

Indigenous Ecological Knowledge and Perceptions of Climate Change on the Environment and Livelihood of Local Communities in Kgalagadi District of Botswana

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Abstract

Extreme climate change causes an immeasurable threat to the livelihood security and prosperity of rural communities, including the natural environment and resources managed by the local people in the Kgalagadi District of Botswana. The study aims to understand the indigenous ecological knowledge of local communities about climate change, its impacts on the environment, and their livelihoods across five villages in the Kgalagadi District of Botswana. The present study used a semi-structured questionnaire survey at the household level who were randomly selected using the village register book. The results indicated that all the respondents in Kang village and some from Lehututu and Tshane villages perceived that the causes of climate change were unknown. However, some respondents across the other four villages believed that climate change is caused by various factors including wildfires, pollution from industries, impacts from livestock, and vehicles, as well as a curse from God. Indigenous knowledge must be well incorporated with scientific methods and up-to-date climate change adaptation and mitigation strategies to envisage more concrete results. This helps to integrate the insight of local people into policies and strategies to make an effort for solutions that are crucial for sustainable development. We suggest that all stakeholders should harmonise the use of indigenous knowledge with climate change strategies, to make the best use of its contribution to the successful execution of climate change policies.

Keywords: climate change, indigenous knowledge, rural communities, sustainable

1. Introduction

Indigenous knowledge is a cumulative body of knowledge, practices, and reflections that are maintained and developed by traditional people with extended narrations of interactions with their local environment (Egan, 2013; Hiwasaki, Luna, & Shaw, 2014; Kolawole, Motsholapheko, Ngwenya, Thakadu, Mmopelwa, & Kgathi, 2016; Rhodes, Jalloh, & Diouf, 2014). According to Warren (1987), Warren and Cashman (1989), indigenous knowledge is a local experience that is irreplaceable to a given culture or society. Warren, (1991) also defined indigenous knowledge (IK) as the facts used by the local communities to make a living in their environment. Similarly, Johnson (1992) defined Indigenous knowledge as a form of knowledge developed by local people through generations of living in close interaction with their environment". As stated by Rajasekaran (1993), indigenous knowledge is the systematic form of knowledge acquired by local people through the accumulation of experiences, informal experiments, and an intimate understanding of their local environment. According to Haverkort and de Zeeuw (1992), indigenous knowledge is the actual knowledge of a given society that reflects their experiences gained through generations and more recent experiences with modern technologies. Traditional knowledge has a role to contribute to the agenda 2030 on Sustainable Development Goals (SDGs) for improving food security and enhancing environmental sustainability through the implementation of climate change policies. This can be achieved by empowering local communities in various aspects of environmental management through advocating and mobilizing their unique knowledge and practices in climate change adaptation and mitigation strategies

(Nyong, Adesina, & Elasha, 2007).

Climate change affects the capacity of local communities to meet their basic needs and livelihoods that are unique to their environment (Ricart, Castelletti, & Gandolfi, 2022). Despite the changes that have been occurring over generations, rural communities manage to adapt to these challenges during their lifetime using the indigenous knowledge they have accumulated through their connection with the local environment (Guodaar, Bardsley, & Suh, 2021). Local knowledge is developed through the lifetime experience of the local communities in close connection with their environment (Oba, Byakagaba, & Angassa, 2008). Such knowledge is used by community members to overcome environmental challenges for survival (Oba & Kotile, 2001). Such knowledge is significant for climate change-related mitigations as a tool for sustainable development and the management of climate variability (Kgosikoma, Mojeremane, & Harvie, 2012). The challenges and impacts of climate change may vary contingent on local environmental conditions, the experience of local communities, and continuous interactions with their environment. The local communities have further developed a detailed knowledge of environmental conditions through sustained consideration, experience, trial, and error that they use in managing and solving their problems, amongst which are climate-related problems, the needs of local people, and strategies for minimizing vulnerability.

