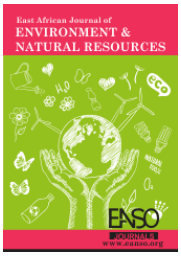

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Original Article

Relevance of Indigenous Knowledge in Sustainable Management of Forest Resources in the 21st Century Uganda

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ABSTRACT

Sub-Saharan Africa is endowed with indigenous knowledge systems and natural forest resources critical to supporting several forms of development. However, the region has experienced rapid population growth and demographic changes, which may lead to a decline in forest resources. Sustainable management of these resources is critical for a healthy forest ecosystem that should continue to provide goods and services to the present and future generations. Of the variety of management strategies employed in the sustainable management of forest resources, indigenous knowledge provides a plausible alternative. To ascertain the relevance of this knowledge, the Lugbara community in Yumbe district, northwestern Uganda, was considered. Data were collected from 371 respondents using questionnaires and 19 key informants using interviews; others included participatory GIS and remote sensing. Data was analysed using descriptive and inferential statistics, thematic and content analysis, and a forest cover change matrix. The results indicated a highly significant correlation between IK availability and usefulness of 0.703 at 0.01 level, and the socioeconomic and demographic variables tested statistically significant with sub-county of origin alone accounting for 11.7% of the variations in utilisation of IK in forest management. Indigenous knowledge was mostly used in the management of community forest resources, while modern scientific approaches were used in managing public forests. The forest resources were not sustainably managed despite the relatively high prevalence of IK. T*he* linear model summary results were marginally significant, indicating that the prevalence of IK accounted for only approximately six% (R^2 = .059) of the variations in SMFR. However, there was a resurrected interest in the use of IK since some forests managed using strict customary laws were the most biologically diverse. The resurrected interest implies that the IK remains relevant in the 21st century. The study therefore, recommends that IK practises be documented, promoted, and integrated into modern formal approaches to achieve SMFR.

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INTRODUCTION

Sub-Saharan Africa is well endowed with forest resources, and sustainable management of these resources is critical to supporting several forms of development on the continent (Gondo et al., 2018; United Nations, 2017). The forest resources are essential because they contain two-thirds of the world's biodiversity and provide a suite of goods and services vital to both humans and the ecosystem (FAO, 2020a; Nwakile et al., 2018). The forest ecosystems are surrounded by human populations and people living within them. The region has one of the fastest population growth rates in the world, and the forest-human population relationship is a vital area to analyse in ensuring sustainable forest management. To increase the productivity of forest ecosystems to meet the needs of the population, several countries have opted for modern technology premised on the assumption that it provides better solutions to their development challenges (Beyene & Bellis, 2020; Cunningham & Cunningham, 2004). Its link to improved management techniques, such as effective monitoring, forecasting, communication, and precise early warning systems based on participatory and remotely sensed data and modelling, is undeniable (Su et al., 2020).

Countries that have adopted this technology in the management of forest resources have experienced a significant reduction in net forest cover loss and wildlife populations (FAO, 2020a). Despite these provisions, forests in Sub-Saharan Africa have been overstretched, creating an ecological crisis (Aboh, Ohara & Felix, 2019). For instance, in the last three decades (1990–2020), the tropical domain accounted for more than 90% of global deforestation, and Africa experienced the highest annual deforestation rate of 4.41 million ha (Burgos-Ayala et al., 2020; FAO, 2020b; Fraser, 2019). This crisis is largely due to intensive resource extraction techniques used such as tropical logging, mining or extraction of petroleum, and extensive commercial agriculture. Considering the origins and causes of the ecological crisis, one wonders whether the science that has shaped our lives and steered rapid developments in the 20th century is up to the task of promoting sustainable natural resource management in the 21st century (Parrotta, Yeo-Chang & Camacho, 2016). Because of this paradox, finding efficient natural resource management (NRM) strategies in the tropics has remained one of the most important problems of the twenty-first century (Keenan et al., 2015; United Nations, 2021).

The international community has just begun to acknowledge the beneficial role indigenous knowledge (IK) plays in the sustainable management of forest resources (SMFR) the so-called *"Rise of the Indigenous Mind"* era (Cajete,

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2019). The local communities, who were formerly ignored and excluded from the conventional management of forest resources, are now being increasingly recognised as crucial stakeholders capable of providing effective management solutions (Diansyah, Abas & Sakawi, 2022). The World Bank and United Nations are unequivocal on this that without the support of indigenous people, Sustainable Development Goal 15 on sustainable management of forests will not be achieved (United Nations, 2017). These people have a wealth of knowledge whose credibility in SMFR has been tested for centuries (Maru et al., 2020; Getahun, 2016). It embodies principles and practises that permit the continuous exploitation of natural resources, including in extremely challenging conditions (Nguyen & Ross 2017). Thus, some of the biologically diverse forest ecosystems are found on lands managed by these people (Fraser, 2019), given that those who rely more on natural resources are more inclined to be responsible stewards, which makes IK effective in natural resource management - NRM (Murmu, 2019).

Whereas the contribution of IK towards SMFR has been acknowledged by international agencies such as FAO, World Bank, and the United Nations, indigenous communities have struggled in recent times in conserving forest resources on their lands. These communities have suffered oppression, discrimination, and marginalization in the hands of their own governments as has been the case in Asia, Australia, Western and Central Africa and Latin America (Cajete, 2019; Getahun, 2016). For governments to achieve their objective of exploiting resources on indigenous lands, indigenous communities have often been subjected to degrading treatment. For instance, many indigenous communities have been evicted from their ancestral lands in the name of "development" or "conservation" of forest resources as has been the case in the Amazon and the Congo basins for the former and the Masai in Eastern Africa, Baka pygmies in Cameroun and the Central African Republic for the later (United Nations, 2021).

Uganda has a wealth of IK due to its ethnic diversity. Numerous investigations into the role of IK in NRM have been conducted in the country, but most have focused on the fields of agriculture and health (Nuwategeka & Nyeko, 2017; Tabuti &Van Damme, 2012). Yumbe district is blessed with natural forests surrounded by the Lugbara people, who have developed and used IK in NRM for centuries. Despite its growing popularity, IK should not be romanticised (Sillitoe, 1998). By virtue of their knowledge, not all indigenous people are effective managers of natural resources (Nelson & Shilling, 2019). Some IK practises may have turned out to be ineffective in SMFR, such as bush clearing using fire and shifting cultivation (Beyene & Bellis, 2020; Jha, 2008). It is against this background that this study set out to assess the effectiveness of IK in SMFR in Yumbe district, northwestern Uganda.

