Integrating Human Capital Technocrats in El Nino Disaster Management Mitigation through Indigenous Knowledge Systems for Sustainable Livelihoods in Zimbabwe

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Abstract

Minimal attention has been given to the effectiveness of integrating human capital technocrats in El Nino disaster management mitigation for sustainable livelihoods in Zimbabwe which this study sought to bridge the gap. The qualitative study purposively selected 20 participants in Mashonaland West Province. The participants were selected from ministries responsible for climate change, chiefs and village heads in communities. Structured interviews were used to solicit data, analysed and presented thematically. Participants were assured of confidentiality and anonymity to avoid bias and due care through informed consent was taken before collecting data. Major findings of the study demonstrated that climate change expert perspectives underscore indigenous people's coping strategy of choice of livelihood through diversification. Findings highlighted that climate change experts identified some early warning signs of the indigenous knowledge system (IKS)indicating drought like specific birds not making sound during rain-season, shrubs/plants not flowering and a lot of fruit from Pericopsis anglolensis trees and subsequently proffer solutions of diversification for livelihoods. However, failure to demystify climate change experts' understanding of IKS could have huge ramifications for its integration into climate change policies. It is recommended that a forum of interaction between the scientist and keepers of IKS be created to contribute to climate and weather forecasting processes and other climate change adaptation intervention at local level and likely contribute towards achieving both SDG 13 and Agenda 2063.

Key Words: Climate Change, Indigenous Knowledge System, Zimbabwe

Introduction

In sub-Saharan Africa, food poverty is linked to several factors, chief amongst them being insufficiency of water for industry, agriculture and domestic use. Water insufficiency is caused by hot and dry conditions created by the El Niño phenomenon. Extreme weather conditions affect crop production, thus reducing food supplies (Food and Agricultural Organization (FAO) 2016; Hao et al. 2019; Regional Inter-Agency Standing Committee (RIASCO), 2017). The El Niño phenomenon poses a global threat to the agricultural livelihoods of millions of people. In addition, factors such as mismanagement of economies, disasters, conflicts, and poor agriculture strategies are linked to food poverty in the region (RIASCO, 2017). The rural communities should make use of indigenous knowledge to enhance and ensure crop and livestock production (Dube 2016; Moyo et al. 2017). However, integrating human capital technocrats in El Nino disaster management mitigation through indigenous knowledge systems for sustainable livelihoods is needed to alleviate food security challenges in Zimbabwe.

Background of the study

Globally, 800 million individuals are hungry and four million face critical water insecurity (Food and Agricultural Organisation, 2020). The United Nations Sustainable Development Goal (UN-SDG) number 2 explicitly emphasises ending starvation and attaining food security. SDG 2 also seeks to advance nutrition and uphold sustainable agriculture for all nations (United Nations (UN), 2015). Climate change is anticipated to have a negative effect in terms of food security and the attainment of sustainable development goals (SDGs) in Africa. Its effect is expected to be tremendously severe in regions of Africa that depend on rainwater agriculture and have inadequate resources to diminish and adapt to climate change. Much of the literature on climate change comes from replicas or scenarios that face certain degrees of indecision (Hove & Kamabanje, 2019). The knowledge of local and indigenous peoples, commonly known to as local knowledge systems (LKS) or indigenous knowledge systems (IKS), is slowly coming to prominence as an important source of evidence for climate mitigation and adaptation (Van Ginkel & Biradar, 2021). It is indispensable that lawmakers draw on the available information in the face of universal climate change (Mukwada & Manatsa, 2019).

Climate change is a menace to smallholder agriculture production systems and leads to food insecurity in many countries, including Zimbabwe (Marume et al. 2017). This has been due to unreliable climate forecast by technical scientific techniques used by meteorological departments (UN, 2015). People need to have medium to long term predictions of climate, especially for rain-fed agricultural systems in Africa (Mukwada & Manatsa, 2019). It is through the past events that knowledge and experiences have been generated and handed down to next generations using oral knowledge (Mukwada & Manatsa, 2019). There has been use of indigenous knowledge systems (IKSs) over a long period of time across Africa and the whole world (Hove & Kambanje, 2019). The IKS brings in full knowledge to people about climate changes in their respective areas, allowing farmers to plan better for the season. This is not the case with scientific methods, as they bring in a broad spectrum of information which cannot actually help farmers to plan better for the entire season (Mapfumo et al., 2015). The IKS uses various methods to predict climate and make forecast for the season. They use methods such as tree phenology, animal behaviour and wind direction to predict the climatic features of the season (Risiro et al., 2012). The use of IKS has been recognised by many people in African countries as a paramount source of knowledge on climate change and adaptations (Mafongoya & Ajayi, 2017). The local knowledge of people for the purposes of seasonal climate forecasting is premised on plant and animal phenology. Therefore, changes in plant and animal behaviour can be related to the changes in the climate based on past experiences of the local communities. Farmers use different observational ways to predict climate change, and these can be employed at various times of the season, giving them proper ideas.

