaptive strategies that reduce vulnerability; and (3) socio-ecological memory, IKS as cumulative memory that stores past climate experience and adaptation responses that can be reactivated in new conditions (Mafongoya, 2017; Leal Filho, 2022).

In practice IKS perform at least three functions: (a) seasonal/weather prediction for planting and harvesting times; (b) short term early warning signals for hazards (flood, drought); and (c) locally appropriate adaptation practices (crop mix, soil and water conservation, community labor rules) that reduce immediate risks and preserve livelihoods (Mafongoya, 2017). Scholars are increasingly looking at IKS as a complement to meteorology science, especially in the context of limited access to technology driven climate information (Ajibade and Adams, 2020).

In Southern Africa, ecological indicators used in seasonal prediction include animal migration, fruiting cycles, insect emergence, cloud movement, and wind direction (Nyarenda et al., 2023). Empirical studies in southern Malawi document rich, specific IK indicators used by farmers: timing of flowering/defoliation of certain trees, behavior of birds and insects, wind and cloud patterns, and astronomical cues – used to predict the onset, length and distribution of rains and to make planting decisions (Nkomwa and Kalanda-Joshua, 2013). These indicators are classified into biological (plants, animals) and abiotic (air, stars) categories and are learned through apprenticeship and oral tradition. (Nkomwa and Kalanda-Joshua, 2013). In general, in Malawi, community perceptions of threats are often consistent with these observations, influencing planting dates, selection of drought-tolerant crops, and use of conservation practices (Tfwala et al., 2023).

3. Methodology

3.1 Study Sites

Research was undertaken in Phalombe, Salima, and Nkhata Bay, selected due to their diverse agro-ecological conditions and recurring exposure to floods and dry spells. Community familiarity with climate sensitive farming practices enabled effective documentation of IKS indicators.

3.2 Research Design

A qualitative case study design facilitated in-depth exploration of locally embedded climate knowledge. The study targeted community elders, farmers, Village Disaster Risk Management Committees (VDRMCs), and climate extension stakeholders.

3.3 Data Collection

Primary data collection involved focus group discussions (FGDs), and key informant interviews (KII), while secondary data was collected from research articles, government reports and books. The study used focus group discussions to collect information from local communities, specifically separating men and women into different groups. Group meetings were also held with the VDRMCs. Discussions were guided by pre-prepared questionnaires and focused on climate change perspectives, indigenous knowledge for prediction and adaptive decisions. The participants were selected based on their age (35-40 years and above) and involvement in their communities, ensuring that they were custodians of indigenous knowledge. In total, 24 FGDs were conducted with community members (12 for men and 12 for women), along with 6 FGDs with VDRMCs members. Ethical standards were maintained through informed consent and anonymity.

Key informant interviews were conducted with government extension workers from the Ministry of Agriculture and staff from non-governmental organizations (NGOs) working in the study areas. The interviews focused on understanding how government and NGO interventions can affect the use of indigenous knowledge and how this knowledge is integrated into community practices.

Semi-structured guides explored climate perception, indigenous forecasting practices and adaptation responses. The interviews provided valuable insights into the effectiveness and challenges of using indigenous knowledge in climate adaptation.

The interviews were conducted at field offices for NGOs and at Extension Planning Area (EPA) offices for government employees. The study also included a review of secondary sources, including both published and unpublished works on climate change and indigenous knowledge at local and global levels. Secondary data sources included government climate policy documents such as the National Adaptation Program of Action (NAPA) and academic publications, enabling triangulation of insights.

3.4 Data Analysis

Audio recordings were transcribed and coded using NVivo software. An inductive thematic approach was applied to derive meaning from community narratives linking natural indicators to weather outcomes.

4. Results

The findings show that indigenous knowledge is deeply embedded in everyday agricultural planning and risk reduction strategies. Communities demonstrated extensive reliance on a wide range of environmental indicators, including atmospheric and astronomical signals, animal and insect behavior, and plant phenology to predict rainfall patterns, drought and flood events. These indicators are locally specific, empirically based, and provide historically reliable guidance for adaptive decision making.

4.1 Atmospheric and astronomical signs

The local communities utilize Indigenous knowledge systems with a range of environmental indicators to anticipate shifts in weather patterns. Observations of cloud dynamics such as the formation, movement, and coloration of clouds are often associated with expectations of either rainfall or prolonged dry periods. For instance, the persistence of south-west winds, locally referred to as *Mphepo ya Mpoto Mwela Manga*, blowing steadily for approximately three weeks is traditionally interpreted as a precursor to extended dry spells during the rainy season. Similarly, the repeated appearance of a rainbow (*utawaleza*) in the early mornings, particularly when it emerges in the east during the rainy period, is believed to signal reduced precipitation that may culminate in drought conditions. Changes in lunar brightness also serve as climatic cues; a notably bright or whitish moon (*Mwezi*) during the rainy season is perceived as an indication that the rains are likely to cease soon.

