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Pre-colonial to post-colonial Kenyan medicinal biodiversity governance and sustainable utilization

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Abstract

In Kenya, there have been at least three main phases of biodiversity governance, utilization, and access, namely the pre-colonial, colonial, and post-colonial phases. This research focuses on medicinal biodiversity governance during these distinct epochs. Using desk-top research, information on policies on medicinal biodiversity use across the country, from pre-colonial to post-colonial, was gathered. Questionnaires were used to collect quantitative data from 69 key informants. A variety of methodologies including historical narrative, thematic, and content analysis were used to analyze the desk-top research. Statistical Package for Social Sciences (SPSS) software was used to analyze quantitative data from questionnaires. Traditional societies in pre-colonial Kenya managed the use of medicinal biodiversity through customary laws, beliefs, and taboos enforced through community leadership structures, according to the findings. During colonialism, colonial overlords deprived indigenous communities of their biodiversity by instituting selfish policies aimed primarily at harvesting precious biodiversity for economic use back home. When Kenya gained independence in 1963, the new government inherited a colonial constitution that hampered biodiversity governance and utilization for nearly five decades until the promulgation of the 2010 Kenya constitution, which brought hope with its provisions for sustainable utilization, management, and conservation of the environment and natural resources, as embedded in Chapter Five. However, thirteen years later, there is no major legislation in Kenya managing the sustainable use of medicinal biodiversity. The research article emphasizes the importance of good biodiversity governance at the grassroots level in order to completely realize the governance and sustainable use of medicinal biodiversity.

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Introduction

Article 2 of the Convention on Biological Diversity (CBD) defines biodiversity as the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems, and the ecological complexes to which they belong; this includes diversity within species, between species, and among ecosystems (CBD, 1992). Biodiversity has been a crucial foundation for all life on the earth, including human life, from prehistoric times (Parajuli and Das, 2013). Humans have relied on biodiversity for food and nutrition security, fuel, energy, medicines and pharmaceuticals, and livelihoods, all of which contribute to good health (NEMA Report, 2019-2021). It also promotes economic opportunities as well as cultural and spiritual enrichment activities, all of which contribute to overall well-being (WHO, 2015). During prehistoric times, most indigenous people relied on biodiversity from the wild for food, energy, medicines, and shelter, among other things. The agricultural and industrial revolutions lessened humans' direct reliance on wild biological resources. Despite advances in agricultural technology, many communities around the world still rely on biodiversity in the wild for survival, particularly in developing nations with high levels of poverty (Amirka and Heinrich, 2004). An estimated 80% of the world's population still depends on biodiversity for a living. It is worth mentioning, however, that biological resources are still important in addressing many societal demands, such as agricultural development and bioprospecting for new medicinal molecules, even in wealthy nations. Medicinal biodiversity has produced or inspired key drugs for global health concerns such as cancer, heart disease, dementia, and malaria, and is revered as a traditional medicine around the world. For example, of the 185 small-molecule cancer medicines licensed between 1981 and 2019, 65% were developed or inspired by medicinal biodiversity (Newman and Cragg, 2020).The growing demand for medicinal biodiversity, combined with the accelerated loss of biodiversity and ecosystem services as a result of exploitation, is exposing the world to its sixth mass extinction event, with one million plant and animal species facing extinction as a result of changes in land and sea use, climate change, pollution, and alien species (IPBES, 2019). As a result, there is a worldwide concern to conserve biodiversity and assure its long-term usage, generating a slew of international conventions and treaties to address biodiversity challenges. The attending nations signed the Declaration on the Human Environment in 1972, during the United Nations Conference on the Human Environment, which included bio-resource conservation among its 26 principles. It founded the United Nations Environment Programme (UNEP) and was a major driving force behind the first biodiversity-related conventions (UNCHE, 1972). Following that, in 1992, the Rio Convention on Biological Diversity (CBD, 1992), which went into effect in 1993, established three goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from the use of genetic resources, ushering in a new era for global biodiversity protection. In 2005, the Millennium Ecosystem Assessment investigated the links between human well-being and biodiversity. More recently, the United Nations Sustainable Development Goals (SDGs) of the 2030 Agenda emphasized the significance of sustainable biodiversity utilization in order to achieve this ambitious agenda (MEA, 2005).