IKS have been used depending on the societal needs in Africa and the rest of the world for various determinations, and this has allowed many people to start to value the indigenous knowledge systems (IKS) in predicting climate (Hove & Kambanje, 2019). Local groups have the knowledge and practices to cope with adverse environmental conditions which occur in their localities (Mafongoya, 2018). This implies that the enhancement of indigenous capacity is key to the empowerment of local communities and their effective participation in the development practice.

Societies in some parts of Africa believe that tree phenology plays an important role in predicting climate changes, for example, the flowering of certain trees early or late during the season signifies the nature of the climate during the season (Risiro et al., 2012; Mapfumo et al., 2015; Jiri et al., 2016). In Zimbabwe, for example, poor flowering of Mangifera indica indicates a season with good rains which may result in better climatic conditions for good crop yields (Mafongoya and Ajayi, 2017). Heavy flowering of this tree species indicates poor rainfall and high chances of drought. Early development of leaves on the Terminalia species, such as Terminalia sericea, indicates early rainfall and good rains during the season which may promote better crop yields. This information has been used by indigenous people for many years, and helps them to identify types of crops to grow depending the tree phenology.

In Ghana, people used a big forest tree called Onyina (Ceiba pentandra), which sheds its leaves early in January, leaving it bare in March. If the tree produces leaves in June or earlier, this indicates good rain-fall patterns (Gyampoh et al., 2011). If the tree sprouts leaves after June, this indicates a poor season, predicting drought and poor yields. This helps farmers to grow drought- resistant crops which adapt to drought conditions, giving them better yields. The use of the Terminalia ivorensis tree, which is evergreen and only drops its leaves when rainfall is about to begin, helps in predicting the occurrence of drought (Mapfumo et al., 2015). This is used in Ghana and is the same as the Terminalia species used in Zimbabwe where the tree produces leaves to indicate the start of rain season. In Ghana, if the Tivorensis drops its leaves and starts to re-produce them, this indicates good rains (Gyampoh et al., 2011). The volume of rainfall is detected by the volume of leaves produced by the tree. If the tree produces leaves quickly, this indicates high rainfall, and if the tree develops few leaves, this indicates low rainfall.

People also use the behaviour of animals to predict climate changes, for example, in Zimbabwe, if red headed ants are seen cutting grass and building their houses early in September, this signifies early rainfall and farmers can start preparing for the season (Joshua et al., 2011; Risiro et al., 2012; Mapfumo et al., 2015). If movement of these ants is seen in late October, it signifies a bad season with poor rainfall distribution. Local people also monitor the actions of millipedes and centipedes and how they behave during the rainy season (Kavu et al, 2022). If millipedes and centipedes are seen climbing to higher areas such as on large trees, it signifies flooding in the area as these organisms sense floods in the soils and try to find safer places (Joshua et al., 2011; Risiro et al., 2012; Mapfumo et al., 2015). In Tanzania, local people use the libido of donkeys to forecast climate change; if donkeys' libido increases, this indicates pending drought (Kijazi et al., 2012), and this allows farmers to search for other options such as the use of rainwater harvesting techniques to store surface runoff and increase soil moisture (Nyamadzawo et al., 2015; Nyagumbo et al., 2019; Tapiwa et al., 2020). This helps farmers on how to overcome drought and improve yields. Traditional people also use knowledge from the slaughtering of animals; empty stomachs when goats are slaughtered indicate drought (Kijazi et al., 2012), and if goat mating increase with births of twins or triplets, it indicates good rains coming. Farmers can use this method to choose long season varieties which thrive during high rainfall. If these organisms?? are not seen moving during the rainy season, it indicates low rains, hence farmers grow early maturing varieties which require low rainfall.