Conversely, a high frequency of strong whirlwinds (*Mangoni Wind*) at the onset of the rainy season is viewed as a warning of excessive rainfall and a heightened risk of flooding. Additionally, behavioral patterns in fauna such as migratory movements of birds and nesting activities of insects are interpreted as natural forecasting mechanisms that offer insights into imminent weather variability.

4.2 Faunal behavior

Research conducted among rural communities reveals that specific avian behaviors are widely regarded as indicators of forthcoming climatic conditions. For example, the vocalization patterns of the White-winged Swamp Warbler (locally known as *Mwinjiro*) at the onset of the rainy season are interpreted as a warning of an extended dry period within that same season. Similarly, the Lilac-breasted Roller (*Lumbe*), a species that typically remains quiet, is believed to signal the likelihood of flooding when it begins calling at dusk or during periods of rainfall.

Additional observations include Wattled Cranes (*Akakowa*) congregating in downstream riverine areas during the rainy season, a behavior that communities associate with imminent flood events. The singing of Yellow Bulbuls (*Mbiru*) as the rainy season approaches is also taken to signify an increased chance of floods.

Furthermore, daily morning calls of the Gray Heron (*Nkhwazi*) near the onset of the rainfall period are interpreted as an indication of heavy precipitation coupled with high flood risk. Likewise, the orientation of nests built by the Red-Necked Francolin (*Tchete*) near water bodies is believed to forecast rainfall distribution: nests with entrances facing downward are associated with heavy rains and potential flooding, whereas upward-facing entrances are viewed as a sign of reduced precipitation and possible drought. Finally, sightings of crows (*Khwangwara*) laying eggs early in the rainy season are interpreted as an omen of prolonged dry spells. Collectively, these indigenous interpretations of bird behavior contribute to localized knowledge systems that support seasonal weather prediction and adaptive decision making within rural settings.

In local communities, insect behavior serves as a powerful tool for predicting seasonal weather patterns, helping people prepare for possible droughts or floods. The initial appearance of large numbers of Elegant grasshoppers, locally known as *Nunkhadala*, is often a cause for concern. When these grasshoppers invade crop fields at the beginning of the rainy season, they are widely understood to be a harbinger of drought.

Similarly, white butterflies, known as *Agulugufe woyera*, moving in flocks from south to north during the rainy season, are taken as a sign that dry land sits on the horizon. Another insect that plays a significant role in these predictions is the *Lonomia* moth, or its caterpillar form, locally called *Chiyabwe or Kapali*.

When these creatures appear again and again in March and April, it is a clear signal to the community that the next rainy season is likely to be marked by prolonged dry spells. On the other hand, the behavior of millipedes, known as *Bongololo*, offers insight into potential floods. As the rainy season approaches, if millipedes begin to migrate to higher ground, it is a strong indication that the season will bring heavy rains, with the possibility of flooding.

4.4 Phenological signals

In indigenous knowledge systems, the appearance of spider holes serves as a natural weather forecast. During the rainy season, the presence of spider webs with open burrows is taken as a sign that the rain is about to stop, indicating impending drought.

Conversely, when small pits covered with cobwebs are found under the shade of trees at the beginning of the rainy season, it is interpreted as a prediction of heavy rains and possible danger of flooding. However, if these holes are found without any cobwebs, it indicates that rainfall will be less. Changes in plant phenology also play a role in predicting weather patterns. Changes in the timing of flowering or fruit set in specific plants are used to predict seasonal changes and weather events. For example, whenever a sugar plum *(Syzygium jambos) – Masuku* tree bears too many fruits it indicates drought. These forecasting methods are deeply embedded in the daily lives of communities and are important for planning agricultural activities, ensuring food security, and mitigating the impacts of adverse weather conditions.

Communities use a variety of indigenous knowledge systems to anticipate climate change and implement adaptation strategies. Key indicators identified include changes in rainfall patterns, rising temperatures and increased frequency of extreme weather events. Indigenous forecasting methods, rooted in careful observation of environmental signals, have proven remarkably accurate in predicting short-term weather patterns and seasonal changes. For example, communities in Malawi rely on cloud formation, wind direction, and animal behavior as reliable indicators of impending rain or drought. Such methods have evolved over centuries, reflecting a deep understanding of local climatic conditions.