Access to and utilization of medicinal biodiversity in Kenya has altered dramatically throughout the years. In the country, three major phases of biodiversity resource governance may be identified: pre-colonial, colonial, and post-independence (Patricia and Philippe, 1997). However, the post-independence phase can be divided into three distinct periods: the first two decades following independence (1964-1984), the third and fourth decades (1984-2004), and the fifth and sixth decades beginning in 2004. As much as these epochs represented the country's political epochs, they also had a significant and varied impact on biodiversity governance and management frameworks as affected by the international community. The biodiversity governance structure was founded on traditional/cultural leadership during

the pre-colonial phase, an oppressive white supremacist system during the colonial phase, and a "hybrid" governance system during the post-colonial phase. This study investigates the relationship between medicinal biodiversity governance systems and their use by local communities in Kenya's rural areas during these three phases. One obvious question that many people have is why we are concerned in the history of biodiversity governance and use in Kenya. Osakwe's solution to this topic is succinct: "To be able to appreciate fully the present, we must know something of the past" (Osakwe, 1994). A historical viewpoint will thus demonstrate how things were done in the past, the causes for such acts, and the consequences. This may assist avoid mistakes in the past, leading current and future actions toward better outcomes. The purpose of this research is to examine the relationship between biodiversity governance frameworks and sustainable utilization by Kenyan rural communities. It takes a historical approach that spans the pre-colonial, colonial, and post-colonial periods.

Material and methods

The study used a mixed methods approach, which includes desk-top research; interviews conducted using an interview guide, and quantitative surveys. Desk-top research, key informant interviews, and quantitative surveys of the relevant Line Ministries, Lead Agencies, and Research Institutions were used to collect information on policies on medicinal biodiversity utilization across the country. A thorough documentary examination aided desk-top research on biodiversity conservation in Kenya for rural community livelihoods from a historical perspective. Relevant documents, including relevant policies, laws, and programs, were carefully selected to provide a balanced and accurate view of the evolution of biodiversity governance in Kenya from pre-colonial colonial to post-colonial phases, as well as the impacts on biodiversity-dependent rural community livelihoods. To gather documentary information, government ministries, departments, lead agencies, and organizations participating in the country's regulatory, conservation, and livelihood initiatives were approached.

Accessing pertinent published and unpublished secondary documents was also aided by an Internet search. Peer-reviewed journal articles, books, and academic theses were accessed using literature search engines such as Google Scholar, Scopus, and Science Direct, among others. Various search terms were used to find articles, such as "medicinal biodiversity governance and utilisation in Kenya," "biodiversity conservation and utilisation in Kenya," "biodiversity conservation and livelihoods in Kenya," "biodiversity conservation policy in Kenya," "evolution of biodiversity governance in Kenya," as well as "natural resource access and use in Kenya. "The topic, abstract, and keywords of the article were used to inform the preliminary selection of an article for consideration. An in-depth examination of the initially chosen publications to determine their suitability as information sources for the study. In evaluating the documented sources of material acquired, a combination of historical narrative, thematic, and content analysis was used. This allowed for the organization of enormous amounts of documentary data into targeted and useful information for addressing the research purpose. The three historical phases (pre-colonial, colonial, and post-colonial) naturally became the themes through which the obtained documentary data was classified and analyzed in accordance with the research purpose. Self-administered interview guides were used to collect qualitative data from 15 key informants from 11 institutions and three line ministries working with biodiversity and biological resources. In addition to the informant interviews with directors and top leadership, the researcher administered structured questionnaires to 6 employees from the 14 organizations in biodiversity management classified as Line Ministries, Lead Agencies, and Research Institutions. The overall number of target respondents from the 14 organizations is 84. However, the researcher got 73 questionnaires, but four of them had significant omissions and were not included in the analysis, leaving 69 questions for analysis. The instrument was designed to assess study variables such as governance instruments, anthropogenic factors, medicinal

biodiversity, environmental factors, and long-term medicinal biodiversity use. The data obtained, which were responses to stated questions for each indicator, was in ordinal scale, using a 5-point Likert scale: (1)= strongly disagree; (2)= disagree; (3)= neutral/unsure; (4)= agree; and (5)= highly agree. The variable was measured using the arithmetic mean of the average of mean ratings for each of the indicators for each variable. The qualitative data was analyzed using content analysis of interview transcripts. Statistical Package for Social Scientists (SPSS) software was used to analyze quantitative data from questionnaires.

Results and discussion

Policy analysis

A summary of the policy and legislative tools relevant to the analytical approach in the case study phases is provided below (Table 1). Each policy/law was denoted by a '√' beneath the phase to which a criticism pertains. If a policy or law does not exist, the field is left blank.

Table 1 shows all three (3) phases have policies in existence for biodiversity management, whether written or unwritten. However, while each phase has taken its own approach to considering biodiversity (and, in rare cases, direct consideration of medicinal biodiversity) in its policies and relevant documents, the study reveals some drivers, barriers, and gaps in policy and laws, as well as institutional arrangements concerning medicinal biodiversity. Table 1 further shows the exception of the pre-colonial phase, the colonial and post-colonial phases were dedicated to various international accords emphasizing biodiversity protection and conservation. It is also obvious that there are national biodiversity policy and legislative frameworks in place. More information on the policy and legislative instruments in the three phases is provided below (Table 2). The Table 2 clearly shows that the three (3) phases had certain parts of policy and regulatory frameworks, whether written or unwritten, that emphasized biodiversity protection and conservation.