IK, thus, minimizes the risks and disasters and this endorses the worthiness of IK in Disaster Risk Reduction. According to Baumwoll (2008:69), 'there are four primary arguments that have been made for the value of indigenous knowledge in disaster risk reduction. To start with, it suggests that numerous indigenous people possess knowledge (that could be approaches or skills); 'and this provides methods for reducing disaster risk'. local knowledge from the grassroots level should not be ignored by authorities as it can help communities to prevent, mitigate, prepare for and recover from the impact of disasters, indigenous knowledge can be used as a planning tool by local communities and such knowledge can be used to predict the occurrence of disasters and their impact so that proper interventions are adopted and that indigenous peoples knowledge provides information and insight that complement conventional science and environmental observations. (Baumwoll, 2008:70). As such, IKS approaches and skills are delivered and adapted by diverse groups who meet climate risks and disasters.

However, technical knowledge is required to help the agriculturalists build a science-based resilience mechanism against El Niño-induced deficiencies (Marume et al. 2017). Sluggish uptake of scientific knowledge weakens the communities' capacity to handle climate- related food disasters (Marume et al. 2017). In this case, a continuous and integrated multi-sectoral, multi-disciplinary process of planning and execution of processes is aimed at: averting and diminishing the risk of disasters; moderating the severity or consequences of disasters; emergency preparedness; a rapid and effective response to disasters; and post-disaster recovery and reintegration (Kunzekweguta, 2017). This is only feasible through integrating human capital technocrats to overhaul the whole process. Researchers have asserted that integrating human capital technocrats into IKS can add the value of IKS into climate change policies to reinforce sustainable adaptation strategies for all stakeholders. The climate change adaptation approaches that farmers can use vary depending on existing weather contexts. Socio-economic and established programmes must be taken into account at the community level when deciding on adaptation strategies which require technocrats' perspectives. It is against this research gap that this study sought to assess if integrating human capital technocrats in El Nino management mitigation through indigenous knowledge system would harness sustainable livelihoods in Zimbabwe.

Zimbabwe has a population of 13,061,239, out of which 67% is found in rural areas (ZIMSTAT, 2013a). This means much demographic attention has to be focused the rural communities which support a larger proportion of the people. Of particular mention is the fact that the rural populations mostly rely on the natural environment in terms of their energy and food demands. Consequently, the climate change effects reported by GoZ-UNDP/GEF (2009a), Brown et al (2012), Mugandani et al (2012) and Gukurume (2013), places the environment under immense pressure (MENRM, 2010). Zimbabwe is generally a semi-arid country with low annual rainfall patterns. The mean annual rainfall is 650 mm but, geographically, it ranges from around 350 to 450 mm per annum in the southern lowveld to 1,000 mm per annum in the Eastern Highlands (Unganai, 1996; MENRM, 2012a). Of late, Zimbabwe has been experiencing unpredictable precipitation patterns, mostly characterised by erratic rains from year to year owing to changing climate (Chagutah, 2010; Mugandani et al., 2012; Gukurume, 2013; Makarau, 2013). Broadly, Zimbabwe's environment faces threats from increasing competing demands of both society and the economy. This, therefore, warrants an investigation of whether integrating human capital technocrats in El Nino management mitigation through indigenous knowledge system would harness sustainable livelihoods in Zimbabwe.

Statement of the problem

Zimbabwe, like most Sub-Saharan countries, is in the grip of the 2023/24 El Nino-induced drought which has resulted in massive crop failure and depletion of water sources and pastures. This has severely reduced people's access to food as stocks have dwindled and prices soared. However, since there is no method to test the validity of indigenous knowledge systems (IKS) in predicting climate hazards, modern scientific methods can be of use in supporting or discrediting IKS. Technical knowledge is required to help the agriculturalists build a science-based resilience mechanism against El Niño-induced deficiencies. Indigenous knowledge systems (IKS) constitute an integral part of the efforts to effectively deal with the climate crisis in the developing world. In Zimbabwe, Sustainable Development Goals (SDG) 13, which speaks directly to the ratification of climate change and practical initiatives, is not fully integrated (Regional Inter-Agency Standing Committee (RIASCO), 2023). Target 13.2 and 13.b, which focus on uplifting capacity building to facilitate crafting plans on climate change with special attention to susceptible sections of society including indigenous knowledge systems (IKS), are not fully harmonized to tackle climate change and achieve the same (Nyagumbo et al., 2019). Researchers have opined that one way to increase the acceptance of indigenous knowledge climate indicators in the scientific community is through validation by comparing them with scientific climate forecasts. Validation would initially include monitoring indigenous knowledge climate indicators to establish the link with known scientific parameters. Where the two methods converge means the capacitation of local communities to withstand their vulnerability to climate change. It is against this research gap that this study sought to assess if integrating human capital technocrats in El Nino management mitigation through indigenous knowledge system would harness sustainable livelihoods in Zimbabwe.

