



Biodiversity Conservation of Forests: The Contribution of Indigenous Communities

Abstract: Excessive exploitation of the planet's resources has led to rapid environmental degradation, reinforcing the need for biodiversity to become a central aspect of public policy. Indigenous communities' contributions in safeguarding biodiversity have received growing recognition amidst increasing biodiversity loss. Human activities such as agricultural encroachment, illegal logging and deforestation, have put Mau Forest, in Kenya, under chronic jeopardy yet it is an important water catchment area. This is a study of how Ogiek indigenous people's traditional knowledge and creativity plays an instrumental role in conservation of Mau Forest biodiversity. The study used a cross-sectional design and integrated both quantitative and qualitative methodologies. A total of 235 members of Ogiek community were selected by a statistical formula, and 13 key informants were selected using purposive sampling. The results show a statistically significant positive relationship between the indigenous community's contributions and biodiversity conservation, with the Ogiek's indigenous ecological practices exerting a significant influence on the health of the Mau Forest ecosystem. The regression analysis conducted to assess the relationship between Ogiek practices and biodiversity conservation shows that all independent variables, including Traditional Ecological Knowledge (TEK), Shifting Cultivation, Cultural Practices, Oral Literature, and Apiculture, have a statistically significant positive influence on the dependent variable, biodiversity conservation. Therefore, it appears that Ogiek practices as a whole play a role in maintaining and enhancing biodiversity in the Mau Forest Complex. The data had a highly significant F-statistic (934.741, $p < 0.001$) and an R-squared value of 0.953, indicating that the model can explain a substantial proportion of variation in biodiversity, concluding that while Ogiek traditional ingenious practices are of little value when contrasted with modern conservation strategies, there is a need to integrate them in modern conservation strategies for long term biodiversity conservation of the Mau Forest. It suggests a collaborative approach, involving Kenyan government, conservation organizations, and the Ogiek community, to evolve conservation policies inclusive of indigenous knowledge and contribute to forest protection.

Lenah Chelangat¹, Dr. Ajitha S²

Affiliation

¹Tutorial Fellow, Department of Humanities and Social Sciences University of Kabianga, Kericho Kenya, and Research Scholar, Department of Political Science, University of Kerala - 695581.

ORCID ID: 0009-0002-2002-4619.

²Research Scholar, Political Science Department, University of Kerala.

Article History:

Received Date : Sep 11, 2025

Revised Date : Oct 30, 2025

Accepted Date : Nov 10, 2025

Published Date : Nov 18, 2025

Keywords: *Biodiversity, Conservation, Indigenous Communities, Mau Forest, Ogiek.*

1.Introduction:

Biodiversity conservation has become an urgent global issue, with ecosystems facing unprecedented threats from human activities such as deforestation, climate change, and land encroachment. Forests, teeming with diverse

species, are highly susceptible to harmful land-use practices that disrupt pristine nature creating a ripple effect of a compromised environmental stability (Yue et al., 2020). The loss of biodiversity has reduced resilience to climate change and threatened the sustainability of ecosystems that provide essential services like food, water, and shelter (Scherer et al., 2020). Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) highlights the alarming global decline in biodiversity, with one million species of plants and animals facing the threat of extinction (Pan et al., 2020) (Ruckelshaus et al., 2020) (Krug et al., 2020). The deterioration of ecosystems is occurring faster than ever, undermining the foundations of ecological stability, food security, and livelihoods, particularly for indigenous communities who rely directly on natural resources (Piccolo et al., 2022).

One of the most biodiverse geographical areas globally, the Amazonian rainforest region is a perfect example of how the human race's exploitation of the environment endangers biodiversity (Lapola et al., 2023) (Ruiz Agudelo et



al., 2020). The Amazon, one of the largest rainforests in the world, which is also referred to as the lungs of the earth, announced diverse endemic and endangered species (Monteiro et al., 2022) (Fazzi-Gomes et al., 2021). It contributes greatly to the regulation of the world climate through carbon stock and climate influencers (Gillespie, 2021) (Hopkin, 2005). Nevertheless, deforestation associated with agriculture, logging, and the establishment of infrastructure reduces the ability of the forest ecosystem to regulate climate by providing fragmented habitats, and reduced biological diversity (Pendrill et al., 2019). Specifically, the Yanomami and Kayapo peoples of the Amazon region can be cited as examples of indigenous people who have been protecting the biome (Chernela, 2005) (Ehrlich, 1998) (Brady, 1988). Practices including agroforestry and the maintenance of sacred natural sites maintain non-domesticated species as well as forests (Fahad et al., 2022). These communities fight against the process of deforestation and use their voices to protect the territories, which are also important from the point of view of biological diversity (Agbor, 2022). They underscore the worth of using ecological knowledge in maintaining the balance between the modern civilizations and the natural world.

Tribals of India have also excelled in sustainable utilization and conservation mainly owing to ethnobiological connection with the natural resources of the land. Several authors argue that territories controlled by Indigenous people are more biodiverse than formally protected areas (Balasubramanian & Sangha, 2023) (Rath & Ormsby, 2020). Indigenous populations in Africa have also played a major role in conserving the natural resources through effective management in the form of shifting cultivation and crop rotation. They practice traditional approaches of conservation to favor ecological sustainable solutions (Sobrevila, 2008). They have also been found useful in improving the management of land for increased biodiversity when implemented in community forests and wildlife departments (Reang et al., 2024) (Jin et al., 2022). Biodiversity conservation grounded in indigenous cultural practices offer a promising solution to the environmental crises of the modern world (Martinez-Reyes, 2012). Pollination which is facilitated by apiculture an

activity commonplace among indigenous communities is very crucial to the reproductive health of plants and ecosystems in general. Such practices also help to cultivate the belief that each living organism should exist in harmony with the rest of the organisms in the world (Moreno-Calles et al., 2016). Indigenous knowledge encourages sustainable utilization of resources and maintenance of a balanced ecological capacity of the land. This genre of knowledge could supplement the contemporary conservation philosophies.

Culture, religion, and spirituality among indigenous population are just as important as ecosystem services because they define who they are and how they interact with the environment. Such beliefs and practice are also seen in the indigenous healthcare, where the traditional medicine, which emphasizes use of natural herbs and spirits, is still paramount (Amuka et al., 2014) (Heywood, 2011). Indigenous peoples' understanding of biological diversity believes that everything in the natural world, plants, animals, rocks, water, and sacred places are all connected (Burton, 2023) (Sullivan, 2019). From their firsthand knowledge of the natural world, indigenous people understand that every flora and fauna play a part in the ecosystems (Tenjei et al., 2022). This is unlike the modern view where the health of the environment is sacrificed for economic growth, a factor that leads to amongst other things, loss of diversity. The concept of indigenous response is more appropriate and eco-friendlier since it respects the natural surroundings and in return expects reciprocation. Consequently, more recent research has called for syncretism of indigenous knowledge in the conservation processes.