Medicinal biodiversity governance and use in pre-colonial Kenya-pre-1895

Prior to 1895, the governance and use of medicinal biodiversity by various communities in Kenya, like other resources, was based on customary rules and customs. These were regionally accepted concepts, special standards, or rules that were passed down orally. They were used by communal institutions to internally control or guide all aspects of their lives and activities. A council of elders and fetish priests who provided technical and spiritual expertise enforced the restrictions (Dore, 2001). There were customary safeguards in place protecting traditional knowledge and linked biological resources, from which they obtained their medicines. A series of unwritten and uncodified regulations governed knowledge exchange and the harvesting of bio-resources from community biodiversity. To protect biodiversity, only skilled herbalists or their chosen apprentices were permitted to collect herbs from forests or shrines. Traditional sustainable medical plant use was governed by management strategies such as taboos and seasonal and societal constraints on medicinal plant harvesting, which limited overharvesting of this resource. For example, the elders ensured the sustainable use of medicinal biodiversity, among other natural resources, by punishments and fines. In contrast to metal equipment, wooden tools such as pointed sticks were used during harvesting to minimize harm to the whole plant or the parts targeted and to manage the amount of bark or roots harvested at a time (Cunningham, 1993).

Aside from harvesting regulations, there were taboos, social controls, and prohibitions that directed people's social behavior in terms of who should harvest or handle medicinal plants. These taboos and beliefs aided in the protection and conservation of medicinal plants. For example, one of the social constraints that governed medicinal plant collecting was that a woman of reproductive age was not permitted to perform herbal medicine in the Kalenjin Community. Mature women who had reached menopause were permitted to practice herbal medicine in the community.

Table 1. A summary of policy and legal instruments relevant to biodiversity use in Kenya

Category	Policy or regulatory instrument	Phase		
		Pre-colonial	Colonial	Post-colonial
Mobilising biodiversity use	Forest policy/Program	√	√	√
	Wildlife conservation and/or National parks Act	√	√	√
	Forest Act/Law/Policy-Call for medicinal use and conservation	√	√	√
	Biodiversity policy/Law/Act/Action plans			√
	Biodiversity strategy and Action plan- Call for the implementation of medicinal management			√
	Constitutions		√	√
	Environmental Policy/Act/Law	√	√	√
Standards, Protocols, and Tools Development	Signed and ratified International treaties and Conventions are found to be relevant for medicinal biodiversity management		√	√
Medicinal biodiversity Infrastructure development	The existence of or a call for a national medicinal biodiversity database	√		
Capacity Building, Outreach, and Open access Initiatives	Environmental policy/Law/Act		√	√
	National Environment Action Plan Framework: Plan for training and research			√
	Biodiversity Strategy and Action Plan			√
	Constitution: the right to conserve and use biodiversity, including medicinal biodiversity			√
	Biodiversity policy/Law/Act- Call for training in medicinal biodiversity management			
	Environmental Impact Assessment Act- Call for access to information on medicinal biodiversity			√
	Wildlife Conservation Policy/Act/Law		√	√

Childbearing mothers, on the other hand, were only permitted to pick medicinal plant parts for the treatment of their children (Kurui *et al.*, 2016). This limited the people who harvested therapeutic herbs to mature, responsible individuals. In some situations, however, young people were permitted to accompany an elder or a herbalist to the forest to assist them in gathering the necessary herbs. After a long time of apprenticeship, the young person may be dispatched to pick herbs for the elder, depending on their interest. These policies tended to limit the number of people who picked herbs, so discouraging overharvesting of therapeutic plants. According to the literature, older men and women practiced herbal medicine and handed the knowledge down to their firstborn or favorite children (Kokwaro, 1993). The aforementioned, as well as other ancient taboos and practices, allowed people in pre-colonial Kenya to live in harmony with nature by preserving a healthy balance between them and the environment. These people were not just close to, but were a part of nature, understanding that their entire survival depended on it.

Before colonialism, every Kenyan community had a sacred spot where elders would conduct cultural and religious activities. That region was designated for prayer and consultation with their God, typically in excluded woodland areas known as sacred gloves or sacred places. Indigenous and local people recognized sacred locations as a source of law that provided them with the knowledge and insight to govern themselves. Sacred gloves were historically managed by local groups. Because of their cultural and religious links to the area, as well as their belief in the local deities, they have remained undisturbed and well-protected by the local populations (Khumbongmayum *et al.*, 2005). Some adult males (Custodians) who had been set aside after various ceremonies and were regarded as "righteous" in the community would visit these areas for a period of time to carry out their sacred activities. They played distinct roles in cleansing, blessing, and extreme instances to "curse" persons who did not confess to crimes done. These Custodians had a social obligation to safeguard the sacred location, which they had done for millennia, generation after generation.