LITERATURE REVIEW

Sustainable Management of Forest Resources

The UN General Assembly recognised SMFR in 2007 as a dynamic and evolving concept that aims to preserve and enhance the socioeconomic and environmental values of all types of forests for the benefit of both present and future generations, using the following thematic components as a framework for comparison: the extent of forest resources; forest biodiversity; forest health and vitality; productive functions of the forest; socioeconomic functions of forests; and a legal, policy, and institutional framework (IUFRO, 2017). Generally speaking, SMFR can be understood as the human-initiated sustainable use and protection of forests for the maintenance and enhancement of several forest values (FAO, 2020b). Several theories have evolved to explain the relationship between knowledge and natural resource management. For instance, the relativism theory upholds the notion that the relevance of any knowledge system is dependent on its evolutionary context (Baghramian, 2021), implying that the solution to problems of NRM among indigenous communities can best be addressed by the use of home-grown knowledge (Lajul, 2018). In addition, Bandura's theory of

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social learning emphasises that SNRM is feasible if we establish a conducive learning environment for joint decision-making (Bandura, 2019).

Indigenous Knowledge and Indigenous People

Indigenous knowledge has been defined differently depending on the situation at hand (Siyanbola et al., 2012; Sullo et al., 2020). For instance, Whyte (2019) defines it as the collective heritage of human experience with the natural world, while Berkes and Berkes (2009) look at it as the cumulative body of knowledge passed down through generations by cultural transmission about the natural world. It depicts an indispensable source from which to learn how to "reconnect" humans to nature in times of weakening and changing human nature associations, which are cardinal in reinforcing unsustainable behaviours (Burgos-Ayala et al., 2020). Despite the varied definitions and terminologies used, the consensus seems to be that such knowledge systems have evolved over centuries and are retained by local communities outside the formal domains (Boafo et al., 2016).

The term "peoples" is fully defined in José R. Martinez Cobo's research on "the Problem of Discrimination Against Indigenous Populations" (Our Common Future, 1987). The fundamental concepts in the definition include indigenous people's right to define what and who they are. This is important because they are the only ones who can provide the most pertinent definition of indigenous people. They are unique among other tribes because of their historical ties to pre-colonial societies on their lands. The indigenous rights organisation Cultural Survival (CS) estimated that there are approximately 370 million indigenous people globally—approximately five% (Garnett et al., 2018). However, Cajete (2019) is hesitant about these estimates which he argues are conservative since it has always been in a country's best interest to underestimate the number of indigenous people. Fewer numbers bring nations closer to their goal of total assimilation, exploitation, and control of the resources in indigenous lands.

Indigenous Knowledge Systems and Practises

There is sufficient testimony from scholars that the lands and territories inhabited by indigenous peoples and local communities around the world are some of the richest in natural resources (Burgos-Ayala et al., 2020; IFAD, 2016). They do not dream of possessing these resources but rather belong to them and are simply their custodians. Through countless experiments and as custodians, they have developed a comprehensive body of knowledge for the sustainable use and management of these resources (Jha, 2008). Religious and traditional practises form part of this body of knowledge and play a decisive role in the effective management of these resources. The knowledge system is embedded in rules and regulations, cosmological beliefs, taboos, and totems (Adom et al., 2016; Gondo et al., 2018). The progression of this knowledge and sustainable management practises of these resources in turn form part of the customary laws and spirituality of the indigenous people and local communities. This prosperous knowledge, established in close collaboration with their environment, has empowered them to live in harmony with nature for centuries (Carson et al., 2018). Therefore, in trying to establish the relevance of IK in management of forest resources (MFR) in the 21st century, consideration was given to the practises of IK already mentioned herein.

Prevalence of Indigenous Knowledge in SMFR

Literature reveals that more than 80% of the world's poor people continue to depend directly or indirectly on biological resources and the accompanying IK systems and practises, which serve as an example of the extent to which IK is applied in SMFR (Aboh et al., 2019). According to Beyene and Bellis (2020) and Lajul (2018), these people use a variety of IK technologies to come up with coping mechanisms that maintain and safeguard the forest resources. The Pygmies in Central Africa, the Yanomamo, and Kayapo in the Amazon in South America, the Oromo in Ethiopia, the Batwa in Uganda, and the Aborigines in Australia are some few examples.

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However, Beyene and Bellis (2020) and Lajul (2018) caution that the prevalence of IK is on a steady decline because the knowledge base of the indigenous communities has been "fractured" by external forces including Western education, religion, and the social media. The challenges IK has gone through has been summarized by Ngugi wa Thiong'o (1965) who argues that as Africans continued to cast their gaze towards the West, African IK was ridiculed, undervalued, dismissed, and, dismantled including by the West, Africans themselves and with the full support of their governments. Studies done by other scholars such as Aboh et al. (2019) in Ikom, Cross River State, Nigeria; Parrotta et al. (2016) in the Philippines; Boafo et al. (2016) in northern Ghana, indicated that the prevalence of IK in livelihood support is quite diverse in both indigenous and non-indigenous communities. However, several communities have faced numerous challenges in recent decades as a result of the socioeconomic and demographic landscape's fast change. The effects of climate change and variability, which have resulted in widespread prolonged drought and flooding, exacerbate these problems even further. Unfortunately, majority of these research have been carried out in indigenous communities, where IK is typically more prevalent than in non-indigenous populations. Consequently, faced with rapid social and economic development, IK is becoming vulnerable (Su et al., 2020), potentially limiting the extent of its application in the SMFR. The loss of such knowledge represents the loss of part or all of the local culture that is cardinal to the sustainability of forest resources on indigenous lands. Indeed, the survival of this knowledge requires a receptive and patronising population to evolve, and sustain itself (Subrahmanyeswari & Chander, 2013).