Mau forest is one crucial ecosystem that plays important roles such as acting as carbon sinks, water sources, and regulation of climate (Jebiwott et al., 2021). However, deforestation and land degradation are gradually becoming an impending danger to its biological diversity. The Ogiek people have lived in this forest for generations and are an integral part of its biodiversity conservation. They employ sustainable use of forest resources through practices like bee keeping, hunting and foraging (Koech & Iteyo, 2023). The Ogiek use proverbs in



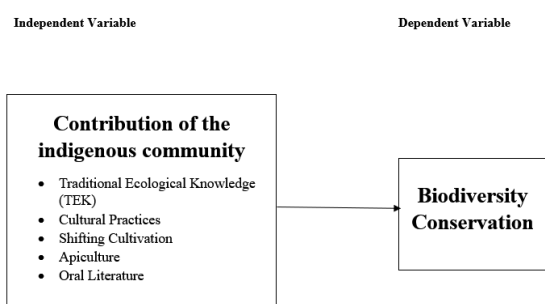
their day-to-day conversations, with those wise sayings and folk tales stemming directly from natural objects or occurrences which underlines their intimate affiliation with nature (Claridge & Kobei, 2023) (Chabeda-Barthe & Haller, 2018). These sayings are as much ecological as they are philosophical and serve to remind the community of a worldview in which nothing in the natural world is inconsequential and that every part is meaningful. These practices have helped the Ogiek to live in harmony within the biodiversity hotspot. Ecological research over the past fifty years has predominantly focused on the impact of ecosystem disturbances on biodiversity (Ruckelshaus et al., 2020) (Burton, 2023). However, these studies did not pay much attention to indigenous people, who have been living within forest biomes for several generations. The Intermediate Disturbance Hypothesis states that biodiversity flourishes when human activities are harmonized with natural ecosystems, suggesting that indigenous practices can be essential to ecosystem stability. Indigenous people integrate nature in their lifestyles and this approach promotes stability within surrounding ecosystems thus fostering the best conditions for increased species diversity (Rivera-Núñez & Fargher, 2021). Forests are instrumental to the sustainability of the encircling environment as well as for the livelihoods of local communities especially the Ogiek people who rely exclusively on the forest for all their resources (Ruto et al., 2023). The Ogiek people living within Mau Forest have long practiced sustainable utilization of resources in the area as they have been its guardians for generations. In light of the above discourse, this study aims at exploring the contributions that the Ogiek community make towards the protection of Mau Forest Biodiversity through their traditional measures. In what ways, do the contributions of the Ogiek community through practising sustainable activities, reinforce conservation of Biodiversity in the Mau Forest? Thus, this study seeks to create awareness of the crucial role of indigenous people in the conservation of forests. Biodiversity discourse is grounded in Biocultural Diversity Theory which propounds that the diversity of life in the form of biological, cultural, and linguistic is interconnected and has co-evolved over time through human-environment interactions (Gavin et al., 2015) (Maffi, 2005; Pretty et al., 2009).

Biological and cultural diversities are part of a phenomena that cannot be estranged from each other but instead are mutually reinforcing binary classification. Ecological knowledge embedded in culture, indigenous practices, and traditions actively shape, sustain, and regenerate ecosystems for posterity (Schwann, 2018). This framework provides a powerful lens for linking independent variables of this study to biodiversity conservation. Biocultural Diversity Theory asserts the undeniable importance of language and storytelling in sustaining both cultural and biological diversity. Practical ecological information such as migration patterns, medicinal plants, seasonal cycles and normative conservation values is encoded by indigenous communities through oral traditions (Mallick et al., 2024). Oral literature therefore enables cultural memory, preserving the traditional wisdom needed for future ecosystem stewardship (Behera, 2016). Such customs, associated with indigenous people such as apiculture, can be considered a form of Traditional Ecological Knowledge (TEK) for the conservation of biological variety. The practice of beekeeping requires protection of indigenous forests and flowering plants crucial to pollination (Ntalwila et al., 2017). In this way, the communities that maintain healthy bee populations also contribute to preserving habitats' connectivity, diversity of plant species and consequently, the overall effective ecosystem services. Traditional apiculture therefore represents the concept of biocultural compatibility embodying the human sustainable use of natural resources while conserving the same. Bee keeping enhances applied livelihood system that sustains critical ecosystem services. Traditional Ecological Knowledge (TEK) ingrains the knowledge base of such indigenous practices (Bethel et al., 2022). Shifting cultivation utilises such knowledge for the stewardship of land management. Traditional governance structures lay down rules and regulations frameworks deeply rooted in cultural practices to guide human behaviour while interacting with nature or the ecosystem. It is through oral literature that intergenerational transmission of conservation knowledge and values is reinforced. These five elements form a mutually reinforcing, co-evolved system where cultural vitality and biological sustainability are intertwined. The breakdown of any element (loss

of Traditional Ecological Knowledge (TEK), abandonment of cultural traditions, erosion of oral literature, apiculture alienation threatens the overall resilience of both cultural and ecological systems. Bee keeping activities execute sustainable resource use that simultaneously protects ecosystems

The conceptual framework illustrated below in Figure 2 represents the relationship between various factors and biodiversity conservation in forest ecosystems, with a focus on the contributions of indigenous Ogiek. The independent variables, including “Traditional Ecological Knowledge (TEK)” “Cultural Practices - Beliefs & Spirituality,” “Shifting Cultivation - Land-Use Practices” “Oral Literature” and “apiculture” all influence the dependent variable, “Biodiversity Conservation”. Biodiversity conservation, in turn, has an impact on the overall health of forest ecosystems and the sustainable livelihoods of the communities. This framework synthesizes both theoretical and empirical insights from the literature, demonstrating how the role of Ogiek while using inherent ecological insights and sustainable practices contribute significantly to the conservation of biodiversity and the general health of the Mau Forest Complex.

Figure 1: Conceptual Framework



2. Research Methodology

This study adopted a cross-sectional design aimed at catching a snapshot of the state of biodiversity conservation in the ecosystem of Mau Forest and the involvement of Ogiek people in its conservation. This enabled the researchers to collect data at a single point in time while exploring the relationship of the independent variables and the dependent variable. The survey was set up to elicit as much information as

possible on Ogiek practices and their relevance to biodiversity conservation. A mixed methods approach, which combined qualitative interviews and quantitative data, was employed in the study of the contribution of the Ogiek people in biodiversity conservation. The research was in the Mau Forest Complex in Kenya, a key biodiversity hotspot (Were et al., 2015). Diverse species are found here, and for this reason it is of great conservation importance. Due to their deep rooted cultural and ecological knowledge of the forest, the Ogiek community who historically inhabited and surrounded the Mau Forest (Kiage, 2019) were the chosen focus group.

The study population was constituted of indigenous community members and leaders engaged in forest management and biodiversity conservation. Proportional stratified sampling was used to draw the sample from the 1200 individuals in the selected members of the indigenous community. The choice for this approach was based on the large population, and stratification gave representation across different groups in the community: forest dwellers, elders, spiritual leaders, and community-based conservation groups. Using the formula for sample sizes from a sample of a finite population (Mugenda and Mugenda, 2003), the sample size was calculated as shown below.

$$S = \frac{X^2 \cdot N \cdot P \cdot (1 - P)}{d^2(N - 1) + X^2 \cdot P \cdot (1 - P)}$$

Where:

- **S** = Required sample size
- **N** = Population size (1200)
- **P** = Proportion of the population (commonly set to 0.5 for maximum variability)
- **d** = Degree of accuracy (margin of error, e.g., 0.05)
- **X²** = Chi-square value for the desired confidence level (e.g., 3.841 for 95%)

Plugging in the values: The calculation becomes:

$$S = \frac{(3.841) \cdot 1200 \cdot 0.5 \cdot (1 - 0.5)}{(0.05)^2(1200 - 1) + (3.841) \cdot 0.5 \cdot (1 - 0.5)}$$

So, the community members' sample size S is:

$$S = \frac{576.6}{2.45775} \approx 234.6$$

The Community Members' sample size is **235**.