They were responsible for the rituals that maintained the health and vitality of the ecosystems, the well-being of local communities, and a respectful interaction between human beings and their environment. Since time immemorial, local communities have used various medicinal plants, primarily those found in these sacred gloves, to cure various diseases because the medicinal properties of the various plants were well known to the local inhabitants and were passed down from generation to generation (Semwal *et al.*, 2010). Because of the advantages of community ownership and traditional sustainable management practices, sacred gloves have the ability to maintain medicinal plant biodiversity. Access to specific resources was restricted and controlled, such as medicinal herbs, firewood collecting, or grazing. The primary guiding norms that shaped access and exclusion to natural resources were beliefs and taboos. Illicit exploitation of these places was thought to cause droughts, famines, epidemics, and other disasters (ABN, 2012). Various consequences, including payment for sacrifices, fines, banishment, and even death sentences, were used to dissuade community members from violating such stipulations. This ensured the long-term utilization of common resources, such as medicinal biodiversity.

Colonial medicinal biodiversity governance and use: 1895-1962

The Colonial Period: 1895-1962 was the time when the affairs of the country were managed by the colonial overlords, whether they were political, economic, or social. The arrival of colonialism in Kenya shattered the tranquility and deep links that existed between indigenous people and nature. To conserve once-abundant populations, the newly constituted colonial authority enacted protective and command-style natural resource and wildlife conservation regulations. Suffice it to say that the Europeans' motivation for colonizing African countries, including Kenya, was to facilitate improved access to natural resources and biodiversity in general for industrial development in Europe. Colonial laws and regulations of natural resource management were self-serving, with the goal of facilitating the extraction of raw materials from the colonies for the benefit of the masters.For example, the Ukamba Woods and Forest Regulation of 1897 was designed to provide fuel for railway engines, whereas the 1900 Convention was designed to provide a consistent supply of game for trophy hunters, ivory traders, and skin dealers. Unfortunately, the ancient, African-medicine-inspired biodiversity management was lost due to ineffective governmental frameworks. The Kenyan Medical Practitioners and Dentists Ordinance 1910, for example, expressly prohibited the professionalization of traditional medicinal extractions. It proclaimed it unsafe to life, thereby ending traditional practitioners' practice, and was followed by the Witchcraft Act of 1925, which further damaged traditional health methods by prosecuting suspected witches.

Post-colonial medicinal biodiversity governance and use: 1963-present

The post-colonial period encompasses the years following 1963. Kenyans were in charge of the country's political, economic, and social affairs at the time. In other words, self-government existed. According to the literature, post-colonial phase medicinal biodiversity governance is robust, with multiple conference participations and signatures on international biodiversity declarations and treaties on biodiversity. Policy and legislation related to medicinal biodiversity conservation in Kenya post-independence include Kenya's old constitution at independence in 1963, the Forest Act cap 365 (1969), CITES (1975), Alma Ata Declaration (1978), GOK Presidential Decree on Aloe (1996), Chiang Mai Declaration (1988), Kenya Wildlife Act (1989), CBD (1992), EMCA (1999), NBSAP (2000), Form DCI 2003, the Forest Act (2005), Sessional Paper on Traditional Medicine in Kenya (2009), Registration of Hemp (2009), protection of Traditional Knowledge and Cultural expressions Act (2016), Health Act (2017) and Traditional and Alternative medicine policy draft (2018).

Table 2. Policy and regulatory frameworks directly and indirectly related to biodiversity conservation and use in Kenya