Reawakened Interest in Indigenous Knowledge for SMFR

Indigenous knowledge and practises experienced a significant decline with the onset of colonialism because indigenous and local people were perceived as impeding the sustainable exploitation of natural resources (Diansyah et al., 2022). But the last three decades have witnessed a new area of interest in its utilisation in managing forest resources (Gratani, 2015). The shift in the attitude of Western-trained scientists towards the use of IK in NRM probably began in the mid-20th century, triggered by the discoveries made by Conklin in the Philippines in 1954 (Mafongoya & Ajayi, 2017). His findings challenged and raised questions about the effectiveness of supposedly superior formal scientific knowledge in NRM. Unfortunately, development activities are destroying these resources as a result of "technological tragedy"- the massive environmental damage caused by the adoption of cutting-edge technologies with roots in intensive resource exploitation. Agriculture, industrialization, mining, and infrastructural development have all seen this occurrence. As a result, the forest resources in Sub-Saharan Africa are in a serious state of decline (Gadgil, Berkes & Folke, 2021; United Nations, 2021). Despite this crisis, indigenous lands experience much less forest depletion and degradation, implying that they provide a useful alternative management strategy for forests, thus making it relevant in the 21st century. Many scientists concur with this view (Macdicken, 2015; Sinthumule & Mashau, 2020) and it is therefore not surprising that efforts to preserve and promote the use of IK in forest resource management in the 21st century are being spearheaded by the West.

Studies conducted by Beyene and Bellis (2020); Boafo et al. (2016); Camacho et al. (2016) may not be conclusive of the scope of the relevance of IK in MFR. But their findings reveal that IK is relevant in the management of forest resources today, despite the declining trend in its usage. This may be due to the numerous socioeconomic and demographic challenges in the cultural landscape exacerbated by climate change. These changes have made IK vulnerable to external forces (Su et al., 2020) potentially constraining its application in the MFR. Though some indigenous people find the various forms of IK practises inadequate in addressing their socio-cultural and economic needs, it remains relevant to the needs of the local community (Beyene & Bellis, 2020). As a result,

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a study on IK utilisation among the Aringa-speaking Lugbara of Yumbe district is essential, especially in light of ongoing efforts in SMFR to be successful, as explained more fully in the materials and methods section.

MATERIALS AND METHODS

Study Area

The study was conducted among the Aringa, a sub-group of the Lugbara tribe, in Yumbe district, northwestern Uganda (*Figure 1*). The district is bordered by South Sudan to the north, the districts of Moyo and Obongi to the East, Madi Okolo and Terego to the south, and Koboko and Maracha to the West. It lies in the climatic zone sub-type "Aw," a tropical savanna climate with mean annual rainfall ranging from 1,200–1,400 mm and a mean temperature of 24.4 °C or 75.9 °F (NEMA, 2010). The soils are predominantly ferralitic in nature, covering more than 75% of the land area (NEMA, 1995). The topography is generally flat, with some notable residual hills in the north (Mount Kei and Midigo) and several minor hills to the East. There were 663,600 residents by mid of 2020 (UBOS, 2020). Ninety-two per cent of the people live in rural areas and are primarily engaged in subsistence agriculture (UBOS, 2016). The majority of the streams have a cyclical nature, which reflects the seasonal rainfall regime.

The district in general and three Subcounties (Kei, Kerwa, and Midigo) where the study was conducted were purposefully selected considering the portion of the land area covered by communal and public forests and a rural-based population that relies heavily on natural resources for food, energy, shelter, and herbal medicine. Yumbe district has been chosen because it has a significant number of elderly people, accounting for 3.2% compared to the national average of 2.8 percent; a high level of illiteracy at 44.5% compared to the national average of 27.8 percent; a rural-based population with a high growth rate of 5.5% compared to the national average of 3.0% and the largest portion of natural forests in the West Nile sub-region (UBOS, 2016). The above conditions were thought to be ideal for the subsistence of IK.

Research Design, Sampling, and Data Collection

A cross-sectional survey research design was employed in the study. Both quantitative and qualitative approaches to data collection were used. The targeted population comprised local communities living in and around forests in the three sub-counties of Kei, Midigo, and Kerwa; key informants (KI) such as cultural and opinion leaders; forest resource managers. The sample size of the study was calculated using Krejcie & Morgan's (1970) formula with a .05 margin of error as; $S = X^2 N P (1 – P) \div d^2 (N – 1) + X^2 P (1 – P)$; where: S = Sample size (15,436 households); X^2 = Value of chi-square for 1 degree of freedom at the desired confidence level (3.841); N = Population size (15,436 households) and P = The population proportion (assumed to be .50). A sample size of 375 respondents, from 375 households were selected using simple random sampling, were interviewed as follows: Kei 152, Kerwa 101, and Midigo 122. The 375 households were selected from eleven parishes and 37 villages spread across the three sub counties. The location of the 375 households were georeferenced using participatory GIS (GPS) to ascertain the spatial prevalence of IK but four later withdrew. Purposive sampling was used to select the 19 key informants and the total number was determined by the theory of saturation level (Braun et al., 2017). Both closed-ended and open-ended questions were used in the questionnaire to collect data on the prevalence and utilisation of IK in SMFR. Due to the high rate of illiteracy, the questionnaires were administered by the researcher and the research assistants. Bio-physical data was collected using the Thematic Mapper (TM) for the period 2000 and 2021 to establish the forest cover. The parameters of IK that were assessed included; prevalence of IK (possession, availability, usefulness) utilisation and growing interest in indigenous forest knowledge.