Theoretical Framework

The study is grounded and guided by the climate change impact assessment approach (UN, 2015). The United Nations asserted that impact assessment (IA) is a structured process for considering the implications for people and their environment, of proposed actions while there is still an opportunity to modify (or even, if appropriate, abandon) the proposals. It is applied at all levels of decision-making, from policies to specific projects. Climate change impact assessments seek to characterize, diagnose, and project risks or impacts of environmental change on people, communities, economic activities, infrastructure, ecosystems, or valued natural resources. A climate Impact Indicators (CII) measure/index of quantitative climate model and/or observation data that illustrate aspects of the historical state of the climate change. The approach is relevant to the study considering its holistic applicability in the integration of diverse approaches in measuring the impact of El Nino management mitigation through indigenous knowledge system to harness sustainable livelihoods.

Literature review

Integrating human capital technocrats in El Nino management mitigation through indigenous knowledge system to harness sustainable livelihoods in Zimbabwe

Scholarship on climate change and indigenous knowledge system (IKS) is still fairly new, but rapidly growing. A first attempt appears to be that by Berkes & Jolly (2001) who assessed adaptive capacity to climate change of the Inuvialuit of the Canadian western Arctic community. Nyong et al (2007) later looked at the value of IK in climate change mitigation and adaptation in the African Sahel. Phenomenal attention to the topic is also seen from Lefale (2009) whose studies were on traditional ecological knowledge of weather and climate of the Samoa, a Polynesian community in the South Pacific; Peloquin and Berkes (2009) on dealing with the ecological complexity of hunters in James Bay, Subarctic Canada; Green et al (2010) on IKS of the weather and climate of the Aboriginal and Torres Strait Islanders in Western Australia. In Kwazulu-Natal in South Africa, Jiyane and Ngulube (2012) explored IKS applications in weather forecasting.

How indigenous knowledge can best be integrated with scientific knowledge grounded on human capital technocrats is one of the important questions facing indigenous communities (RIASCO, 2023). Modern science is more acceptable to the indigenous communities if it is integrated with what they already know (Kunzekweguta, 2017). Scientific weather forecasts, for instance, may be more credible to the communities in the project countries if ways are found to integrate them with indigenous knowledge that they have relied on for generations to predict and cope with droughts, floods, and other natural hazards (Hove & Kambanje, 2019). A case in point is the experience with peasant farmers who listen to weather forecasts on radio by the meteorological department but still prefer to rely on their own traditional knowledge of when to start planting (Ngulube, 2012, Marume et al. 2017). The more the “scientific” forecasting deviates from traditional knowledge, the less it is used for planning purposes by the indigenous communities (Jingping et al. 2022). However, what should be known here is that the production of IKS is contextually grounded (Maila & Loubser, 2003) and, given the case-specific approaches limited to the areas studied, the Zimbabwean context deserves some attention. In Zimbabwe, IKS practices are in various forms. Attention to the matter of IKS has largely been on its deployment in agriculture and disaster management (for example, Patt & Gwata, 2002; Gwimbi, 2009; Mubaya, 2010) and, apparently, not much has been done to ground IKS in climate change science.

Researchers have argued that efforts to evaluate the integration of human capital technocrats in El Nino management mitigation through indigenous knowledge system to harness sustainable livelihoods in Zimbabwe has not been fully captured in literature (Mazvimavi, Murendo & Chivenge, 2017, Kunzekweguta, Rich & Lynne, 2017, Dube, 2017, Makwada & Manatsa, 2018). In an effort to bridge this gap, and due to increased occurrences of climate variability in Southern Africa, farmers call for scientific forecasts to help generate more accurate forecast. While this call is widely acknowledged in Southern Africa, some argue that farmers in the region continue to rely heavily upon indigenous forecasts because their cultural identity underpins it as the knowledge was passed on to households by their forefathers (Tume et al, 2019). This has fortified the call for integration of IKS with scientific forecasts to generate richer weather information through human capital technocrats. The integration of knowledge will result in better crop production during El Nino, preserve IKS which are gradually becoming extinct partly because young people abandon agriculture and migrate to urban areas in search for better livelihood opportunities (Ebhuoma et al. 2021).