Period	Policy or regulatory instruments
Pre-colonial phase	Policies and Regulations were usually unwritten and were centred on cultural controls and regulations. A council of elders and fetish priests enforced the rules. Medicinal plants were regulated by management practices such as taboos and seasonal and social restrictions on harvesting to limit overharvesting of the resource.
	A set of utilitarian laws motivated by a need to ensure a sustainable supply of resources
Colonial phase	The Ukamba Woods and Forest Regulation of 1897
	The 1900 Convention
	The East African Forestry Regulations of 1902
	The Kenyan Medical Practitioners and Dentists Ordinance of 1910
	The Forest Ordinances of 1911. 1915 and 1916
	The Witchcraft Act of 1925
	The 1933 London Convention
	The Forest Ordinances of 1941
	The Forest Ordinances of 1949 and 1954
	The White Paper No. 85 of 1957
Post-colonial phase	Old Constitution (At independence-1963)
	Forest Act of 1969
	CITES 1975
	Alma Ata Declaration 1978
	Presidential Decree on Aloe vera 1986
	Chiang Mai Declaration 1988
	Kenya Wildlife Act 1989
	The Convention of Biological Diversity (CBD) 1992
	The Environment and Management and Coordination Act (EMCA) 1999
	The National Biodiversity Strategy and Action Plan (NBSAP) 2000
	Form DC12003
	Kenya Forests Act 2005
	Sessional Paper on Traditional Medicine in Kenya 2009
	Registration of Herbal and Complementary Products Guidelines to submission of Applications-Poisons and Pharmacy Board, 2010
	Traditional medicine and Medicinal plants draft policy 2010
	The Kenya Constitution 2010
	The Health Bill, 2012
	Protection of Traditional Knowledge and Cultural Expressions Act No 33 of 2016
	Traditional and Alternative Medicine Policy Draft, 2017 -Ministry of Health
	The Health Act 2017

Table 3. Kaiser-Meyer-Olkin and Bartlett's test

	KMO Measure	Approx. Chi-Square	df	Sig.
Legislation	.704	155.461	91	.000
Policies	.632	194.827	78	.000
Regulations	.860	164.220	91	.000
Medical &Biodiversity lead agencies	.704	208.011	104	.000
Settlement	.625	225.139	126	.000
Cultivation	.544	198.214	98	.000
Mining Activities	.682	141.705	84	.000
Bioprospecting activities	.740	151.942	70	.000
Medicinal Plants	.723	110.399	66	.001
Medicinal Animals	.564	171.709	66	.000
Medicinal Microorganisms	.703	127.444	66	.000
Climate Change	.765	150.318	60	.000
Pollution	.668	178.750	70	.000

The principal legislations governing biodiversity conservation in Kenya are the EMCA 1999, the Kenya Forests Act 2005, the Kenya Forests Act 2005, and the Kenya Wildlife Act 1989. However, no specific mention of medicinal biodiversity usage mobilization, sustainable use, infrastructure development, capacity building, outreach, or open access activities is made. Although the Forest Act of 2005 emphasizes the value of medicinal herbs in terms of community engagement, it fails to address their conservation and

long-term use. Similarly, the Kenya Wildlife Conservation and Management Act Cap 376, the Wildlife Conservation Act no. 16 of 1989, the Wildlife Conservation and Management Act 1989, and the Wildlife Management Act 2013 all formalize provisions for establishing and conserving flora and animals in protected areas. However, there was no single paragraph devoted solely to medicinal biodiversity. Furthermore, Sessional Paper No.3 of 1975 deals with the revocation of wildlife product traders, which was upheld by legal notice in 1978. It is worth mentioning that this regulation has effectively criminalized animal medicine (Zootherapy). Moreover, the National Environmental Management and Coordination Act of 1999 establishes criteria for successful environmental management, with which all state institutions must conform in their decision-making. Although the EMCA has established an important platform for biodiversity protection, the specifics of how to control medicinal biodiversity have not been specified.

Findings from the relationship test of governance instruments, medicinal biodiversity, and sustainable use of medicinal biodiversity

The links between governance instruments, medicinal biodiversity, and sustainable usage were examined using a conceptual framework (Fig. 1), which indicated that governance instruments would have some effect on medicinal biodiversity sustainability.

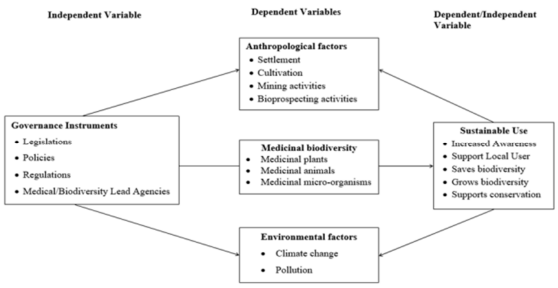

Fig. 1. Conceptual framework of governance instruments, medicinal biodiversity and sustainable use

Regression analysis was used to examine associations, and factor analysis was used to improve the instrument's validity and reliability. The majority of empirical research suggests big samples of more than 300 people. Samples larger than 1000, on the other hand, are appropriate for advanced analytical conclusions and factor analysis (Wolf *et al.,* 2013).There are, however, several sample size guidelines for regression analysis. According to Kline (1998), 100 subjects are sufficient. However, Hatcher and O'Rourke (2013) believe that if the sample size is smaller than 100, 5 participants per variable is sufficient. Furthermore, Costello and Osborne (2005) contend that two participants per variable are adequate for smaller sample sizes. The target sample size for this study was 75 people. However, the data sample size was 69, which is appropriate since there are 5 variables equivalent to 13.8 participants per variable. Pett, Lackey, and Sullivan (2003) recommend 10-15 subjects per variable for factor analysis, which agrees with the assertions of Wolf *et al.,* (2013). Cronbach's alpha was used to assess the study instrument's reliability, and composite validity was utilized to assess internal consistency. Prior to the reliability test, all constructs were subjected to KMO and Bartlett's Sphericity test. Table 3 summarizes the findings.