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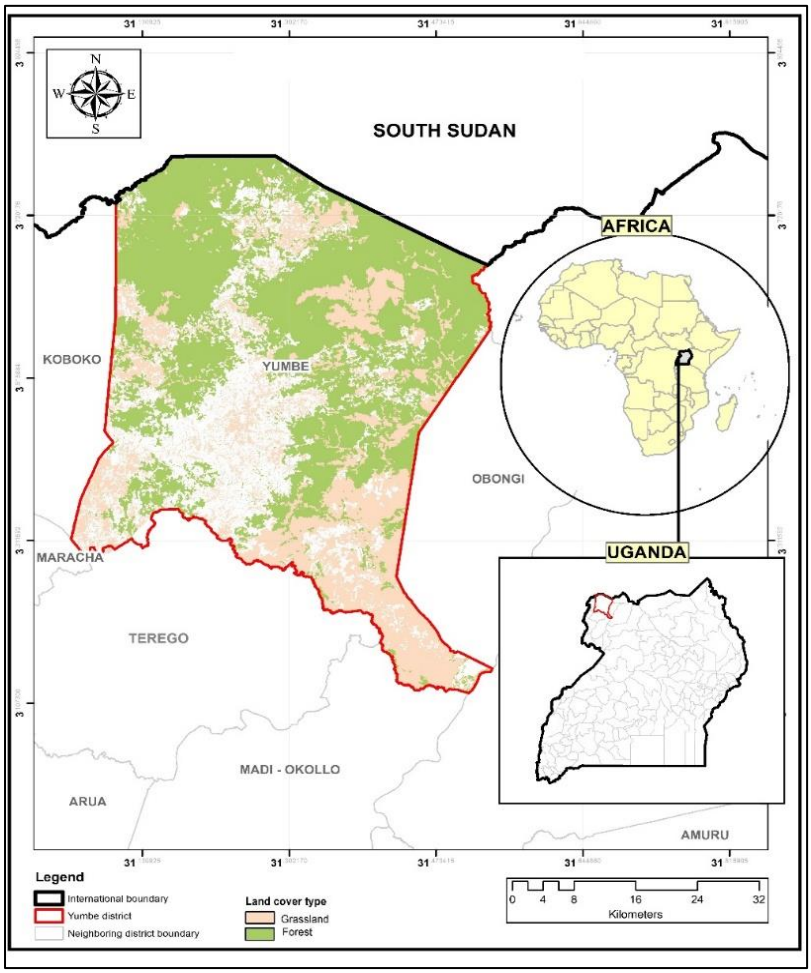
Figure 1: Location of Yumbe district



Source: Remotely Sensed Data

Data Analysis

Both descriptive and inferential statistics were used to analyse data. For example, frequencies were used to establish the prevalence of various IK practices, cross-tabulation was used to establish the relationship between age and possession of IK, correlation was used to establish the relationship between IK availability and usefulness in forest management, the prevalence of IK and SMFR, and the relationship between contributing factors and the prevalence of IK. A linear regression was used to establish the relationship between prevalence of IK and SMFR, a multiple regression was used to establish which socioeconomic and demographic variables had a significant impact on the utilisation of IK in MFR. The socioeconomic and demographic variables considered included; age, gender, education, religion, marital status, occupation, income of the respondents; years lived in the area, identity as indigenous person; IK availability and subcounty of origin. The GPS coordinates for the georeferenced households were used to generate a prevalence map for IK in forest management in the area. This was then mapped on the forest cover map of 2021 using overlay function in ArcGIS software to establish the role IK played in MFRs in the 21st century.

To analyse qualitative data obtained using key informant interviews (KII) content and thematic analysis techniques were used (Malunda & Atwebembeire, 2021). In some cases, qualitative data were transformed into quantitative data using numeric counts and variables by coding and counting the frequency of codes or domains identified. The transformed data were then integrated with quantitative data for analysis. Data were also analysed in words, focusing on themes

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that emerged from various participants in line with the objectives of the study. For instance, data on the resurgence of IK in NRM.

RESULTS

Availability and Usefulness of Indigenous Knowledge

Results from questionnaires and key informant interviews indicated that the local communities in the area had diverse forms of IK, even when the knowledge appeared to be on the decline. The most common IK practises in the area included rules and regulations, beliefs, customs, and rituals, while taboos, totems, proverbs, and sacred places were on the decline. The perceptions of the local communities in the study area revealed that IK was still available and useful in managing forest resources, as reflected by 96% and 92 percent, respectively. The correlation result between IK availability and usefulness of 0.703 was highly significant at the 0.01 level, as shown in *Table 1*.

Table 1: Correlation between IK availability and usefulness

	Indigenous knowledge usefulness		
Indigenous knowledge availability	Pearson Correlation	Sig. (2-tailed	N
	0.703**	< 0.001	371

***Correlation is significant at the 0.01 level (2-tailed)*

The coefficient of determination for the relationship was 0.49, implying that the availability of IK accounted for 49% of the variations in its usefulness. Key among these practises were taboos (40.2%), totems (40.4%), rules and regulations (96.2%), metaphors and proverbs (45.2%), customs and rituals (71.2%), sacred places (31.8%), and beliefs (95.1%). Some key informants confirmed that IK was very useful because *"it was the reason why they have lived this long".*

The Prevalence of Indigenous Knowledge

Results from the study further revealed that 90% of the population possessed IK, but this varied by age. Whereas, the prevalence was highest among the elderly, the relatively high prevalence among the young (76%) was particularly interesting. A respected elder observed that, "*in his community children are taught the importance of preserving valuable tree species. So, they have the knowledge……". Figure 2b)* showed variations in the prevalence of IK by Subcounty. *T*he prevalence was highest in Kei subcounty and lowest in Kerwa subcounty. Figure 2b) also shows the forest cover in 2021, a big reduction from the forest cover in 2000 *(Figure 2a)*.

The results further revealed that the prevalence of IK did not automatically translate into SMFR. A comparison in forest cover between *Figure 2a* and *Figure 2b* clearly showed that the forests were not managed sustainably. There was a reduction in forest cover from 149,628 ha. in 2000 to 27,459.81 ha in 2021, a percentage decrease of 81.6%. To confirm the findings in *Figure 2a and 2b,* a linear regression was run and the equation for the model was $y = 0.0379x + 0.1431$. T*he* model summary results were marginally significant ($R^2 = .059$) and indicated that there was little reason to believe that the prevalence of IK adequately explained the variations in SMFR. The key informants argued that the prevalence of IK was important in SMFR. A correlation analysis was run to establish the relationship between contributing factors and the current IK prevalence in the area. The results are presented in *Table 2*.