Despite extreme weather challenges confronting rural households in Southern Africa, those households are not docile victims of the challenges. They are continuously navigating ways strongly guided by IKS to outwit the weather challenges to produce their own food and attain their livelihoods (Mubanga &Umar, 2014; Nkomwa Et al. 2014 and Ebhuoma et al. 2021). Like most indigenous people in Southern Africa, a key strategy in Southern Africa to produce food effectively is the application of indigenous weather forecasts to determine the types and quantity of food to grow in a particular farming season. The indigenous weather forecasts are not limited to lunar and cloud observations, they also involve close monitoring of plants and animal behaviour (Mubanga &Umar, 2014; Nkomwa et al. 2014 and Ebhuoma et al. 2021). These indigenous indicators used to generate forecasts have been applauded by local people for their ability to create weather forecasts with fine spatial resolution, better than most scientific forecasts due to the absence of weather stations in the proximity of rural communities (Ebhuoma & Learnard, 2020). However, identifying the influence and applicability of IKS research compels researchers to acknowledge their biases and to regulate power dynamics created by their roles as reporters of culturally rooted knowledge (Gao & Mataira, 2019).

Policies must recognise information that is salient, credible, legitimate and operational (Cash et al., 2003; Clark et al., 2016). They, thus, must signify altered voices, understanding and lived understandings, including those of Ethnic Peoples, and be based on reciprocal relationships and inter-generational sustainability. Appealing to indigenous information helps broaden the scope of science, test hegemonic epistemological nitty-gritties, and underwrite equitable and inclusive awareness pathways (Mistry & Berardi, 2016; Smith, 2021; Tengö et al., 2017). By diagnosing and respecting the multiplicity and intricacy of understanding systems, we can move towards a more holistic and maintainable slant to environmental policy (de Sousa Santos, 2018**)**.

Knowledge of climate science should be all-inclusive. In climate change discourses, therefore, the collective information, resourcefulness and action of all stakeholders (including communities affected by climate change) merits exceptional courtesy. This understanding situates indigenous societies in an important position in terms of climate inquiry. Apart from being vulnerable targets of climate change (Boko et al., 2007; Nyong et al., 2007; IUCN, 2008), long-time inhabitants depend on ecosystem-based and climate-sensitive livelihoods that are focused on ecological transformation and variability (Turner & Clifton, 2009; Green & Raygorodetsky, 2010; Green et al., 2010; Nakashima, 2012). Therefore, their immersion in ecological matters cannot be in doubt.

Fundamentally, the lenses of technical enquiry through integrating human capital experts ought to cover traditional communities in which indigenous knowledge systems (IKS) are prevalent. This can enhance approving of climate change interventions against the minimized facts about current and future climate, and the aggregate tasks associated with the phenomenon. Therefore, the role of indigenous knowledge (IK) in climate science should also address the impact of assessment, mitigation, adaptation and policy formulation. IK is a locally developed knowledge form, acquired in situ through the progressive study of the community's interaction with the environment (Mapara, 2009; Labode et al., 2012). Investigation that explores local understandings, views, observations and rejoinders of people undergoing variability and change in the climate system can enhance useful thoughts on the subject. Overall, the study argues that indigenous based knowledge is capable of filling knowledge gaps and validating current information about climate change, particularly at local levels in Zimbabwe.

Research methodology

The study took a qualitative approach where purposive sampling method was used to select 20 participants, who form the study sample size in Mashonaland West Province, Zimbabwe. The study sample frame came from Ministry of Climate Change, chiefs and village heads in the communities; these were rich sources of information on indigenous knowledge systems and El Nino. Data was collected using structured interviews, cultural mapping and focus group discussions. However, in collecting data meetings were deemed important for informing and building community trust with the researchers and laying the groundwork for further research. Cultural mapping was seen as important because it involved making use of local experts, which made respondents feel that they were sharing information with fellow informants. Tape recorders were used to ensure the fidelity of the interviews, and field staff were trained to conduct interviews without the use of questionnaires where appropriate. All discussions and interviews were conducted in the local language, recorded, transcribed verbatim and translated into English. Data analysis was thematic. Due diligence to ethical considerations was done where participants were assured of confidentiality and anonymity to avoid bias and due care through informed consent was taken before collecting data.

Results and discussion

Response rate

The study purposively selected 20 participants which formed the sample size. However, only 15 participants took part and responded to administered structured interviews and focus group discussions. This implies that the response rate translated to 75%, signifying that the matter was of great importance to all stakeholders.