Table 1: Sample Size and Sample Plan

SN	Type of Respondents	Sampling Tools	Sample Size	Remarks
1	Key Informants	Purposeful Sampling	13	Local leaders and experts in forest conservation
2	Community Members	Stratified Sampling	235	Indigenous people engaged in forest conservation
Total			248	

A structured questionnaire comprising of Likert scale was used to survey the 235 community members to assess their attitudes towards different aspects of forest conservation such as land-use practices; cultural beliefs; apiculture, shifting cultivation and oral literature for resource management. Collected data was coded and analysed using SPSS and Stata software to measure the direction of the relationship amongst variables. Semi-structured interviews were conducted with the selected key informants to capture in-depth qualitative data on the contributions of indigenous Ogiek, as well as their involvement in forest conservation practices. These interviews were guided by open-ended questions and conducted in the participants' local languages to ensure comfort and clarity. Focus group discussions were held with community members to explore collective perceptions and practices related to forest management and biodiversity conservation. Thematic analysis was used to identify recurring patterns and themes in the responses from key informants and focus group discussions in relation to the Ogiek community's indigenous conservation practices. This approach allowed the researcher to understand the underlying stories and contextual factors that shape indigenous conservation practices as a whole.

For the analysis of relationships between the dependent variable (biodiversity conservation) and independent variables (Traditional Ecological Knowledge (TEK), shifting cultivation, cultural practices, oral literature, and apiculture),

correlation analysis was performed to determine the strength and direction of the associations. Furthermore, regression analysis was employed to examine the impact of these independent variables on the dependent variable.

Table 2: Reliability and Validity Analysis

Variables	No. of Items	Cronbach's Alpha
Biodiversity Conservation	5	0.717
Traditional Ecological Knowledge (TEK)	5	0.714
Shifting Cultivation	5	0.723
Cultural Practices	5	0.708
Oral Literature	5	0.722
Apiculture	5	0.725

The reliability of the variables used in the study has been analysed in table 2 above. From the table, it can be observed that each variable comprises of five items and have a Cronbach's Alpha ranging from 0.708 to 0.725. These values suggest that all the variables are reliable as Cronbach Alpha values greater than 0.7 are considered desirable. The validated questionnaires used to measure Biodiversity Conservation was determined to have a Cronbach's Alpha of 0.717, meaning moderate reliability value, and the questionnaires for measuring Traditional Ecological Knowledge (TEK)



gave a slightly lower Cronbach's Alpha value of 0.714 thereby indicating acceptable reliability. Another factor reflection to the validity of the measuring tool is the Cronbach's Alpha of Shifting Cultivation which stands at 0.723 which is good enough. Cronbach's Alpha for Cultural Practices is 0.708, which falls on the low end of the acceptable range. Oral Literature scores a Cronbach's Alpha of 0.722 implying that it has a credible internal consistency, thus, the internal consistency threshold is set. Of the 5 subfields, apiculture receives the highest Cronbach's alpha value which is 0.725, indicating that the items in this subfield possess a high internal reliability. The Cronbach's Alpha values for all the variables implies that all the measurement items capture the intended constructs hence making the variables reliable for analysis. The results justify the reliability of the scales employed to measure various aspects of indigenous people's participation in the preservation of biodiversity.

3. Data Analysis

Thus, to achieve the intended objectives of the study, descriptive and inferential statistics were used. For the descriptive statistics whereby the central tendency and the dispersion were employed, the mean, the standard deviation, the maximum and the minimum were used. For the inferential statistics, Regression model was used whereby scores were generated from the Likert Scale questions. Given the discussion above, the following regression model was employed to assess the contribution of indigenous communities to biodiversity conservation

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon_i$$

Where by

X_1 stand for Traditional Ecological Knowledge (TEK)

X_2 stand for Shifting Cultivation

X_3 stand for Cultural Practices

X_4 stand for Oral Literature

X_5 stand for Apiculture

ε_i stand for error term.

4. Results

The purpose of this study was to assess how Ogiek indigenous practices impacted on biodiversity conservation in the Mau Forest Region. The focus of the analysis was to establish the role played and entrenchment of the Ogiek people in the protection of the forest resources, including their participation rates and perception towards the conservation of the resource, their ecological knowledge, cultural beliefs, and practices. In this study, data was collected through the administration of questionnaires to 235 Ogiek people and from a structured interview involving 13 key informants who were purposefully chosen for the study based on their in-depth knowledge of the phenomenon under study.

5. Contribution of indigenous communities toward biodiversity conservation

The independent variables used in this study describe the Ogiek's contribution concerning the status of the conservation of biological diversity. They include Traditional Ecological Knowledge (TEK), shifting cultivation, oral literature, cultural beliefs, and beekeeping. The following sections present the data analysis results for each of the independent variables.

5.1. Traditional Ecological Knowledge (TEK)

Table 1: Descriptive Statistics for Traditional Ecological Knowledge (TEK)

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Traditional Ecological Knowledge (TEK) provides valuable insights into the sustainable management of natural resources.	235	1	5	4.3277	0.80535
Traditional Ecological Knowledge (TEK) is essential for understanding the long-term health of ecosystems.	235	1	5	4.2468	0.86648



Communities with a strong connection to Traditional Ecological Knowledge (TEK) are more effective at managing local biodiversity.	235	1	5	4.3064	0.7843
Incorporating Traditional Ecological Knowledge (TEK) into modern environmental management can lead to more effective conservation practices.	235	1	5	4.2809	0.783
Traditional Ecological Knowledge (TEK) should be preserved and passed down to future generations to maintain ecological balance.	235	1	5	4.2596	0.81954
Overall Mean				4.284	

Table 3 shows the mean values for all variables related to Traditional Ecological Knowledge (TEK). It indicates a strong agreement with the importance of perceptions derived from indigenous knowledge in managing biodiversity. The highest mean score was in relation to “Traditional Ecological Knowledge (TEK) provides valuable insights into sustainable management of natural resources” (mean = 4.3277), underscoring the respondents' recognition of Traditional Ecological Knowledge (TEK)’s utility in ecological

management. The lowest mean was still high, with “Traditional Ecological Knowledge (TEK) should be preserved and passed down to future generations” scoring 4.2596. The findings in Table 3 show that the overall mean is 4.284, which ranges between 4 and 5. This implies that the majority of the respondents agree that Traditional Ecological Knowledge (TEK) substantially contributes towards biodiversity conservation.