Climate change is any change in weather conditions over a longer period because of environmental variability and anthropogenic activities. According to a study by Tume et al. (2019), the local communities' knowledge and perception of climate change on the environment and livelihood is a responsibility of oral histories and practices, passed from one generation to the next generation. In the Kgalagadi district of Botswana, indigenous environmental knowledge and perceptions of climate change are built on traditional customs and culture, communities' main concerns, desires, experiences, and talents, which empower local communities to manage the impact of environmental change for improving their livelihoods. Understandings of these changes by the local communities are focused on opinions of variations in weather conditions (e.g., temperature, rainfall), and fluctuations in vegetation resources, which are frequently supported by bringing together the local perceptions with scientific evidence (Mabula & Angassa, 2020). Rural communities depend on their local environment for sustenance and survival whereas communities' ecological knowledge is built through centuries of interaction with their local environment (Berkes, 1998). As a result, local communities have established knowledge of environmental changes and extreme weather events for centuries and have developed effective strategies for adaptation and resilience (Bollig & Schulte, 1999). Indigenous knowledge practices are crucial in informing the best adaptation strategies since they reflect the realities on the ground. An approach that is usually built on local knowledge alleviates the risk of failure to adjust adequately to the inapplicable reactions to local conditions. Indigenous ecological knowledge has a key role to play in academic research and in informing government policies for sustainable development (IIED, 2015a, 2015b, 2018). The present paper seeks to: (1) explore indigenous ecological knowledge of the local communities and their perception of climate change; (2) assess the impacts of climate change on the environment and local livelihoods in the Kgalagadi district of Botswana.

2. Materials and Methods

2.1 Study Area

The study survey was carried out in five villages namely: Hukuntsi, Kang, Lehututu, Lekgwabe, and Tshane in the Kgalagadi District in southwest Botswana (Figure 1). According to Statistics Botswana (2014), the district consists of 14 villages. According to Statistics Botswana (2014), the total area of Kgalagadi District is 72,400 Square kilometers with a population of about 20,500. On average, the elevation of the study area is 915 m above sea level. The plant life forms are a mix of open grassland and woodland savanna. The pattern of precipitation is unpredictable with an average annual precipitation of 250 mm, occurring between November and May (Singh, 2011). About 16.4% of the residents are engaged in agricultural activities (Statistics Botswana, 2014) while the great majority of the residents (51,4%) in the district were workers (Statistics Botswana, 2014).