The results were solicited from the assessment done on the effect of integrating human capital technocrats in El Nino management mitigation through indigenous knowledge system harness sustainable livelihoods in Zimbabwe. Diverse responses were given and participants underscored the value of the inclusion of experts in El Nino management mitigation through indigenous knowledge system.

Participant 1 and 4 underscored the value inclusion of technocrats in preserving cultural heritage in the form of indigenous sciences and had this to say:

"…plainly, the wave of interest in climate change and indigenous knowledge has gathered momentum in El Nino management mitigation in our communities… we have the right to maintain, control, protect and develop our cultural heritage, traditional knowledge and traditional cultural expressions, as well as the manifestations of indigenous sciences through inclusion of technologies and cultures, to identify and protect ourselves from misleading ideas of our indigenous knowledge which give us signs of impending droughts."

Participant 2, 3 and 8 argued that it is only through the resilience of some local communities that IKS is still noticed as of great significance in times of drought when key warning signs of drought are noticed early and action taken to, for example, preserve food using traditional means. They added that the need for inclusion of technocrats in food sciences helps in hygienic preservation of more food to help those in dire need. They further comment that:

"…despite a continued cultural onslaught on African thought, particularly our knowledge and belief systems through the spread of the Western scientific worldview…we have maintained our traditional thought and values here. A case in point is the of droughts of 1981/82, 1991/92 and 2002/03 which had massive negative impacts on the livelihoods of the majority of the peasantry… it is the adoption of indigenous knowledge through food gathering and preservation strategies in most rural areas which was a necessary adaptation strategy that saved them from what was otherwise potentially tragic …but what is needed is to have modern technological means of preserving food which is quicker and can be done through inclusion of technocrats in this domain to save more people from hunger peril."

Participant 12, 14 and 10 highlighted the need for proper integration of holistic approaches of IKS and climate change mitigation strategies to harness sustainability and livelihoods. They commented that:

"…emerging from this linkage is the fact that sustainable development paths through proper institutional, social, economic and technological arrangements collectively form a bundle of mitigation strategies necessary in addressing climate change. Depending on the scale and magnitude of climate impacts, communities can harness a variety of adaptation options from their bio-physical and socio-economic environment to position themselves on sustainable paths. Thus, mitigative and adaptive capacity is a measure of society's sustainability level in a mutually reinforcing mechanism between sustainable development policies and climate change policies."

Participant 5, 6 and 7 reiterated that IKS such as knowledge, practices, views, technologies and skills of the indigenous people deserve attention in the current agenda for climate change research. However, comments asserted were that:

"In climate change mitigation, IKS is potentially useful in the implementation of policies enhancing management of agriculture, ecosystem and other forestry management projects. The challenge, however, could be the limited scale at which such projects can be implemented to cause significant sequestration of atmospheric changes. In disaster and risk management practices, IKS can be harnessed in projects that reduce community vulnerability to the hazards posed by climate change extreme events such as drought, floods, hurricanes and thunderstorms."

"…considering mitigation and adaptation as parts of an integrated portfolio of strategies, policies, and actions is complicated, mitigation to reduce changes in precipitation patterns that would affect agriculture versus adaptive development of crop varieties resilient to a wider range of precipitation. In some cases, they reinforce each other: e.g., more efficient space cooling both reduces electricity consumption for space cooling (mitigation) and makes cooling more affordable for lower income groups (adaptation). In either case, the actions are also related to other aspects of sustainable development pathways as well."

Participant 10, 11 and 13 underscore the hazards associated with climatic events whose occurrence usual exceed society's adaptive capacity. Inevitably, human capital technocrats are needed to guide communities in ameliorating disasters and preservation food. The participants had this to say:

"Due to poverty-climate change milieu, it is clear that climate change is adding to other entrenched drivers of unsustainability in most parts of this society. Drawing from IKS in designing mitigation and adaptation interventions can be one of the ways of addressing vulnerabilities of indigenous communities affected by climate change. Conceptually expressed, sustainable development cannot be separated from climate change discourses. However, the challenge of climate change responses is to make them sustainable."

Indigenous people and their communities have an historical relationship with their lands (environments) and are generally descendants of the original inhabitants of such lands (environments)... They have developed over many generations a holistic traditional scientific knowledge of their lands, natural resources and environment. Indigenous people and their communities shall enjoy the full measure of human rights and fundamental freedoms without hindrance or discrimination. Their ability to participate fully in sustainable development practices on their lands has tended to be limited as a result of factors of an economic, social and historical nature."