5.2. Shifting Cultivation

Table 2: Descriptive Statistics for Shifting Cultivation

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Shifting Cultivation practices support the natural regeneration of forests and biodiversity.	235	1	5	4.2043	0.87265
Indigenous rotational farming methods help maintain soil fertility and preserve plant diversity.	235	1	5	4.2213	0.87826
Shifting Cultivation minimizes long-term environmental degradation compared to modern farming techniques.	235	2	5	4.1404	0.92072
Traditional land-use patterns in Shifting Cultivation contribute to the protection of local ecosystems.	235	1	5	4.217	0.85718
Integrating Shifting Cultivation knowledge into conservation strategies can enhance biodiversity outcomes.	235	1	5	4.1447	0.972
Overall Mean				4.186	

Table 4 results reveal strong support for the conservation benefits of shifting cultivation, with “Indigenous rotational farming methods help maintain soil fertility and preserve plant diversity” and “Traditional land-use patterns in Shifting

Cultivation contribute to the protection of local ecosystems” having the high mean scores of (4.2213) and (4.217) respectively. Similarly Shifting Cultivation particularly practices that support the natural regeneration of forests and biodiversity



utilized by indigenous people has been depicted to significantly contribute to biodiversity conservation as indicated by a mean score of (4.2043). The corresponding lowest mean scores of (4.1447) and (4.1404) still showcase relatively high scores which confirms that shifting cultivation supports biodiversity to a large extent. The overall

mean which ranges between 4 and 5 infers that the findings accentuate the sustainable nature of shifting cultivation, offering a valuable alternative to more intensive, industrial agricultural practices that often result in biodiversity loss.

5.3. Cultural Practices

Table 3: Descriptive Statistics for Cultural Practices

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Cultural Practices are crucial for the sustainable management of natural resources in their community.	235	1	5	4.2596	0.86025
The traditional knowledge embedded in indigenous Cultural Practices contributes significantly to the conservation of local ecosystems.	235	1	5	4.1617	0.82134
Cultural Practices promote a deep connection between the community and its surrounding environment.	235	2	5	4.2043	0.8968
Incorporating Cultural Practices into modern environmental policies can enhance biodiversity conservation efforts.	235	2	5	4.2213	0.79661
Cultural Practices should be preserved and respected for their role in maintaining ecological balance in the region.	235	1	5	4.1787	0.82817
Overall Mean				4.205	

Table 5 reveals that respondents hold Cultural Practices in high regard for sustainable resource management, with the item “Cultural Practices are crucial for the sustainable management of natural resources” receiving the highest mean (4.2596). The descriptive statistics show that Cultural Practices are considered crucial for managing natural resources and contribute significantly to the conservation of local ecosystems (mean = 4.1617). These practices foster a deep connection between the community and its surrounding environment (mean = 4.2043). Furthermore, incorporating Cultural Practices into modern

environmental policies is believed to enhance biodiversity conservation efforts (mean = 4.2213), and there is a strong consensus on the importance of preserving these practices for maintaining ecological balance (mean = 4.1787). Generally, the overall mean score of (4.205) which is within the 4 to 5 threshold highlights the significance of Cultural Practices in fostering a sustainable relationship between indigenous communities and their environments, promoting effective biodiversity conservation.

5.4. Oral Literature

Table 4: Descriptive Statistics for Oral Literature

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Indigenous communities' Oral Literature contains valuable knowledge that supports biodiversity conservation.	235	1	5	4.4043	0.7297



Stories, songs, and proverbs in indigenous communities' Oral Literature promote respect for nature and sustainable practices.	235	1	5	4.1617	0.89599
Learning from indigenous communities Oral Literature can improve community-based biodiversity conservation efforts.	235	1	5	4.2809	0.80454
Oral traditions of indigenous people help preserve knowledge about local species and ecosystems.	235	1	5	4.2596	0.77671
Integrating indigenous communities' Oral Literature into environmental education would strengthen biodiversity conservation outcomes.	235	1	5	4.2085	0.76455
Overall Mean				4.263	

Table 6 shows that Indigenous communities have an important role to play in the Conservation of Biodiversity through Oral Literature with a mean score of 4.4042 being the highest. It is an effective approach in developing sustainable practices, as culture and traditions play an instrumental role as ingredients towards sustainability. The descriptive statistics also show that Indigenous Communities' Oral Literature includes proverbs, songs, and stories that portray nature reverence with a mean of (4.1617). Further, the enhancement of community-based approaches to biodiversity

conservation through learning from indigenous communities' Oral Literature has been believed to be possible, based on the mean score of 4.2809. The findings indicate that indigenous people's oral knowledge works well in the conservation of local species and ecosystem (mean =4.2596), and mainstreaming this literature into environmental education is expected to foster conservation efforts (mean = 4.2085).

5.5. Apiculture

Table 5: Descriptive Statistics for Apiculture

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Traditional apiculture supports the conservation of forest ecosystems and plant diversity.	235	1	5	4.3745	0.73102
Practices used in beekeeping help maintain habitats that are important for biodiversity.	235	1	5	4.2723	0.79143
Traditional apiculture encourages the protection of indigenous tree species that are vital for bee populations and biodiversity.	235	1	5	4.2511	0.81699
Traditional beekeeping promotes sustainable use of natural resources.	235	1	5	4.2809	0.78844
Incorporating apiculture practices into conservation programs can enhance biodiversity conservation.	235	1	5	4.2596	0.79841
Overall Mean				4.288	

Table 7 shows that Apiculture received strong support, particularly in relation to “Traditional apiculture supports conservation of forest ecosystems”, with a mean score of (4.3745) which was the highest, indicating respondents’ perceived importance for forest ecosystem and plant diversity conservation. The results further indicate that beekeeping practices are highly valued because it promotes sustainable use of natural resources, with a mean score of 4.2809 which is still considerably high. Beekeeping practices help maintain habitats that are crucial for biodiversity (mean score = 4.2723), and encourage the protection of indigenous tree species, which are vital for bee populations and

overall biodiversity (mean score = 4.2511). Additionally, incorporating these practices into broader conservation programs is seen as beneficial for enhancing biodiversity conservation (mean score = 4.2596). These results underline the importance of traditional apiculture as a sustainable practice that contributes to ecosystem preservation and the protection of biodiversity as revealed in the overall means score (4.288) which is substantially high as it is ranging within 4 and 5 considered satisfactory high threshold.

Regression and Correlation Analysis

Table 8: Correlation

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-3.638	0.405		-8.986	0.000
Traditional Ecological Knowledge (TEK)	0.249	0.077	0.222	3.244	0.001
Shifting Cultivation	0.031	0.015	0.031	2.035	0.043
Cultural Practices	0.213	0.028	0.196	7.597	0.000
Oral Literature	0.353	0.074	0.311	4.784	0.000
Apiculture	0.31	0.089	0.271	3.498	0.001

Table 8 presents the results from a regression analysis examining the relationship between the dependent variable; biodiversity conservation or ecological practices) and the five independent variables. The (intercept) constant term is -3.638 with a standard error of 0.405. The t-statistic of -8.986 with a significance level of 0.000 indicates that the constant term is statistically significant. It represents the baseline value of the dependent variable when all independent variables are zero. Pertaining Traditional Ecological Knowledge (TEK) the Unstandardized Coefficient (B) = 0.249 indicates that for each unit increase in TEK, Biodiversity Conservation is expected to increase by 0.249 units, holding all other variables constant. The Standardized Coefficient (Beta) = 0.222 is the standardized effect, showing that TEK has a moderate positive effect on

Biodiversity Conservation. The t-statistic $t = 3.244$ and p-value $p = 0.001$ indicate that this relationship is statistically significant, denoting TEK significantly contributes to Biodiversity Conservation.