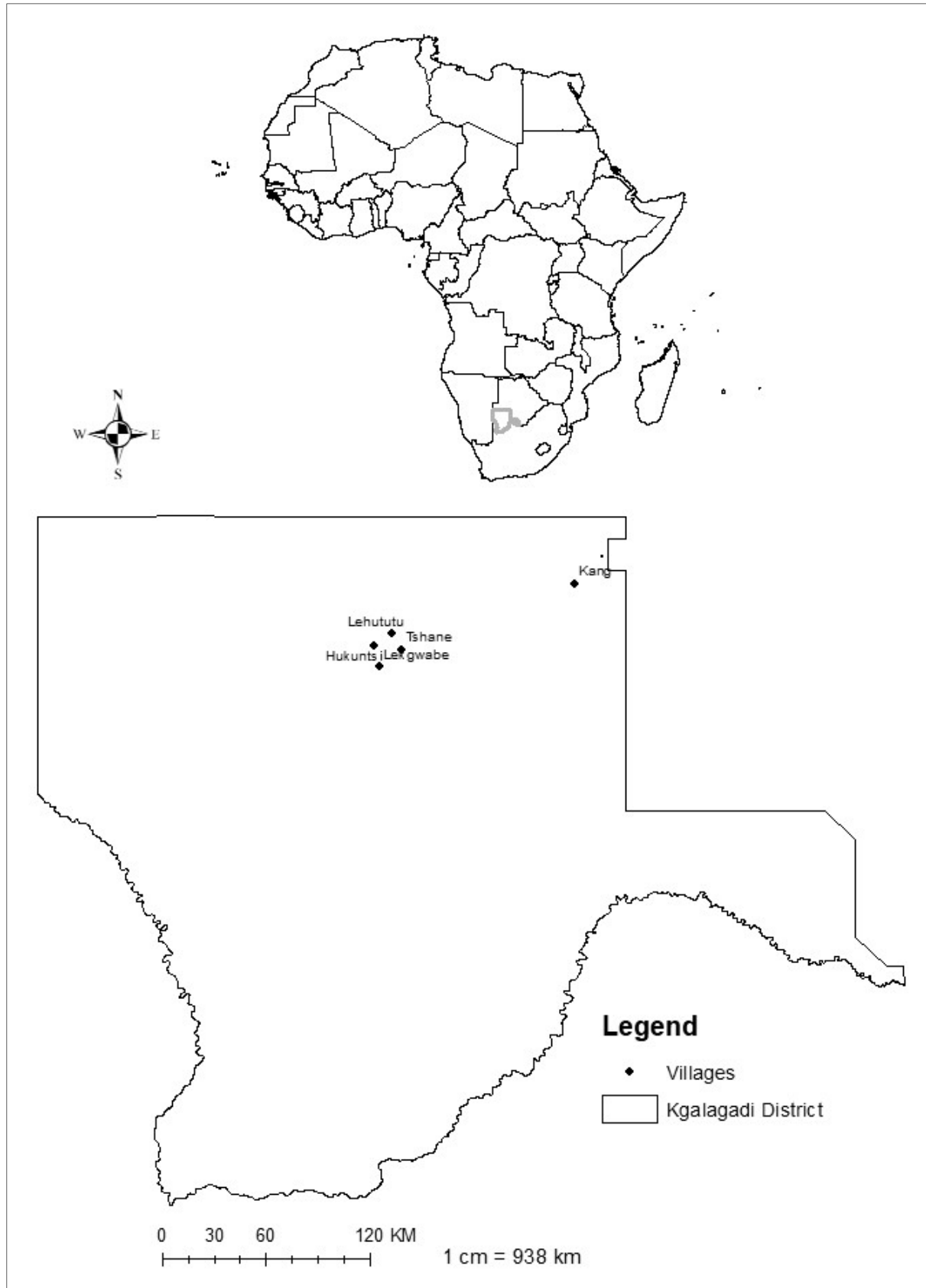


Figure 1. Study sites in the Kgalagadi - North District, Southwest Botswana

2.2 Methods

In southwest Botswana, Kgalagadi District, we selected five villages to conduct household surveys through interviews using semi-structured questionnaires. Before interviews were conducted, informed consent was obtained verbally, and participation was, therefore, based on willingness by the respondents. We interviewed 15 household heads per village focusing on those residents engaged in agricultural activities and understanding climate challenges. The interview was conducted using a purposive sampling method focusing on community members who involved themselves in agricultural activities using the village households' record list with the help of Agricultural extension agents. In the survey and household interview, we considered participants whose ages were 50 and above.

From the five villages, we interviewed 75 households with the same number of interviewees. The interviews were carried out from home to home by visiting all households. The local language was used to gather information from respondents for ease of understanding. Respondents who would not be able to read and write the interview questions were assisted by the first author in reading the questions and recording respondents' perceptions. A focus group discussion (FGD) was also conducted with the help of village leaders in selecting participants of the FGD interviewees, and the selection of FGD. Key informants such as extension officers from the various sections of the Departments of Agricultural Development and Food Security also participated in discussions using the same questionnaire applied to household heads. A total of five agricultural extension agents were interviewed across the five villages.

3. Data Analysis

The data collected across the five villages through the household survey were analysed using descriptive statistics. The number of respondents was used in presenting the results of the analysed data.

4. Results

The results showed that all the respondents from Kang village and some from Lehututu and Tshane villages perceived that the reasons for climate change were unknown (Figure 2). A few respondents from Hukunsi and Tshane mentioned deforestation as a cause of climate change, while some respondents from Hukunsi and Lehututu villages believed that climate change was caused by wildfires. A few respondents from Kang perceived that industries and a curse from God were causing climate change (Figure 2). The results also showed that a few of the participants from Lehututu believed that livestock and vehicles are behind the causes climate change (Figure 2).