The study results are in agreement with some other studies recorded in literature. In attempting to understand how local communities deal with climate change, Berkes and Jolly (2001) examine the indigenous practices of the Inuit of Sachs Harbour in Canada. The two researchers observe that both long-term adaptation and coping strategies through switching species and adjusting hunting practices are based on the community's detailed knowledge on the environment. Berkes et al (2007), in the same study area, intend to understand if IK can be used for monitoring environmental change. They show that community monitoring provides an extensive scan of environmental parameters based on signs and signals of environmental change developed from indigenous science. Later, Gearheard et al (2009) observe that the Inuit use environmental indicators like wind to observe weather and climate. They note that three aspects of wind have changed over the last decades namely; wind variability, wind speed and wind direction. The Inuit observations could actually correspond to station data in the area. Speranza et al (2009) describe the IK held by agro-pastoralists in Makueni District, Kenya and how they use it to monitor, mitigate and adapt to drought. They identify various IK indicators of climate change and variability; namely animal, birds and insect behaviour and signs; local weather conditions and signs; rainfall patterns and amounts; signs from flora; astrological constellations; and signs from the local environment. These indicators are used to make seasonal climate projections and to understand changes in the local climate system.

Conclusions and Recommendations

Arguments presented in this study offer useful insights in the mitigation and adaptation that not only potentially capture knowledge of the indigenous people, but is also necessary in sustainable development discourses. The discussion given in this study is also clear testimony that the validity of inclusion of experts in El Nino management mitigation through indigenous knowledge system is an important aspect geared towards improving livelihoods for communities in Zimbabwe. Clearly, the significance of IKS in environmental issues like climate change is globally recognized. What remains, therefore, is the need to explore local-specific knowledge and practices that indigenous communities have in order to provide useful insights for climate change interventions. Since IK is a broad concept covering all forms of knowledge in a particular area, there is need to isolate the specific knowledge related to climate change, mitigation and adaptation. Undoubtedly, faced with the challenge of climate change and the various risks it poses, whose severity and magnitude are largely unknown, a framework for constructive dialogue between indigenous scientists (local climate experts) and conventional scientists (mainstream scientists) is no longer an option but a requirement. However, the question that needs to be addressed is how such a framework should be instituted. Key in this focus is the design of appropriate epistemology, methodology and methods for analysing IK in climate change through the inclusion of human capital technocrats in climate change mitigation for sustainable livelihoods in Zimbabwe.

References

Alejo, C., Meyer, C., Walker, W. S., Gorelik, S. R., Josse, C., Aragon-Osejo, J. L. (2021). Are indigenous territories effective natural climate solutions? A neotropical analysis using matching methods and geographic discontinuity designs. PLoS One 16:e0245110. doi: 10.1371/journal.pone.0245110

Altieri, M. A., and Nicholls, C. I. (2017). The adaptation and mitigation potential of traditional agriculture in a changing climate. Clim. Chang. 140, 33–45. doi: 10.1007/s10584-013-0909-y

Avila-Bello, C. H., Hernández-Romero, Á. H., Vázquez-Luna, D., Lara-Rodríguez, D. A., Martínez-Jerónimo, A., Meneses-García, B. N., et al. (2023). Design of complex agroecosystems: Traditional and formal knowledge to conserve agrobiodiversity in the Santa Marta Mountains, Veracruz, México. Environ. Dev. Sust. 26, 7129–7161. doi: 10.1007/s10668- 023-03002-9

Baul, T. K., Peuly, T. A., Nandi, R., Kar, S., and Karmakar, S. (2022). Role of homestead forests in adaptation to climate change: a study on households' perceptions and relevant factors in Bandarban Hill district, Bangladesh. Environ. Manag. 69, 906–918. doi: 10.1007/s00267-022-01598-8

Berkes, F., Colding, J., and Folke, C. (2000). Rediscovery of traditional ecological knowledge as adaptive management. Ecol. Appl. 10, 1251–1262. doi: 10.1890/1051-0761(2000)010[1251:ROTEKA]2.0.CO;2

Boillat, S., and Berkes, F. (2013). Perception and interpretation of climate change among Quechua farmers of Bolivia: indigenous knowledge as a resource for adaptive capacity. Eco. Soc. 18:21. doi: 10.5751/ES-05894-180421

Brattland, C., Eythórsson, E., Weines, J., and Sunnanå, K. (2019). Social–ecological timelines to explore human adaptation to coastal change. mBio 48, 1516–1529. doi: 10.1007/s13280- 018-1129-5