With regards to Shifting Cultivation, the Unstandardized Coefficient (B) = 0.031 shows that for every unit increase in Shifting Cultivation, Biodiversity Conservation increases by 0.031 units, holding all other variables constant. The effect size of Shifting Cultivation on Biodiversity Conservation is small as indicated by the Standardized Coefficient (Beta) = 0.031: The t-statistic $t = 2.035$ and p-value $p = 0.043$ depicts a meaningful relationship between Shifting Cultivation and Biodiversity Conservation. The relationship is statistically significant at the 0.05

level, though the effect is relatively modest. In relation to Cultural Practices, the Unstandardized Coefficient (B) = 0.213 depicts that for each unit increase in Cultural Practices, Biodiversity Conservation increases by 0.213 units. The Standardized Coefficient (Beta) of 0.196 indicates a moderate effect of Cultural Practices on Biodiversity Conservation. The t-value of 7.597 with a p-value of 0.000 indicates a highly statistically significant result, suggesting that Cultural Practices have a strong influence on predicting Biodiversity Conservation. Based on the Unstandardized Coefficient (B) of 0.353 for Oral Literature, the result implies that for each unit increase in Oral Literature, Biodiversity Conservation increases by 0.353 units. The Standardized Coefficient (Beta) of 0.311 indicates that Oral Literature has the strongest effect, demonstrating a significant relationship with Biodiversity Conservation. With a t-value of 4.784 and a p-value of 0.000, the effect of Oral Literature is highly significant, suggesting that it is one of the strongest predictors of Biodiversity Conservation.

The Unstandardized Coefficient (B) of 0.31 connotes that for each unit increase in Apiculture, Biodiversity Conservation increases by 0.31 units. The Standardized Coefficient (Beta) of 0.271 indicates that Apiculture has a moderate impact on Biodiversity Conservation. Having obtained a t-value of 3.498 and a p-value of 0.001, the relationship between Apiculture and Biodiversity Conservation is statistically significant. Traditional Ecological Knowledge (TEK), Shifting Cultivation, Cultural Practices, Oral Literature, and Apiculture, are statistically significant, with p-values all less than 0.05 indicating that each factor is a meaningful predictor of Biodiversity Conservation. Oral Literature (Beta = 0.311) and TEK (Beta = 0.222) show the strongest effects, followed by Apiculture (Beta = 0.271). Shifting Cultivation and Cultural Practices have more modest but still significant effects on Biodiversity Conservation. Incorporating traditional knowledge systems (like TEK and Oral Literature) and practices (Cultural Practices and Apiculture) is crucial for enhancing biodiversity conservation efforts. Shifting cultivation also contributes, albeit to a smaller extent.

The regression model suggests that Traditional Ecological Knowledge (TEK), Shifting Cultivation, Cultural Practices, Oral Literature, and Apiculture positively influence the Biodiversity Conservation. The strongest influences come from Oral Literature and TEK, while Shifting Cultivation shows a more modest effect. Each factor plays a significant role, highlighting the importance of integrating these traditional ecological practices into conservation strategies.

Table 6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.976 a	0.953	0.952	0.67939

Table 10 presents the model summary for the regression analysis. The R-value is 0.976, indicating a very strong positive correlation between Traditional Ecological Knowledge (TEK), Shifting Cultivation, Apiculture, Oral Literature, Cultural Practices and Biodiversity Conservation as the dependent variable. The R Square value is 0.953, meaning that approximately 95.3% of the variation in Biodiversity Conservation is explained by either of the 5 independent variables in the model. This suggests a high level of explanatory power for the model. The Adjusted R Square value is 0.952, which accounts for the number of predictors in the model and adjusts the R Square for potential overfitting. This value is very close to the R Square value, indicating that the model's fit is robust and not overly influenced by the number of predictors. The Standard Error of the Estimate is 0.67939, which represents the average distance between the observed values and the predicted values. A lower value indicates a better fit of the model to the data.

6. Discussion

This study investigated the relationship between traditional ecological knowledge, shifting cultivation, apiculture, cultural practices, oral literature, and biodiversity conservation. The results confirm that these traditional practices significantly enhance biodiversity outcomes significantly with varying degrees of impact. Revealing several important insights, these



findings contribute a novel perspective to biodiversity conservation. This study proves that adopting traditional knowledge and skills into present-day approaches in natural protection yields better solutions. It further indicates that Traditional Ecological Knowledge (TEK) plays a significant role in the conservation of biological diversity which supports the belief that people who fully embrace traditional knowledge practices in relation to their environment are in a better position to manage and sustain biodiversity (Agbor, 2022) (Sobrevila, 2008). Despite the magnitude being considerably small, shifting cultivation which is a form of conservation aids regeneration of ecosystem and soil fertility (Stachowicz et al., 2021). Cultural practices, oral literature, and apiculture also emerged as significant contributors, with oral traditions, in particular, playing a vital role in promoting sustainable practices and respecting nature (Martinez-Reyes, 2012). These findings are novel in their attempt to show how valuable it is to look at conservation through indigenous eyes and to consider ancient approaches to natural resource management.

Based on the outlined variables, the significance of our study can be summed up through the confirmation of successful conservation of species or ecosystems in the indigenous territories. This study opens up new possibilities for rethinking current approaches to protection and restoration of species and ecosystems. They are a progressive approach to the conservation of biological diversity because they suggest that it is possible to combine indigenous knowledge systems and practices with those developed in the scientific realm as posited by Mallick (2024). It could result in enhanced and more efficient formulations of sustainable community conservation strategies. As such, this study reveals that these practices are not extraneous to the process of conservation, but instead are core with regards to building long-term ecological integrity and resilience. The analysis confirm that such knowledge and practices are valuable and can immensely help in the conservation of the world's biogeographical wealth.

Specifically, TEK is revealed to be a factor that assumes a highest Beta value of 0.222, which suggests that TEK greatly influences the conservation of biodiversity. This finding

confirms the proposition made in the literature that those communities who are closely associated with TEK are in a better position to handle local biological diversity (Rath & Ormsby, 2020) (Sobrevila, 2008). Additionally, the shifting cultivation variable, although ranks lower in impact (Beta = 0.031), remains a significant factor; therefore, these forms of traditional agriculture, when practiced, may reduce negative impacts on species, fauna and flora, leading to ecosystem and soil rejuvenation (Sullivan, 2019). The Beta of 0.196 for cultural practices bring out the issue of indigenous cultures in the preservation of the natural environment. Such practices are vital in the retention of the ecological equilibrium as it is seen in the Ogiek community where cultural practices are correlated with the conservation measures as pointed by Koech and Iteyo (2023).