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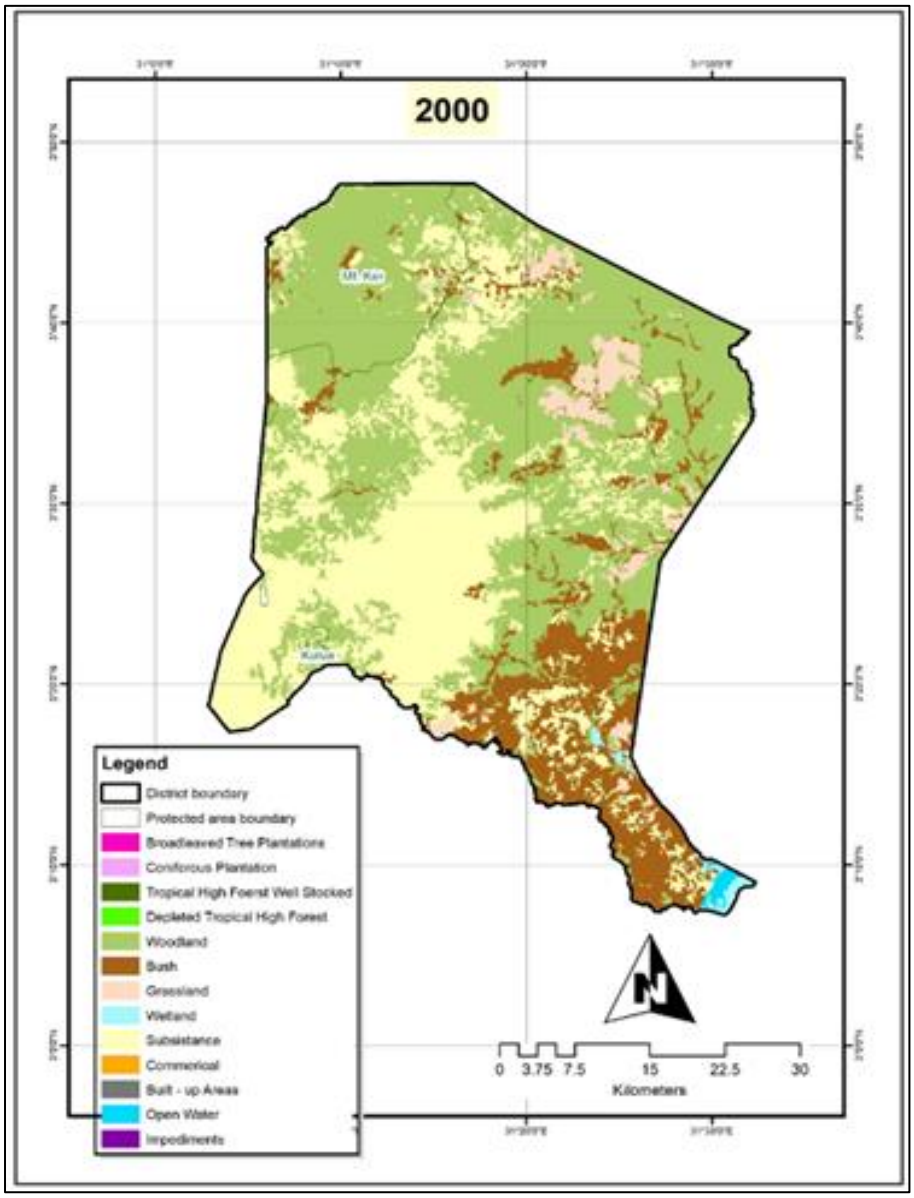
Figure 2a: Yumbe district land cover 2000



Source: Remotely sensed data for land cover 2000

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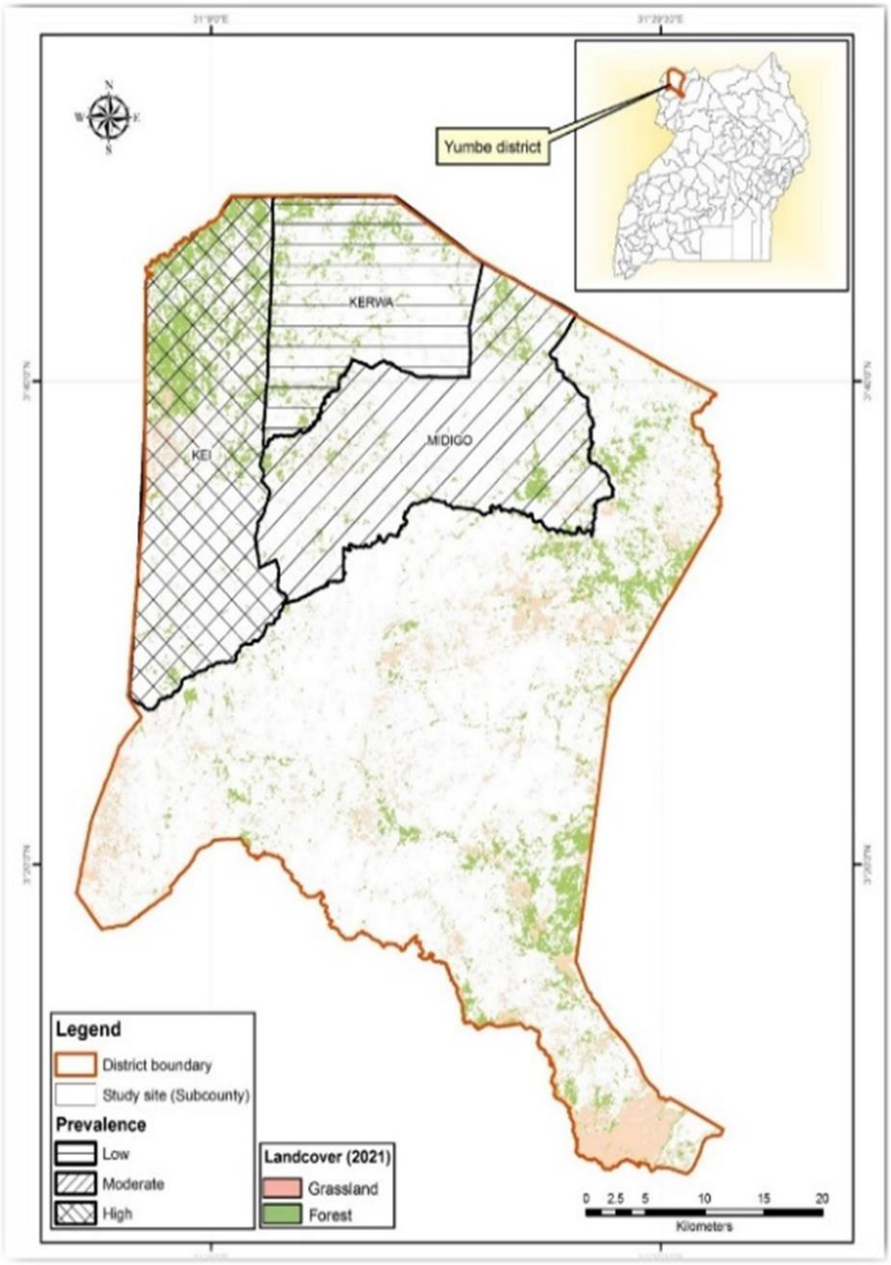
Figure 2b: Yumbe district IK prevalence and land cover 2021