The role of indigenous knowledge in climate change forecasting cannot be overstated, especially in areas where formal meteorological services are limited or inaccessible.

The findings of this study underline the critical importance of indigenous knowledge systems (IKS) in enhancing the resilience of rural communities to climate variability and change in Malawi. However, the study also suggests that the accuracy of some indigenous indicators may be reduced due to the increased unpredictability of climate patterns due to global climate change. For example, traditional indicators that once signaled the beginning of the rainy season may now be less reliable due to changes in rainfall patterns. This highlights a significant challenge, thus, while indigenous knowledge is invaluable, it must be constantly updated and adapted to take into account changing climate realities.

5. Discussion

The study confirms that IKS remains core to seasonal foresight and collective decision-making in rural agriculture. Communities depend on observable environmental cues rather than technological forecasts that may not reach them in actionable form (Makwiza et al., 2022). However, climate change introduces knowledge uncertainty, such as seasonal shifts which disrupt typical animal behaviours, rainfall onset which is less predictable than before and some species that have migrated or reduced in population

Despite these challenges, IKS continues to function as a risk-reduction mechanism, a cultural system for resilience transmission and a bridge where scientific forecasts lack local trust. Therefore, integrating IKS with early warning systems could expand community adoption of climate information (Leal Filho et al., 2022). And as such, agricultural extension services should incorporate local ecological insights during advisory delivery, aligning with Malawi's Disaster Risk Management (DRM) Act 2023 and National Resilience Strategy which were develop to establish a robust framework for reducing disaster losses, strengthening preparedness, and ensuring effective response and recovery. And key goals include integrating DRM into development, implementing a comprehensive risk identification and monitoring system, creating people-centered early warning systems, promoting a culture of safety, and decentralizing disaster management to the local level.

6. Conclusion and Recommendations

IKS remains an essential component of localized climate forecasting among rural farming communities in Malawi. Although environmental shifts are affecting the accuracy of some natural indicators, these knowledge systems still provide meaningful guidance for livelihoods and hazard preparedness. This study recommends an integration of IKS into formal early warning frameworks to enhance uptake at community level, support research partnerships among farmers, meteorologists, and local institutions. Documentation of ecological knowledge nationally, especially among aging custodians, and promotion of youth engagement to sustain knowledge transfer across generations.

Future studies should assess the accuracy of specific IK indicators under evolving climatic conditions and explore digital platforms for co-production of local climate knowledge.

REFERENCES

1. Ajibade, I., & Adams, E. A. (2020). *Climate adaptation and local knowledge*. Climate and Development, 12(4), 299–309.
2. Chanza, N., & De Wit, A. (2016). Enhancing climate governance through indigenous knowledge. *Climate Policy, 16*(2), 201–216.
3. Dube, T., & Moyo, F. (2021). Indigenous knowledge and climate adaptation in Southern Africa. *Environmental Development, 40*, 100641.
4. FAO. (2024). *Malawi country climate and agriculture outlook*. Food and Agriculture Organization of the United Nations.
5. Government of Malawi. (2023). *National Resilience Strategy Progress Report*.
6. Leal Filho, W., et al. (2022). Climate change impacts in Africa. *Environmental Science & Policy, 136*, 1–10.
7. Makwiza, C., Kamoto, J., & Phiri, M. (2022). Barriers to accessing seasonal climate forecasts among smallholder farmers in Malawi. *Climate Risk Management, 37*, 100441.
8. Mistry, J., & Berardi, A. (2016). Bridging indigenous knowledge and science. *Ambio, 45*(7), 737–753.
9. Nyirenda, V. R., et al. (2023). Local ecological knowledge and climate early warning in Southern Africa. *Sustainability, 15*(2), 912.
10. Tfwala, S., Chirwa, W., & Banda, K. (2023). Farmers' perceptions of environmental indicators for seasonal forecasting. *Journal of Rural Studies, 99*, 102–115.
11. World Bank. (2023). *Malawi Climate and Development Report*.
12. (Nkomwa and Kalanda-Joshua, 2013). Assessing Indigenous Knowledge Systems and Climate change adapatation strategies in Agriculture. A Case of Chagaka Village Chikwawa, Southern Malawi
13. Mafongoya, P.L. and Ajayi, O.C. (editors), 2017, Indigenous Knowledge Systems and Climate Change Management in Africa, CTA, Wageningen, The Netherlands, 316pp.