Similarly, oral literature (Beta = 0.311) indicates a significant positive correlation with the conservation of biological diversity, where traditional stories, songs, and proverbs on nature and management of the environment support sustainable use and respect of nature (Asefa & Debella, 2022). This is in harmony with the assertion made by Kiage (2019) that taboos are actually important ecological knowledge embodied within the communities which, if enacted, could aid in the conservation processes. Apiculture variable (Beta = 0.271) is directly related to traditional beekeepers' practices such as how they contribute to environmental stewardship including supporting pollinator habitats and plant species preservation. Besides improving forest ecosystems, apiculture also enhances agricultural biodiversity and promotes pollination (Ntalwila et al., 2017). In particular, these findings indicate that incorporating traditional ecological knowledge, shifting cultivation, cultural practices, oral literature, and apiculture into the conservation framework would lead to improved conservation of the environment. These positive correlations prove that human interactions with ecosystems through traditional practices can successfully be utilised as management and conservation strategies in the current environment.

One of the most prevalent themes that emerged was intergenerational ecological wisdom,



reflecting how Traditional Ecological Knowledge (TEK) is passed down through oral literature and observation. This gesture insinuates indigenous people current positioning as guardians of nature and their steward responsibility in maintaining the forest conservation ([Balasubramanian & Sangha, 2023](#)) ([Agbor, 2022](#)). Survey findings on indigenous Conservation Practices highlighted that the indigenous communities conserve the forest using cultural practices including taboos ([Kiage, 2019](#)). Measures like the protection of cultural ritual places, sustainable resource utilization, and beekeeping emerged frequently in the data. They serve as self-regulating measures that complement the formal institutional frameworks and help maintain forest stability and retain forest resources for posterity. This conforms with scholars who have established that apiculture buttresses regeneration of plants through pollination and creates a ripple effect in maintaining animal diversity ([Ntalwila et al., 2017](#)) ([Rath & Ormsby, 2020](#)) ([Schwann, 2018](#)).

Participants showed a profound understanding of plants, animals, and environmental processes. They relied on features like flowering cycles, bird migration, and animal behaviour to gauge the state of the environment. This in-depth knowledge is passed by word of mouth and enacted through everyday survival activities, coalescing into a flexible, iterative understanding of the forest environment. The capture of bees is a means of food security and supplements income as well as an avenue of preserving forest natural resources. This finding resonates with Zocchi's study on ethnobotanical knowledge and beekeeping benefits ([Zocchi et al., 2020](#)). From the Ogiek, we learnt that there is a strong correlation between honey production, tree cover and the abundance of flowers. Mastery of practice of traditional bee hives, which discourage tree cutting, contributes to the protection of forests.

Traditional shifting cultivation was reported by the participants as being rotational and intensive. Arable land is used, abandoned and allowed to revert back to their natural status. Regarded as traditional agricultural practice, respondents averred that it preserves soil fertility and sustains ecological diversity through mosaics. Analysing the Ogiek population's

perceptions of modern conservation policies, it can be noted that they have negative attitudes towards state-led conservation practices ([Koech & Iteyo, 2023](#)). A common complaint was the loss of access to ancestral territories and limitations placed on resources usage. They complained that such policies overlook their rightful role in managing forests and weaken the conservation agenda. This was a common thread pointing for the need to embrace and incorporate indigenous knowledge and stewardship in conservation frameworks. In sum, the results present evidence that the Ogiek people's Traditional Ecological Knowledge (TEK), resource utilization framework, and cultural practices are integrated for sustainability and biodiversity conservation. The results of this study show that formal conservation regimes uphold fortress conservation and potentially threatens both the objective of environmental preservation and indigenous peoples' rights ([Claridge & Kobei, 2023](#)).

Consequently, the study revealed that these traditional practices espoused by indigenous people underscore their importance as key conservation stakeholders in influencing access, preservation, and management for the benefit of regional forest biodiversity. These findings build on a growing body of scholarship noting the importance of Indigenous Peoples and Local Communities (IPLCs) in the management and protection of ecosystems ([Rivera-Núñez & Fargher, 2021](#)) ([Souza et al., 2023](#)). Indigenous communities' traditional practices of sacred site protection, forbidden areas for harvesting resources, and restrictions during certain times of the years are seen as effective modes of governance of the environment. These are consistent with [Elinor Ostrom's \(1990\)](#) principles of commons management where communal structures can effectively self-police and manage resources in ways that are as effective as externally imposed legal systems ([Schwann, 2018](#)).

Integration of apiculture and shifting cultivation into indigenous livelihood systems illustrates how local economic pursuits can be complementary to conservation efforts. Honey collection, being closely tied to forest health, provides a clear and direct motivation for the preservation of species. Likewise, the rotational



model of shifting cultivation does not deplete the soil when practiced in accordance to traditional customs and beliefs. These practices contradict narratives that suggest indigenous peoples' land use is detrimental to conservation and aligns with recent calls to decolonize conservation approaches (Agbor, 2022). Nonetheless, the experience of the Ogiek in the new conservation regime tells a story of continued structural injustice. Interviewees' experiences of exclusion and marginalization align with arguments against conservation rationalities that entail state-centric and enclosure-based management (Claridge & Kobei, 2023). The conflict between customary practices of indigenous people and the official conservation legislations serves to highlight a key area of institutional development: the acknowledgement and legitimization of indigenous knowledge and power. In this context, the models of co-management or community-led conservation seem to be a potential solution. These enhanced and collaborative approaches, that involve participation of both state actors and community partners, have been instrumental in increasing both ecological and social benefits (Doehler, 2023). For the Ogiek, these models may offer a way to regain the recognition of their custodianship role thus supporting the preservation of biodiversity and cultural sustainability.

In a nutshell, the study supports the argument that meaningful involvement of indigenous communities is essential when it comes to forest conservation. In this way, their practices are not archaeological remains that can be studied as inert forms and meanings of extinct practices; they are still functioning systems of the ecology of knowledge and practices of caring for nature. This approach shows that the integration of indigenous ideas and scientific methods is not only feasible, but necessary for generations to come.

7. Conclusion

The conclusions of this study are based on the findings of the study and hence correlate to the objective of the study. Indigenous lifestyle activities have been identified to have positive effects on Biodiversity Conservation. The study shows that historical uses of land, traditional practices of shifting cultivation, cultural beliefs, traditional knowledge/ folklore and traditional

bee keeping are the social aspects of indigenous participation that are fundamentally important for biodiversity conservation in the forests and the larger ecosystem. Traditional ideals of indigenous people are culturally embedded solutions that are beneficial for forest conservation and management. If these practices could be incorporated into the current concept of conservation, then it can lead to a better approach to conservation that is well aligned with indigenous cultural practices. Moreover, promoting indigenous peoples' rights in conservation enhances sustainable use of natural resources while maintaining the balance of the ecosystem. More systematic studies and policy actions should be carried out to advance such indigenous practices into mainstream and professional conservation processes. Nonetheless, the research focused primarily on one community, the Ogiek, and may not fully reflect the diversity of indigenous practices across different regions. The reliance on self-reported data, may have introduced social desirability and memory recall biases in the responses regarding cultural practices and traditional knowledge. Future research could extend this work by examining how these practices can be systematically integrated into national and international conservation frameworks.