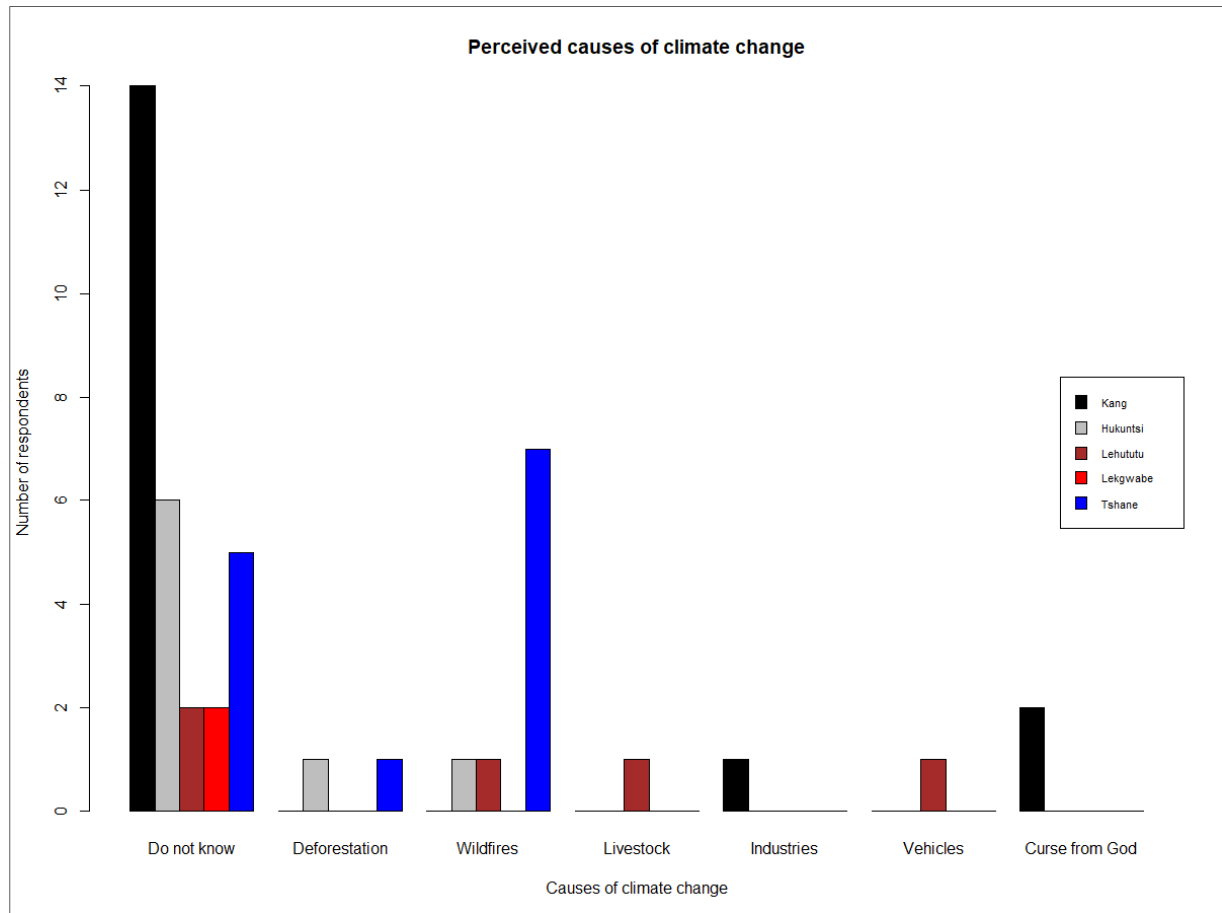


Figure 2. Communities’ perceptions about the causes of climate change in Kgalagadi, Southwest Botswana

Respondents in the five villages suggested that climate change was causing a noticeable declining crop yield (Figure 3). All the respondents believed that climate change was causing an increase in invasive plant species, pests, and ticks, drying of water sources creating food insecurity, and grassland degradation (Figure 3). Some respondents believed that climate change was neither increasing nor changing tree mortality (Figure 3).