Brook, R. K., and McLachlan, S. M. (2008). Trends and prospects for local knowledge in ecological and conservation research and monitoring. Biodivers. Conserv. 17, 3501–3512. doi: 10.1007/s10531-008-9445-x

Brugnach, M., Craps, M., and Dewulf, A. (2017). Including indigenous peoples in climate change mitigation: addressing issues of scale, knowledge and power. Clim. Chang. 140, 19–32. doi: 10.1007/s10584-014-1280-3

Buckley, H. L., Hall, D., Jarvis, R. M., Smith, V., Walker, L. A., Silby, J., et al. (2023). Using long-term experimental restoration of agroecosystems in Aotearoa New Zealand to improve implementation of nature-based solutions for climate change mitigation. Front. For. Glob. Change. 5:950041. doi: 10.3389/ffgc.2022.950041

Chanza, N., and de Wit, A. (2013). Epistemological and methodological framework for indigenous knowledge in climate science. Indilinga Afr. J. Ind. Know. Syst 12, 203–216.

Chanza, N., and Musakwa, W. (2021a). “Trees are our relatives”: local perceptions on forestry resources and implications for climate change mitigation. Sustain. For. 13:11. doi: 10.3390/su13115885

Chanza, N., and Musakwa, W. (2021b). Indigenous practices of ecosystem management in a changing climate: prospects for ecosystem-based adaptation. Environ. Sci. Policy 126, 142–151. doi: 10.1016/j.envsci.2021.10.005

Dube, K., (2016) ‘Implications of rural irrigation schemes on household economy. A case of lower Gweru irrigation scheme, Zimbabwe’, South African Journal of Agricultural Extension 44(1), 75–90. 10.17159/2413-3221/2016/v44n1a371

Hove, L. & Kambanje, C., (2019), ‘Lessons from the El Nino–induced 2015/16 drought in the Southern Africa region’, Current Directions in Water Scarcity Research 2(2019), 33–54. 10.1016/B978-0-12-814820-4.00003-1 [CrossRef] [Google Scholar]

Kunzekweguta, M., Rich, K.M. & Lyne, M.C., (2017) ‘Factors affecting adoption and intensity of conservation agriculture techniques applied by smallholders in Masvingo district, Zimbabwe’, Agrekon 56(4), 330–346. 10.1080/03031853.2017.1371616 [CrossRef] [Google Scholar]

Matunhu, J., Mago, S. & Matunhu, V., (2022), ‘Initiatives to boost resilience towards El Niño in Zimbabwe’s rural communities’, Jàmbá: Journal of Disaster Risk Studies 14(1), a1194. https://doi.org/10.4102/jamba.v14i1.1194

Mazvimavi, K., Murendo, C. & Chivenge, P., (2017) The impacts of the El Niño-induced drought on seed security in Southern Africa: Implications for humanitarian response and food security, viewed 30 September 2021.

Mukwada, G. & Manatsa, D., (2018) ‘Is climate change the nemesis of rural development? An analysis of patterns and trends of Zimbabwean droughts’, in Climate change, extreme events and disaster risk reduction, pp. 173–182, Springer, Cham. [Google Scholar]

Owusu, K., Emmanuel, A.K., Musah-Surugu, I.J. & Yankson, P.W.K., (2019) ‘The effects of 2015 El Nino on smallholder maize production in the transitional ecological zone of Ghana’, International Journal of Climate Change Strategies and Management 11(5), 609–621. 10.1108/IJCCSM-02-2018-0014 [CrossRef] [Google Scholar]

Thierfelder, C., Chivenge, P., Mupangwa, W., Rosenstock, T.S., Lamanna, C. & Eyre, J.X., (2017) ‘How climate-smart is conservation agriculture (CA)? – Its potential to deliver on adaptation, mitigation and productivity on smallholder farms in southern Africa', Food Security 9(3), 537–560. 10.1007/s12571-017-0665-3 [CrossRef] [Google Scholar]

Van Ginkel, M. & Biradar, C., (2021), 'Drought early warning in agri-food systems', Climate 9(9), 134. 10.3390/cli9090134 [CrossRef] [Google Scholar]

World Food Programme (WFP), (2016), El Niño: Undermining resilience: Implications of El Niño in Southern Africa from a food and nutrition security perspective, viewed 14 May 2020, fromhttps://documents.wfp.org/stellent/groups/public/documents/ena/wfp282004.pdf?iframe.