8. Recommendations

This study suggests the need to incorporate traditional ecological knowledge and other indigenous practices into mainstream conservation programs. Since indigenous people are inextricably linked to nature and to the forests their participation should not be tokenistic: it must be systemic. The study therefore suggests that the government institutions, the various conservation agencies, and other non-governmental actors construct legal and organizational structures that engage the indigenous people on aspects of forest governance such as decision making on the sustainable use of resources. It is also recommended that indigenous biodiversity training programmes are developed to enable sharing of both scientific and indigenous knowledge to inform policy and practice. Legal reforms should be given the highest priority in a bid to secure tenure for the indigenous

communities to enable them to consolidate their conservation efforts without having to be evicted due to external forces, which is majorly destructive to social and ecological health. For the purpose of implementation, it is recommended that funding of indigenous-led conservation projects should be targeted. This entails support to the indigenous forest monitoring systems, complementary local species, and cultural endowments for improved forest health. There should be collaboration between agencies to guarantee that Indigenous people are not just protected across a range of sectors but that there are comprehensive and rights-based forest conservation policies. These recommendations should ensure that the Ogiek and other indigenous people are no longer viewed as beneficiaries but rather as co-managers of biodiversity.

9. References

- [1] Agbor, D. T. (2022). Convention on Biological Diversity Post 2020 Target: A critical analyses of the threat posed by 30 x 30 target, devoid of a human rights approach towards conservation to land rights in developing countries: Case study Cameroon. *American Journal of Environment and Climate*, 1(2). <https://doi.org/10.54536/ajec.v1i2.628>
- [2] Amuka, O., Okemo, P. O., Machoch, A. K., & Mbugua, P. K. (2014). Ethnobotanical survey of selected medicinal plants used by Ogiek communities in Kenya against microbial infections. *Ethnobotany Research and Applications*, 12. <https://doi.org/10.17348/era.12.0.627-641>
- [3] Asefa, A., & Debella, H. J. (2022). Oromo folklore manifested through features of the northern ground-hornbill in Ethiopia. *Ethiopian Journal of the Social Sciences and Humanities (EJOSSAH)*, 17(2).
- [4] Balasubramanian, M., & Sangha, K. K. (2023). Valuing ecosystem services applying indigenous perspectives from a global biodiversity hotspot, the Western Ghats, India. *Frontiers in Ecology and Evolution*, 11. <https://doi.org/10.3389/fevo.2023.1026793>
- [5] Behera, B. (2016). Persistence and reflective of tribal narratives on art and craft: A curatorial study on the particularly vulnerable tribes of Odisha. *International Journal of Science and Research (IJSR) Index Copernicus Value*.
- [6] Bethel, M. B., Braud, D. W. H., Lambeth, T., Dardar, D. S., & Ferguson-Bohnee, P. (2022). Mapping risk factors to climate change impacts using traditional ecological knowledge to support adaptation planning with a Native American Tribe in Louisiana. *Journal of Environmental Management*, 301. <https://doi.org/10.1016/j.jenvman.2021.113801>
- [7] Brady, N. C. (1988). International development and the protection of biodiversity. In *Biodiversity*.
- [8] Burton, W. (2023). A review of Klein, N., & Steffoff, R. (2021)'s *How to Change Everything: A young human's guide to protecting the planet and each other*. *Education*, 28(2). <https://doi.org/10.37119/ojs2023.v28i2a.675>
- [9] Chabeda-Barthe, J., & Haller, T. (2018). Resilience of traditional livelihood approaches despite forest grabbing: Ogiek to the west of Mau Forest, Uasin Gishu County. *Land*, 7(4). <https://doi.org/10.3390/land7040140>
- [10] Chernela, J. M. (2005). Brazil's Indians and the onslaught of civilization: The Yanomami and the Kayapó. *Journal of Latin American Anthropology*, 10(1). <https://doi.org/10.1525/jlca.2005.10.1.227>
- [11] Claridge, L., & Kobei, D. (2023). Protected areas, indigenous rights and land restitution: The Ogiek judgment of the African Court of Human and Peoples' Rights and community land protection in Kenya. *ORYX*, 57(3). <https://doi.org/10.1017/S0030605322000989>
- [12] Ehrlich, P. (1998). The loss of diversity. In *Biodiversity*.
- [13] Fahad, S., Chavan, S. B., Chichaghare, A. R., Uthappa, A. R., Kumar, M., Kakade, V., Pradhan, A., Jinger, D., Rawale, G., Yadav, D. K., Kumar, V., Farooq, T. H., Ali, B., Sawant, A. V., Saud, S., Chen, S., & Pocai, P. (2022). Agroforestry systems for soil health improvement and maintenance. *Sustainability (Switzerland)*, 14(22). <https://doi.org/10.3390/su142214877>
- [14] Fazzi-Gomes, P., Aguiar, J., Cabral, G. F., Marques, D., Palheta, H., Moreira, F., Rodrigues, M., Cavalcante, R., Souza, J., Silva, C., Hamoy, I., & Santos, S. (2021). Genomic approach for conservation and the sustainable management of endangered species of the Amazon. *PLoS ONE*, 16(2). <https://doi.org/10.1371/journal.pone.0240002>
- [15] Gavin, M. C., McCarter, J., Mead, A., Berkes, F., Stepp, J. R., Peterson, D., & Tang, R. (2015). Defining biocultural approaches to conservation. *Trends in Ecology and Evolution*, 30(3). <https://doi.org/10.1016/j.tree.2014.12.005>
- [16] Gillespie, T. W. (2021). Policy, drought and fire sear Amazon biodiversity. *Nature*, 597.
- [17] Heywood, V. H. (2011). Ethnopharmacology, food production, nutrition and biodiversity conservation: Towards a sustainable future for indigenous peoples. *Journal of Ethnopharmacology*, 137(1), 1-15. <https://doi.org/10.1016/j.jep.2011.05.027>
- [18] Hopkin, M. (2005). Amazon hit by worst drought for 40 years. *Nature*. <https://doi.org/10.1038/news051010-8>
- [19] Jebiwott, A., Ogendi, G. M., Agbeja, B. O., Alo, A. A., & Kibet, R. (2021). Mapping the trends of forest cover change and associated drivers in Mau Forest, Kenya. *Remote Sensing Applications: Society and Environment*, 23. <https://doi.org/10.1016/j.rsase.2021.100586>
- [20] Jin, X., Jiang, P., Li, M., Gao, Y., & Yang, L. (2022). Mapping Chinese land system types from the perspectives of land use and management, biodiversity conservation and cultural landscape.