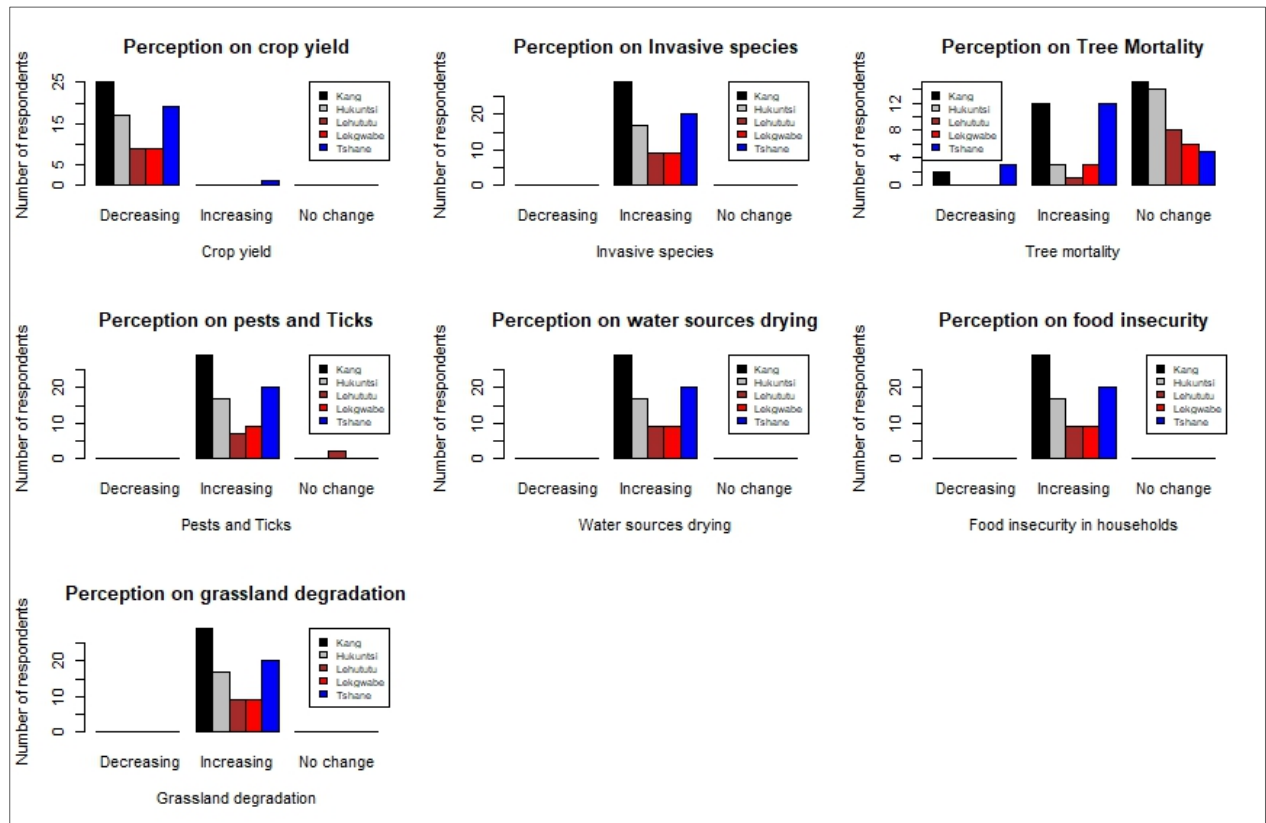


Figure 3. Respondents perceptions about the impacts of climate change in Kgalagadi, Southwest Botswana

Respondents across the five villages believed that different strategies could be implored to mitigate the impact of climate change (Figure 4). Respondents in Kang and Lekgwabe suggested that soil conservation practices and praying for rains are important in mitigating the impacts of climate change, whereas, in Lehututu, respondents believed that environmental management and planting of trees were important strategies in mitigating the impacts of climate change (Figure 4). In Hukuntsi and Tshane, respondents believed that climate change could be mitigated by minimizing the use of chemicals (Figure 4).