According to Table 3, all KMO measures fall between 0.544 and 0.860. That means the latent constructs met the 0.5 threshold, implying substantial relationships between the components. The *p*-values for all latent constructs were less than 0.05, indicating that the test was significant at 0.05, according to Bartlett's test of Sphericity, which analyzes correlations based on Chi-square. Factor analysis can be applied to the data based on the results of the two tests.

All variables were evaluated based on whether the actions of the relevant ministry, lead agency, and research organization had an influence on the conservation, utilization, acquisition, and commercialization of medicinal biodiversity. Governance instruments were one of the variables studied, and were examined using four indicators: laws, policies, regulations, and the actions of medical or biodiversity lead agencies. Before CB-SEM analysis, the factors were tested for validity and reliability.

Relationship analysis and hypothesis testing

The data was subjected to regression analysis in order to test various hypotheses. Each regression analysis employed the natural logarithm form of the dependent variable data. The dependent variable was logarithmically converted. According to Chatterjee and Hadi (2006), data transformation can assist make data more symmetric/normal, data variance more consistent, and non-linear relationships more linear. The regression findings and hypothesis testing are as follows:

Governance instruments, medicinal biodiversity and sustainable use

One study goal was to determine whether the presence or availability of medicinal biodiversity mediates the association between governance instruments and the long-term usage of medicinal biodiversity. This means that governance instruments, such as legislation, policies, and established medical/biodiversity lead agencies, have an impact on medicinal biodiversity aspects of settlements, cultivation, mining activities, and bioprospecting activities, and, as a result, the sustainable use of medicinal biodiversity through increased awareness, support local users, saves biodiversity, grows biodiversity, and supports medicinal biodiversity conservation. The mediation test is carried out using path analysis, as described by Baron and Kenny (1986).The first test looks at the links between the predictor (governance instruments) and the dependent variable (sustainable usage), then between the dependent variable and the mediator (the presence of medicinal biodiversity), and finally between the mediator and the dependent variable. The following was the hypothesis:

H_{o1}: The effect of governance instruments on the sustainable use of medicinal biodiversity is not mediated by the availability of medicinal biodiversity.

The availability of medicinal biodiversity is used to assess whether governance tools influence sustainable use in this study. Table 4 shows the test results for the direct effect of governance mechanisms on medicinal biodiversity sustainability. R and R-Square values are 0.412 and 0.17, respectively. This suggests a weakly favorable association between governance tools and the long-term use of medicinal biodiversity. The model is trustworthy because the ANOVA significant value is 0.002, which is less than 0.05, implying that the model is reliable. The coefficient and significant value for governance instruments are 0.54 and 0.002, respectively, indicating that it is significant at the 5% level. As a result, governance instruments can aid in the long-term use of medicinal biodiversity.

Since the first condition in Baron and Kenny (1986) is fulfilled, the test of indirect effect was examined through the test of both the relationship between governance instruments with the mediator and then between the mediator and dependent variable. The test sought to determine whether governance instruments can help ensure medicinal biodiversity availability. The results in Table 5 show that R and R-Square are equal to 0.56 and 0.314, respectively, which shows a weak positive relationship between the variables. The coefficient corresponding to the governance instrument is 1.057; the significant value is 0.0064, less than 0.05, meaning the relationship is significant at a 5% level. The significant value of the ANOVA, too, is less than 0.05, implying that the model is appropriate in explaining the relationship between the variables. Based on the results, better governance can enhance the availability of medicinal biodiversity, possibly through conservation.

The final statistical test for mediation, according to Baron and Kenny (1986), is to examine the connection between the mediator and the dependent variable. Table 6 displays the findings for the mediator-dependent variable relationship. R and R-square are 0.33 and 0.11, respectively, demonstrating a positive but weak connection between medicinal biodiversity and long-term usage. The coefficient for medicinal biodiversity was 0.342 with a significant value of 0.007, which is less than 0.05, meaning that the association is positive and statistically significant at the 5% level.

Table 4. Governance instruments and sustainable use

Model summary

Model	R	R square	Adjusted R square	Std. Error of the estimate
1	0.412	.170	.16415	.10744

a. Predictors: (Constant), LN governance instruments?