Source: Remotely sensed land cover data and georeferenced household data

Table 2: Correlation between IK prevalence and contributing factors

Contributing factors to IK prevalence	Indigenous Knowledge Prevalence		
	Pearson Correlation	Sig. (2-tailed	N
Familiarity	0.112*	0.031	371
User friendly	-0.029	0.572	371
Cheap	0.170**	0.001	371
Readily available	0.083	0.111	371
Environmentally friendly	0.108*	0.038	371

**Correlation is significant at the 0.05 level (2-tailed)*
***Correlation is significant at the 0.01 level (2-tailed)*

The most important contributing factor to IK prevalence was cheapness (*p=0.001*), followed by familiarity (*p=0.031*) and environmental friendliness (*p= 0.038*). For example, cheapness

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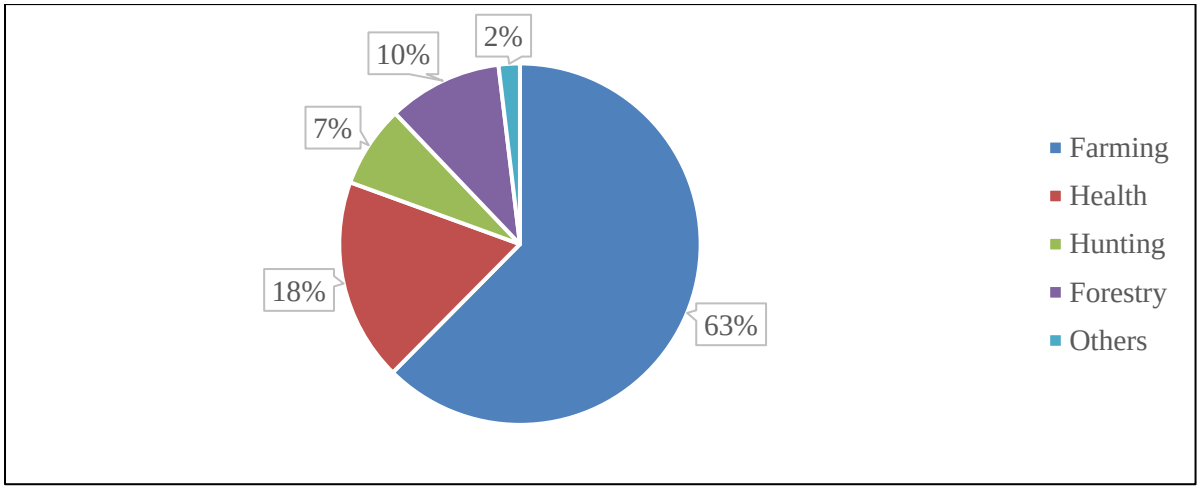
alone accounted for seventeen% of the variations in IK prevalence, followed by familiarity and environmental friendliness. User friendliness and availability of IK did not show significant results. The finding was similar to that of KI who associated IK prevalence to familiarity, and cheapness.

Utilisation of Indigenous Knowledge in Management of Forest Resources

Whereas the prevalence of IK was relatively high, its utilisation varied by activity. For instance, IK was widely used in farming, health, forestry, hunting, and others, as shown in *Figure 3*. Others included art and craft.

Figure 3: Sectorial Utilisation of Indigenous Knowledge



Source: Field data

The forest resources in the area were owned by different actors. Approximately 48% of the forests were owned by the community, and 52% were public forests. In areas that were surveyed, some places had both community and public forests, while others had only one type. The results further indicated that the utilisation of IK in the management of forest resources was not uniform. This was evident based on the ownership of the forest and the subcounty where the forest was located. For instance, IK was widely used in managing community forests as opposed to public forests. Kei emerged as the subcounty where the utilisation of IK in MFR was highest in the district.

A multiple regression analysis was run to establish the socioeconomic and demographic variables that determined the utilisation of IK in the management of forest resources in the study site. The variables that most contributed to the utilisation of IK in MFR was subcounty of origin *($p = 0.001$)*, followed by religion *($p = 0.018$)*, years lived in an area *($p = 0.039$)*, and gender *($p = 0.042$)*. Other variables did not show significant results as in *Table 3*. The equations resulting from the multiple regression analysis are $y = 0.5736x+2.2174$ for subcounty of origin; $y = 0.0039x+0.6252$ for religion; $y = 0.2282x+0.7246$ for years lived in the area and $y = 0.1229x+1.4565$ for gender of respondents.

The model summary results showed a significant relationship between socioeconomic and demographic variables and the utilisation of IK in SMFR at the 0.01 level of significance (2-tailed). The R square value was 0.168, implying that socioeconomic and demographic variables shared approximately seventeen percent of the variations in utilisation of IK in MFR, as shown in *Table 4*.

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Table 3: Multiple regression to establish the influence of socioeconomic and demographic variables and utilisation of IK in forest resource management

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.417	.276		1.510	.132
	Age of respondents	-.018	.018	-.059	-.956	.340
	Gender of respondents	.095	.049	.098	1.925	.042
	Education of respondents	.025	.040	.033	.626	.532
	Religion of respondents	-.066	.028	-.124	-2.376	.018
	Occupation of respondents	.004	.017	.011	.206	.837
	Income of respondents	.013	.022	.031	.592	.554
	Subcounty of respondents	-.230	.031	-.386	-7.409	.000
	Years lived in the area	.066	.035	.114	1.872	.039
	Identity as indigenous/local person	.425	.240	.091	1.774	.077
	Indigenous knowledge availability	.091	.123	.038	.734	.463

a. Dependent Variable: Utilisation of indigenous knowledge in management of forest resources

Table 4: Summary model results of multiple regression to establish the contribution of socioeconomic and demographic variables in the utilisation of IK in MFR