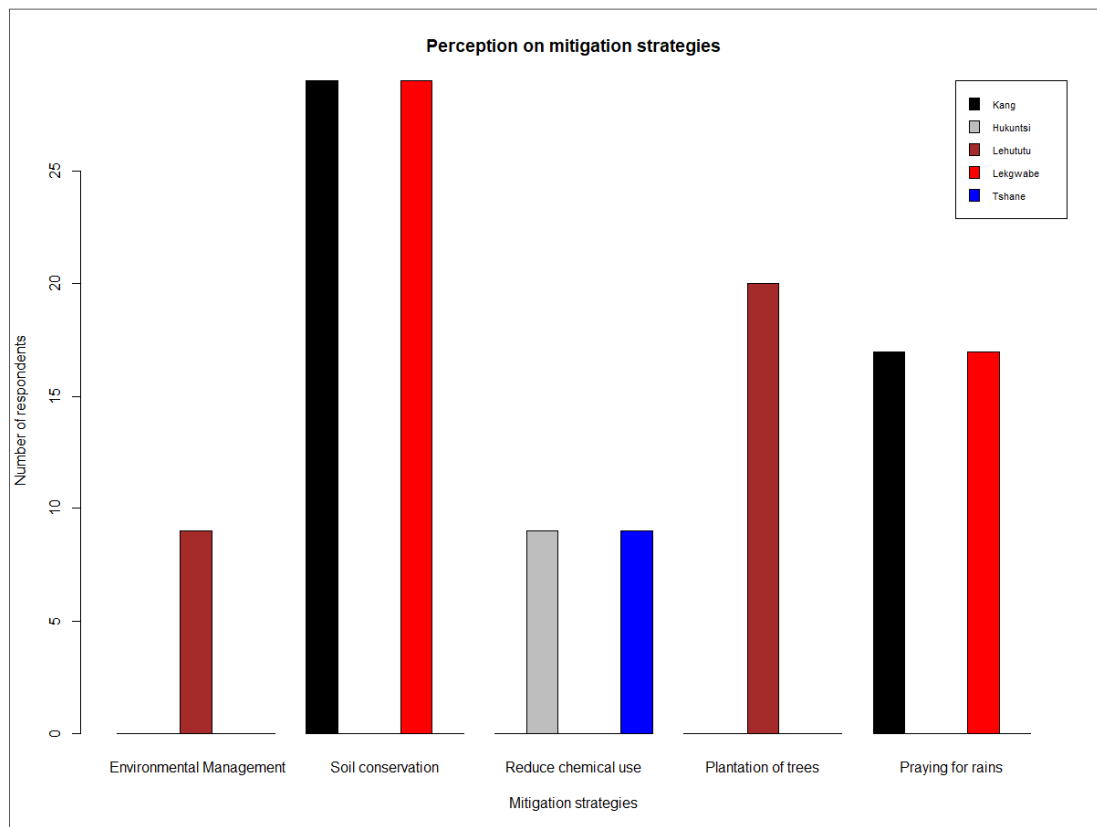


Figure 4. Respondents' perceptions about the strategies to mitigate climate change in Kgalagadi, Southwest Botswana