- Ecological Indicators, 141.
<https://doi.org/10.1016/j.ecolind.2022.108981>
- [21] Kiage, O. E. (2019). The Ogiek peoples' indigenous knowledge: A pathway towards sustainable natural resource management in the Mau Forest, Kenya. *African Journal of Hospitality, Tourism and Leisure*, 8(1).
- [22] Koech, B. C., & Iteyo, C. (2023). Effects of Mau Forest evictions on human security of the Ogiek community, Kenya. *African Journal of Empirical Research*, 4(2).
<https://doi.org/10.51867/ajernet.4.2.29>
- [23] Krug, C. B., Sterling, E., Cadman, T., Geschke, J., Drummond de Castro, P. F., Schliep, R., Osemwegie, I., Muller-Karger, F. E., & Maraseni, T. (2020). Stakeholder participation in IPBES: Connecting local environmental work with global decision making. *Ecosystems and People*, 16(1).
<https://doi.org/10.1080/26395916.2020.1788643>
- [24] Lapola, D. M., et al. (2023). The drivers and impacts of Amazon forest degradation. *Science*, 379(6630).
<https://doi.org/10.1126/science.abp8622>
- [25] Mallick, M., Singh, P. K., & Pandey, R. (2024). Harvesting resilience: Tribal home-gardens as socio-ecological solutions for climate change adaptation and sustainable development in a protected area. *Journal of Cleaner Production*, 445.
<https://doi.org/10.1016/j.jclepro.2024.141174>
- [26] Martinez-Reyes, J. (2012). Biocultural diversity conservation: A global sourcebook. *Ethnobiology Letters*, 3. <https://doi.org/10.14237/eb1.3.2012.46>
- [27] Monteiro, W. P., Dalapiccola, J., Carvalho, C. S., Costa Veiga, J., Vasconcelos, S., Ramos, S. J., Gastauer, M., Jaffé, R., & Caldeira, C. F. (2022). Genetic diversity and structure of an endangered medicinal plant species (*Pilocarpus microphyllus*) in eastern Amazon: Implications for conservation. *Conservation Genetics*, 23(4).
<https://doi.org/10.1007/s10592-022-01454-6>
- [28] Moreno-Calles, A. I., Casas, A., Rivero-Romero, A. D., Romero-Bautista, Y. A., Rangel-Landa, S., Fisher-Ortiz, R. A., Alvarado-Ramos, F., Vallejo-Ramos, M., & Santos-Fita, D. (2016). Ethnoagroforestry: Integration of biocultural diversity for food sovereignty in Mexico. *Journal of Ethnobiology and Ethnomedicine*, 12(1).
<https://doi.org/10.1186/s13002-016-0127-6>
- [29] Ntalwila, J., Mwakatobe, A., Kipemba, N., Mrisha, C., & Kohi, E. (2017). Contribution of beekeeping to livelihood and biodiversity conservation in Inyonga Division (Mlele district), Western Tanzania. *International Journal of Entomology Research*, 2(6).
- [30] Pan, Y., Zhang, B., Wu, Y., Dai, F., & Tian, Y. (2020). The latest developments of IPBES and China's countermeasures. *Biodiversity Science*, 28(10).
<https://doi.org/10.17520/biods.2019372>
- [31] Pendrill, F., Persson, U. M., Godar, J., Kastner, T., Moran, D., Schmidt, S., & Wood, R. (2019). Agricultural and forestry trade drives large share of tropical deforestation emissions. *Global Environmental Change*, 56.
<https://doi.org/10.1016/j.gloenvcha.2019.03.002>
- [32] Piccolo, J. J., Taylor, B., Washington, H., Kopnina, H., Gray, J., Alberro, H., & Orlikowska, E. (2022). "Nature's contributions to people" and peoples' moral obligations to nature. *Biological Conservation*, 270.
<https://doi.org/10.1016/j.biocon.2022.109572>
- [33] Rath, S., & Ormsby, A. A. (2020). Conservation through traditional knowledge: A review of research on the sacred groves of Odisha, India. *Human Ecology*, 48(4).
<https://doi.org/10.1007/s10745-020-00173-1>
- [34] Reang, D., Hazarika, A., Sileshi, G. W., Nath, A. J., Paramesh, V., Singha, W. R., & Das, A. K. (2024). Piper agroforestry in the Indian Himalayas: Indigenous peoples' practices, policies and incentives. *CABI Agriculture and Bioscience*, 5(1).
<https://doi.org/10.1186/s43170-024-00214-5>
- [35] Rivera-Núñez, T., & Fargher, L. (2021). The concept of "palimpsest" in a reconceptualization of biodiversity conservation. *Environmental Conservation*, 48(1).
<https://doi.org/10.1017/S0376892920000399>
- [36] Ruckelshaus, M. H., Jackson, S. T., Mooney, H. A., Jacobs, K. L., Kassam, K. A. S., Arroyo, M. T. K., Báldi, A., Bartuska, A. M., Boyd, J., Joppa, L. N., Kovács-Hostyánszki, A., Parsons, J. P., Scholes, R. J., Shogren, J. F., & Ouyang, Z. (2020). The IPBES global assessment: Pathways to action. *Trends in Ecology and Evolution*, 35(5).
<https://doi.org/10.1016/j.tree.2020.01.009>
- [37] Ruiz Agudelo, C. A., Mazzeo, N., Díaz, I., Barral, M. P., Piñeiro, G., Gadino, I., Roche, I., & Acuña-Posada, R. J. (2020). Land use planning in the Amazon basin: Challenges from resilience thinking. *Ecology and Society*, 25(1).
<https://doi.org/10.5751/ES-11352-250108>
- [38] Ruto, D. K., Musila, F. M., Limbua, P. G., Kinyanjui, J. M., & Kaigongi, M. M. (2023). Effects of land use on the riparian vegetation in Mau Forest Complex in Kenya. *Global Ecology and Conservation*, 46.
<https://doi.org/10.1016/j.gecco.2023.e02624>
- [39] Scherer, L., Svenning, J. C., Huang, J., Seymour, C. L., Sandel, B., Mueller, N., Kumm, M., Bekunda, M., Bruelheide, H., Hochman, Z., Siebert, S., Rueda, O., & van Bodegom, P. M. (2020). Global priorities of environmental issues to combat food insecurity and biodiversity loss. *Science of the Total Environment*, 730.
<https://doi.org/10.1016/j.scitotenv.2020.139096>
- [40] Schwann, A. (2018). Ecological wisdom: Reclaiming the cultural landscape of the Okanagan Valley. *Journal of Urban Management*, 7(3). <https://doi.org/10.1016/j.jum.2018.05.004>
- [41] Sobrevila, C. (2008). The role of Indigenous peoples in biodiversity conservation: The natural but often forgotten partners. *The World Bank*.
- [42] Stachowicz, I., Ferrer-Paris, J. R., & Sanchez-Mercado, A. (2021). Shifting cultivation and hunting across the savanna-forest mosaic in the Gran Sabana, Venezuela: Facing changes. *PeerJ*, 9.
<https://doi.org/10.7717/peerj.11612>
- [43] Sullivan, H. (2019). Robin Wall Kimmerer. Braiding sweetgrass: Indigenous wisdom, scientific knowledge and the teachings of plants. *Seminar: A Journal of Germanic Studies*, 55(4).
<https://doi.org/10.3138/seminar.55.4.rev005>



-
- [44] Tenjei, T. E., Wabwire, E., & Norvy, P. (2022). Indigenous cultural practices and environmental conservation: A case study of Ogiek community of Mau Forest of Kenya. *International Journal of Culture and Religious Studies*, 3(2). <https://doi.org/10.47941/ijcrs.1089>
- [45] Were, K. O., Singh, B. R., & Dick, Ø. B. (2015). Effects of land cover changes on soil organic carbon and total nitrogen stocks in the Eastern Mau Forest Reserve, Kenya. In *Sustainable Intensification to Advance Food Security and Enhance Climate Resilience in Africa*. https://doi.org/10.1007/978-3-319-09360-4_6
- [46] Yue, S., Munir, I. U., Hyder, S., Nassani, A. A., Qazi Abro, M. M., & Zaman, K. (2020). Sustainable food production, forest biodiversity and mineral pricing: Interconnected global issues. *Resources Policy*, 65. <https://doi.org/10.1016/j.resourpol.2020.101583>