Model	R	R Square	Adjusted R^2	Std Error of the Estimate.	Sig. F Change
1	.410[b]	.168	.145	.448	.000

a. Predictors: (Constant), Subcounty of respondents, Marital status of respondents, Income of respondents, Socio-cultural group of respondents, Identity as indigenous/local person, Gender of respondents, Indigenous knowledge availability, Education of respondents, Religion of respondents, Occupation of respondents, Age of respondents

b. Dependent Variable: Utilisation of IK in Forest Management

DISCUSSION

Indigenous Knowledge Practises

The strong relationship between the availability and usefulness of IK was attributed to the strong culture-nature relationship. The local community lived with this knowledge for centuries and relied upon it where Western scientific knowledge was absent, inadequate, or expensive. Compared to other practices, taboos, totems, metaphors, proverbs, and sacred places were seriously on the decline. This seems to have been largely associated with a decline in forest cover caused by several factors, namely rapid population growth and its associated effects, such as increased demand for forest products, wide-spread poverty, and land shortage; the influence of Western education and foreign religions, especially Islam and Christianity, which branded these practices as evil; and the influence of social media that exposed the youthful population to Western civilization, undermining the use of IK. The findings were consistent with those of Diansyah et al. (2022), Fernández-llamazares et al. (2021), Gondo et al. (2018), Mavhura and Mushure (2019) that the survival of IK has been threatened by rapid population growth and external interference.

Indigenous Knowledge Prevalence

The prevalence of IK was generally high in the district. The strikingly higher level of prevalence among young people is an indication of steady knowledge transfer, both inter-generational and possibly intra-generational. This may imply that the IK is being practised since one of the characteristics of this knowledge is that it is highly practical and embedded in the daily lives of the people. Despite the high prevalence, IK was mostly used in farming and health, a finding consistent with Depicker et al. (2021) and Nuwategeka and Nyeko (2017). It was found to be more efficient in terms of time, effort, money, and technical know-how than other knowledge

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systems. For example, the protection of forest resources around sacred grounds did not require the physical presence of guardians but was rather done remotely through the spirits. The people adhered to these demands since they lived with them throughout their lives. This was in line with the findings of Beyene and Bellis (2020) in Ethiopia and Aboh et al. (2019) in Nigeria that IK practices are cheap compared to formal modern practices. The high rate of prevalence in Kei Subcounty seemed to have been associated with the presence of several minor effectively managed community forests such as Menjere and Rikachu. These forests were managed in accordance with customary laws. In the Midigo sub-county, similar forests also existed, such as Totoro, Kukudu, and Monobu, where the prevalence was relatively high compared to other parts of the district. This correlates with the findings of Reyes-García et al. (2022) and Camacho et al. (2016) that communities near forested regions have diverse forms of IK used in conserving forest resources compared to non-forest communities. This relationship is important because the future of IK is dependent upon strong culture-nature connectedness.

Contrary to the above findings, the relatively low prevalence of IK in the Kerwa sub-county was surprising because significant portions of its land area were covered by Mt. Kei CFR and some community-managed forests. This appeared to have been largely due to the lack of involvement of indigenous communities in managing public forest resources. This is in line with the acknowledgement by the World Bank and the NFA, a body mandated by law to manage forest resources in Uganda, that participatory approaches would make a significant difference in SMFR in the 21st century. The use of formal scientific methods enshrined in modern policies, regulations, and international conventions in managing public forests appeared to have relegated IK practises to the background, a finding consistent with Boafo et al. (2016) and Mavhura and Mushure (2019). The low prevalence of IK in the rest of the district seemed to have been associated with limited natural forest cover, as most were depleted by human activities. This seemed to have contributed to the loss of the indigenous knowledge base, leading to its decline. Whether the relatively high prevalence rate translated to SMFR in the district, the answer seemed to be no. Inferring that IK was not widely used in managing forest resources. This seemed to have been due to large portions of forest land under CFR where indigenous communities were passively engaged in their management; secondly, there was a population influx into forest lands within the district and beyond due to land shortage. Even where it was used in managing community forest resources, the forests were generally declining in acreage.

Utilisation of Indigenous Knowledge in Forest Resource Management

The findings of the study revealed that IK remained a force to reckon with in the effective management of community forest resources in the area. Indigenous wisdom has been found to be quite helpful in distant locations when official modern procedures are either absent or ineffective. The local communities in the study area looked at IK as the only credible alternative approach for managing forest resources. This finding was consistent with that of Milupi et al. (2017) in Zambia. They developed several viable techniques hinged on culture-nature relations that helped them live in harmony with these resources. For example, the local communities preserved big trees for several reasons: first, they believed that such trees had evil spirits; thus, cutting them down would invite the wrath of the spirits; second, they were used as compasses for purposes of direction as well as natural pillars to mark land boundaries between tribes, clans, sub-clans and households; third, they served as important meeting points for cultural functions; and lastly, it was believed that they stored huge volumes of water critical in regulating rainfall and ensuring a constant supply of surface water in streams, wells, and springs. If cut, the water sources would dry up, and rainfall would become unreliable. For these reasons, such trees were preserved and even baptised by local names such as '*Amayibe*' in the 'Daca River.

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These findings were consistent with those of forest communities in the Ashante region in Ghana (Asante et al., 2017).

The second category of trees were those that provided food such as fruits, tubers, leaves, barks, and seeds, e.g., shea nut trees (*komoro*), tamarind *(itii)*, *"lugba"*, and *"lo'boni".* Such trees were prohibited from being cut down because it was believed that they "feed" people and, therefore, helped to avert a looming famine. This was consistent with the practices among the Teso community in Kenya (Ayaa & Waswa, 2016). The third category of trees were those that provided herbal medicine, such as mahogany *(marigo), "izekize", "galabalogoro", and "gbulikigbuli"*. Such trees were to be used cautiously because it was believed that their extinction would put the health of the entire community in danger. The fourth category was very old trees that contained honey. Such trees were to be spared because it was believed that preserving the tree would help preserve the honey intended to benefit both the present and future generations. The fifth category was trees in sacred grounds; these places were only accessible to certain specific leaders or members of a particular clan or subclan and, therefore, were the richest in biodiversity. The rich biodiversity seems to be related to the fear of the spirits. This was similar to the findings in the Nharira community in Zimbabwe, where sacred places have remained the richest in biodiversity (Mavhura & Mushure., 2019). For example, in Menjere and Totoro forests that had sacred places, the cultural leaders assigned the responsibility of managing these resources took regular stock of important tree species, animals, and wild honey for purposes of effective management and accountability.