ANOVA

Model		SS	Df	MS	F	Sig.
1	Regression	0.270	1	.103	12.059	0.002
	Residual	0.504	67	0.02		
	Total	0.774	68			

a Dependent Variable: LN sustainable use

b Predictors: (Constant), LN governance instruments?

Coefficients

Model		Unstandardised coefficients		Standardised coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.30	0.16		5.37	0.00
	LN governance instruments	0.54	0.16	0.12	6.10	0.02

a Dependent variable: LN sustainable use?

Table 5. Governance instruments and medicinal biodiversity

Model summary

Model	R	R square	Adjusted R square	Std. Error of the estimate
1	.56[a]	.314	.302	.22599

a. Predictors: (Constant), governance instruments

ANOVA[a]

Model		SS	Df	MS	F	Sig.
1	Regression	1.011	1	.114	5.212	.0064[b]
	Residual	2.422	67	.051		
	Total	3.433	68			

a. Dependent variable: medicinal biodiversity

b. Predictors: (Constant), governance instruments

Coefficients[a]

Model		Unstandardised coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.659	.337		3.886	.0081
	Governance instruments	1.057	.123	1.056	4.460	.0064

a. Dependent variable: medicinal biodiversity

Table 6. Medicinal biodiversity and sustainable use

Model Summary

Model	R	R square	Adjusted R square	Std. Error of the estimate
1	.33	0.11	.102	.28772

a. Predictors: (Constant), medicinal biodiversity

ANOVA[a]

Model		SS	Df	MS	F	Sig.
1	Regression	3.006	1	.364	4.074	.007
	Residual	2.546	67	.283		
	Total	5.552	68			

a. Dependent variable: sustainable use

b. Predictors: (Constant), medicinal biodiversity

Coefficients[a]

Model		Unstandardised Coefficients		Standardised coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.765	.438		6.307	.000
	Medicinal biodiversity	0.342	.155	.331	3.273	.007

a. Dependent variable: sustainable use

The results in Tables 4, 5, and 6 fulfil the Baron and Kenny (1986) conditions for mediation – the causal is influenced by the dependent, the dependent influences the mediator, and the mediator influences the causal. In summary, governance instruments influence the sustainable use of medicinal biodiversity and the availability of medicinal biodiversity. In contrast, the availability of medicinal biodiversity has a causal effect on sustainable use.

The three phases

Kenya's three (3) phases of biodiversity governance had certain parts of policy and regulatory frameworks, whether written or unwritten, that emphasized biodiversity protection and conservation. However, with the exception of the pre-colonial phase, most existing biodiversity plans are excessively broad and lack specific schedules for medicinal biodiversity. Where there is some reference, however, it is biased, discriminating, or not fully developed (not entirely passed into law). For example, the Ukamba Woods and Forest Regulations of 1897, the 1900 Convention, and the East African Forestry Regulations of 1902, respectively, provided for the regulation and protection of forests and forest produce solely for the benefit of the colonial government, disregarding the interests of the natives, whereas the Witchcraft Act of 1925 prohibited the use of medicinal biodiversity, and it is worth noting that the Traditional Medicine and Medicinal Plants Draft Policy of 2010 has never seen the light of the day as a policy to guide the use of medicinal biodiversity in Kenya. Unlike pre- colonial and post-colonial phase policies, which took an anthropocentric approach to the environment and the sustainable use of biodiversity, colonial phase biodiversity-related policies and regulations were tailored to benefit colonial masters in extracting biodiversity resources to further their economy at the expense of natives. Despite the fact that Kenya has enacted numerous post-independence laws, strategies, and policies to govern biodiversity conservation and use, it is remarkable that no single policy or body of regulation gives comprehensive advice on the sustainable use of medicinal biodiversity. Despite promulgation of Kenya's 2010 Constitution that provides for the sustainable use, management, and conservation of the environment and natural resources, one would have expected the Draft policy on Traditional Medicine and Medicinal Plants of 2010 to be the primary legislation governing the sustainable use of medicinal biodiversity in Kenya. Unfortunately, this is not the case because the policy remains in draft form 13 years later. However, despite the inadequacies in national policy and regulatory frameworks, Kenya has ratified international biodiversity-related accords that are critical for addressing medicinal biodiversity and its long-term usage. Key among these agreements is the Convention on Biological Diversity (CBD, 1992), which came into effect in 1993, whose three objectives are- the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits resulting from the use of genetic resources. Other treaties recognized by the Kenyan Constitution include the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Convention on Migratory Species of Wild Animals (CMS), Ramsar (the Protection of Important Wetlands Convention), and the United Nations Framework Convention on Climate Change (UNFCCC). Perhabs, the effective domestication of these international biodiversity-related accords at the national level in terms of policy and regulatory frameworks could be the missing link.