5. Discussion

Indigenous knowledge of local communities is an important tool that needs to be utilised in resource management and in mitigating the impacts of climate change. Continuous usage and reliance on indigenous knowledge by the local communities in Africa have improved their accuracy in predicting the impacts of climate change (Filho, Vidal, Chen, Petrova, Dinis, Yang, & Neiva, 2022). For example, limited access to conventional sources of information such as televisions and meteorological services by the indigenes in the Bui Plateau, Bamenda Highlands of Cameroon have increased their reliance and accuracy on the usage of indigenous traditional knowledge on predicting the impacts of climate change (Tume, Kimengsi, & Fogwe, 2019). Similarly, Filho et al. (2022) stated that the use of indigenous knowledge in farming systems, including crop and livestock management, is well-known across Africa. Respondents in the Kgalagadi district demonstrated their limited familiarity with the concept of climate change, and yet they perceived that weather patterns have been changing. This agrees with the perception of local communities as reported by others (e.g. Kolawole, 2014), suggesting that the flowering of peach trees in Botswana, and other SADC countries is linked to the beginning of the rainy season. These findings are supported by a study in Khasia, Tripura, and Garo in the Lawachara National Park in Bangladesh where the indigenous communities stated that they do not understand the term climate change (Rahman & Alam, 2016). However, despite the respondents' limited knowledge about climate change, there was a perception that the rising temperatures and erratic rainfall patterns over the years were being caused by logging, wildfires, overgrazing by livestock, and pollution from industries and vehicles, while others believed it was a curse from God.

The current study demonstrated that rising temperatures and erratic rainfall have increased the explosion of invasive species, pests, and ticks, drying of water sources, degradation of grasslands, and tree mortality respectively. Similarly, there was a perception that climate change will contribute to a decline in crop yield which will result in food insecurity. The rise in temperatures as evidenced because of climate change is likely to damage crops and hence lower their productivity. These results were supported by Miah et al. (2014), Pautasso et al. (2012), Rahman and Alam (2016), Rosenzweig et al. (2001), Saha and Azam (2004) who found an increase in crop damage, and a decrease yield due to climate change. As a response to climate change, the respondents in the Kgalagadi district believed that different strategies such as ecosystem management, soil conservation, reduction of chemical

usage, tree planting, and praying for rains could be adopted and practiced as mitigation measures. Rahman and Alam (2016) also suggested that the adoption of management practices is seen as key to mitigating the impacts of climate change. In addition, Chaudhary et al. (2011), Chaudhary and Bawa (2011), Chhetri and Easterling (2010), Pautasso et al. (2012), Supit et al. (2010) and Tume et al. (2019) suggested that management strategies such as diversifying crops and the introduction of new crop varieties, changing the sowing and harvesting seasons may be adopted to mitigate the impacts of climate change. The perception that climate change is likely to cause an explosion of invasive species, pests, and their associated diseases, was supported by perceptions of communities in the Chittagong Hill Tracts, Bangladesh who believed their vulnerability to disease-causing mosquitoes was a result of climate change (Fardous, 2011; Rita Sharma, 2012). As supported by Ishaya and Abaje (2008) and Mertz et al. (2009), the respondents perceived that adaptive measures are important in mitigating the impacts of climate change. These measures are based on the management of ecological and socio-economic factors (Nhemachena & Hassan, 2007; Thomson, Calvin, Chini, Hurtt, Edmonds, Bond-Lamberty, Frolking, Wise, & Janetos, 2010).

6. Conclusion

Despite limited understanding and knowledge about climate change, indigenous communities in the study areas experienced notable changes in weather patterns over the years. They mentioned increased impacts of climate change predominantly caused by deforestation, wildfires, grazing pressure by livestock, and related impacts. The respondents knew that climate change has an impact on the environment and their livelihoods, and they were willing to engage in environmental management and conservation activities to mitigate the impacts of climate change. Adaptive strategies to climate change should be considerate of indigenous knowledge of the local communities, as they could contribute positively. Accordingly, the role of indigenous knowledge should be recognized in line with the scientific approach for better climate change adaptation and mitigation. We suggest refinement and interventions in environmental management strategies and supportive public policies to promote the role of indigenous ecological knowledge to mitigate the impact of climate change for sustainability.

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Authors contributions

Dr. K. Sianga, Mrs S. Mabula and Prof A. Angassa were responsible for study design and revising. Mrs S. Mabula was responsible for data collection. Dr. K. Sianga and Prof. A. Angassa drafted and revised the manuscript. All authors read and approved the final manuscript.

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Data sharing statement

No additional data are available.

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