Resources in the sacred places were prohibited from being exploited without the knowledge of the custodians. The clan and other members of the community would only access the forest products after performing some ritual, or else the consequences would be dire for the culprit, such as mental case and death, or for the entire community, such as a severe localised drought or an epidemic. Exploitable resources in the sacred places were not to be sold and instead were shared by the clan members. For instance, the honey harvested from the Menjere forest would be distributed to all the "Magumiro" clan members to show solidarity. This made the people feel part of the resources. On the contrary, some of the resources were not tempered at all. For instance, harvesting honey from Totoro Forest was prohibited because the culprits would either run mad or die. The sixth category were those trees planted to mark the graves of important figures in the community, such as '*laru*' and '*poyi'*. It was believed that cutting these trees down would invite some kind of retaliation from the spirits of the dead. As a result, trees in grave sites were spared. These findings were consistent with those in the West African subregion (Aboh et al., 2019; Boafo et al., 2016).

Though wild animals were not prohibited from being killed, the Lugbara developed strategies that enabled them to effectively manage the number of these animals. For example, communal hunting *(Dora)* was done in gazetted places only in the dry season, and specific clans had the authority to organise such hunting sessions. The hunting activity was organised once a year (male *dora*), and a second one (female *dora*) was only allowed in the same area if several animals survived the first hunting session. This correlated with the findings of Mbobda et al. (2018) and Milupi et al. (2017) in Cameroon and Zambia, respectively. During hunting, only mature animals were killed, and this enabled a continuous supply of wildlife resources, a deliberate mechanism to promote sustainable hunting. By so doing, the animal numbers would recover a year before the next hunting season, a finding consistent with (Nelson & Shilling, 2019).

Several birds were equally preserved by the Lugbara for various reasons. The seasonal appearance and disappearance of certain birds were a reflection of changes in seasons. For example, the appearance and disappearance of *"Kapaya"* and hornbill (*Ugbuluku*) marked the beginning and end of the dry season. The presence

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of an owl (*Lungudu*) in a household was interpreted as a bad omen, which was only averted if the bird was chased away but not killed. The Honeyguide bird (*Apinga*) was yet another tiny bird that led people to the wild bee's nest. *"Kamgbe"* alerted people from eminent attacks by the enemy. For the above reasons, killing such birds was taboo. However, in line with the findings in Yunnan, China, an increase in population coupled with external interference has made IK vulnerable, potentially constraining its application in SMFR (Su et al., 2020). This possibly explains why some locals were sceptical about the use of IK in managing forest resources in their areas. They argued that rapid socioeconomic and demographic changes made the use of IK ineffective.

Revitalized interest and the Future of Indigenous Knowledge

Whereas the local communities were blamed for the massive destruction of natural forest resources through activities such as subsistence farming, charcoal burning, and hunting, there was a renaissance in their attitude towards conserving these resources. While the contributions and resilience of forest-related IK remained less recognised, efforts to promote its usage are gaining ground. This was consistent with the observation made by Parrotta et al. (2016) and Whyte (2019). This resurgence was due to unprecedented levels of degradation and depletion of forest resources. Several changes were noticed by the local communities in the area, especially crop failure and rampant diseases. The predominantly subsistence farming communities that relied so much on nature associated these changes (frequent and severe cases of drought, erratic rainfall, drying up of surface water sources) with unsustainable management of forest resources. They realised that clearing the forest to create fresh land for agriculture, settlement, and wood fuel production caused more problems than provided solutions to their sustenance. Many acknowledged the rich biodiversity in some community forests in the district, especially in the Kei and Midigo sub-counties. In fact, substantially less forest depletion and degradation was observed in some forests where strong customary regulations were used, suggesting that IK could be able to offer an alternative management strategy for SMFR. This was compatible with the findings of Sinthumule and Mashau (2020) in Limpopo Province, South Africa, and Mavhura and Mushure (2019) in Zimbabwe. It was therefore not surprising that the locals were at the forefront of revitalising, preserving, and promoting the use of IK in MFR. It was deduced that IK had a huge potential to influence the future of forest resources on indigenous lands beyond the current Western worldview, which hypocritically claims to be the only knowledge capable of producing expected results. This was consistent with the observation made by Ndlovu (2014).

The relatively high prevalence rate of IK, especially among the young who supported the view that IK should be passed on to the next generation, provided a big hope and progress in IK and SMFR because the future survival of both relies on them. This contradicted the findings of Aboh et al. (2019) in Nigeria, who identified the lack of recognition of IK by the youth as the biggest problem hindering its use in the conservation of forest resources. In addition, the successes registered by IK in the area, coupled with commitments from international and national agencies such as the FAO, World Vision, NEMA, and DRDIP (Development Response to Displacement Impacts Project), provided yet another hope for utilisation of IK in MFR. Many people reiterated that integrating IK in forest management by involving the locals and their technologies would help save the situation. This does not imply that contemporary forest resource managers should simply adopt IK practises, but rather sounds a warning bell that indigenous strategies of sustainably managing forest resources are an essential principle to achieve Sustainable Development Goals in the 21st century.

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CONCLUSION

The idea of indigenous people and IK is a reality that should not be disputed. The Lugbara have developed a wealth of this knowledge that enables them to live in harmony with nature for centuries. As a result, some of the biologically diverse ecosystems on their lands remained those managed in accordance with strict customary laws. Unfortunately, the utilisation of IK in MFR has declined sharply over time despite the relatively high prevalence rate. This has negatively impacted the state of forest resources in the district. However, the resurrected interest in this knowledge system from the local community as well as the international community is an acknowledgement that IK plays a critical role in SMFR. Lessons learned from this can help develop better management strategies suitable for the 21st century. Thus, incorporating Lugbara cultural perspectives in planning and effective MFR should not be perceived by the government (NFA) as interference but rather as an avenue for creating alternative approaches for collaborative management of these resources. A management strategy in which the local people are fully involved in making critical decisions on how resources on their land are managed. Otherwise, the survival of forest resources in the unstable 21st century remains a shared responsibility, partially answered by "*the revitalization of indigenous knowledge*".

Recommendations

Based on the findings, the study recommends that:

- Indigenous knowledge must be documented in order to ensure its long-term survival because the death or inactivity of the custodians would present a serious constraint to it.
- The local knowledge in the management of forest resources ought to be promoted by funding and appreciation of the efforts of the custodians.
- Indigenous knowledge practises and modern approaches ought to be used synergistically in order to achieve sustainable management of forest resources.

CONFLICT OF INTEREST

The authors declare no conflicting interests.

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