Governance instruments, medicinal biodiversity and sustainable use

This study also looked at how governance tools affect the long-term usage of medicinal biodiversity by protecting medicinal plants, medicinal animals, and microoganisms. The aim here was whether medicinal biodiversity mediates the relationship between governance instruments and long-term biodiversity usage. According to the path analysis, medicinal biodiversity partially mediates the relationship between governance tools and the sustainable use of medicinal biodiversity. It indicates that a focus on protecting medicinal biodiversity can be achieved through governance instruments, which aid in the long-term usage of biodiversity if residents are aware of its value. According to Assessment (2001) and Köninger *et al.* (2021), the existence of medicinal biodiversity is dependent on state and community governance actions aimed at promoting and safeguarding medicinal biodiversity. Governance instruments, according to Mestre-Ferrandiz *et al.* (2022), are evident where there are known pharmaceutical advances. It implies that there is a link between the existence of governance tools and pharmaceutical innovation.

The problem is that the existing governance instruments can curtail the conservation, utilization, acquisition, and commercialization of medicinal biodiversity. According to MacDicken (2015), demand for space and other biodiversity products have prompted the construction of governance structures, but the results have been uneven. According to MEWNR (2015), more than 80% of Kenyans rely on plants for medicine, showing that biodiversity influences lifestyle and livelihood. According to Rodriques and Barnes (2013), strong regulation can assist solve the safety concerns about medicinal biodiversity in both developed and developing populations. Unfortunately, medicinal biodiversity is not recognized since some governments regard it as scientifically invalid. It indicates that the presence of medical biodiversity might mitigate the impact of governance instruments on the long-term use of medicinal biodiversity by raising awareness among local users, protecting biodiversity, growing biodiversity, and supporting medicinal biodiversity conservation.

Governance instruments, medicinal biodiversity, and sustainable use of medicinal biodiversity

By intuition, the availability of medicinal biodiversity and awareness of its significance should result in some adherence to the precepts of sustainable biodiversity use. The study investigated whether the availability of biodiversity and sensitization, would result in knowledge of its significance, may moderate the relationship between governance instruments and sustainable use. Path analysis reveals that medical biodiversity mediates the relationship between governance tools and the long-term usage of medicinal biodiversity in part. As a result, this study finds that where people are aware of medicinal biodiversity and its significance, governance instruments would produce more sustainable use of it. Locals who are aware of the medicinal biodiversity and its significance can assist governance efforts to produce more sustainable use. That makes sense because, intuitively, knowing the value of a resource should result in better utilization of the resource. In this sense, the more individuals become aware of the relevance of medicinal biodiversity, the less effort the government and regulators will have to expend to achieve major sustainable use of medicinal biodiversity. Another way to look at this is that governance instruments can boost medicinal biodiversity, which in turn increases the long-term usage of medicinal biodiversity.

Conclusion

Interactions with the various stakeholders in medicinal biodiversity organizations indicated the following: In Kenya, there is a lack of coherence in pre-colonial, colonial, and post-colonial policies on the use of medicinal biodiversity. While reverting to pre-colonial settings may be impossible, the study finds that medicinal biodiversity was better managed back then. This could be due to rising populations and industrialization, resulting in increased strain on biodiversity. According to the interviewees, the legislations and policies are disjointed, excessively generic, and lack coherence in their implementation. The stakeholders operate essentially autonomously, and their tasks are not well coordinated. The overlap of duties complicates the role of medicinal biodiversity management stakeholders and the general public in identifying, conserving, utilizing, acquiring, and commercializing medicinal biodiversity. The study's findings demonstrated that the effect of governance instruments on the long-term usage of medicinal biodiversity is mediated by knowledge or the presence of medicinal biodiversity. The effect of governance tools on the sustainability of medicinal biodiversity is greater where people are more knowledgeable about it. Furthermore, the study's findings revealed that long-term use of medicinal biodiversity minimizes both anthropogenic influences and environmental degradation tendencies. These two variables have a negative impact on medicinal biodiversity. They either induce overuse, depletion, or misuse, resulting in biodiversity damage. The study proposes mobilizing biodiversity support at the local government level. A more grassroots understanding of medicinal biodiversity resources can strengthen the influence of governance instruments to improve sustainable use.

It is necessary to develop suitable regulatory and legal frameworks to improve local health systems, foster collaboration between traditional healers and medical doctors, and incorporate local health systems into the national healthcare sector. This study also suggests a multimodal approach to ensuring the long-term usage of medicinal biodiversity. This is critical for addressing the harmful consequences of disconnected governance efforts as soon as possible. To strengthen confidence and inspire good intentions, there is a need for sustainable management and conservation of medicinal biodiversity and natural ecosystems, respect of indigenous peoples' and traditional healers' rights, and equitable benefit sharing.

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