

Full Length Research Paper

Sociocultural conservation strategies of prioritized medicinal plants, their historical context and space for integration

Willy Kibet Chebii*, John Kaunga Muthee and Karatu Kiemo

Department of Earth and Climate Sciences, Faculty of Science and Technology, University of Nairobi, Kenya.

Received 26 January, 2022; Accepted 2 September, 2022

The conservation of medicinal plants must be an all-inclusive endeavor that factors in the contribution of all stakeholders, both formal and informal. This paper highlights the importance of sociocultural aspects in the conservation of medicinal plant sources and resources using both traditional and modern conservation strategies. Efficacious traditional conservation strategies that featured prominently in the study include cultural methods of preventing overharvesting, enforcing social and cultural taboos, totemism, rituals and norms. Modern conservation strategies are mainly *in situ* and *ex situ* refined with education and research. The paper underscores the application of both local and modern conservation approaches ensuring a multipronged measure to have a sustainable traditional medicine trade and practice alongside market expansion. There is need for a well-structured harmonization of both traditional and modern conservation strategies for a holistic conservation of medicinal plant species.

Key words: Conservation, medicinal plants, sociocultural aspects, harmonization.

INTRODUCTION

Conservation of medicinal plants can be done locally by the traditional medicine practitioners (TMPs) or conventionally with the aid of modern conservation agencies or institutions. Medicinal plants or herbal remedies are harnessed for socioeconomic, sociocultural, environmental purposes and are invaluable in supporting livelihoods. The principal holders of the key sociocultural values and taboos are mainly the elderly people, rural folk and rich indigenous people leading traditional lifestyle (Plieninger et al., 2020). Traditional indigenous knowledge

is mostly passed orally or verbally and this largely contributes to the gradual decline in folk knowledge, and this calls for sustainable conservation and protection of medicinal plants and their sources (Tilahun, 2018; Ageh and Lall, 2019). Sustainability is a broad terminology that emphasizes on meeting the needs of the present and the future, ensuring a constant supply of the natural resources in demand (Shahrajabian et al., 2019). It is common knowledge that most of the traditional medicines (TM) are gathered from the wild, and the common

Corresponding author. E-mail: willy.chebii@uonbi.ac.ke.

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documented threats include but not limited to overharvesting, unsustainable exploitation of medicinal plants for other uses, unmonitored and unregulated trade, habitat and biodiversity loss, agricultural expansion and intensification, human encroachment, irresponsible mining activities, uncontrolled urbanization, inadequate data on threatened medicinal plants, secretive nature of the TM practice, unfair competition from imported TM, covert bioprospecting and biopiracy, overgrazing and excessive browsing, population pressure, detrimental exotic and invasive plants, indiscriminate forest fires and adverse climate change (Barata et al., 2016; Ibrahim et al., 2016; Sanwal et al., 2017; Amsalu et al., 2018; Duguma and Mesele, 2019; Chebii et al., 2020). Most traditional healers uphold secrecy for posterity and thus find it hard to disclose or even patent the esoteric elements of TM since they directly affect their livelihoods. Disclosure of esoteric elements of TM comes with financial compensation, patenting or intellectual property rights (IPR), therefore secrecy carries out the role of patents (Kwame 2016, Masango 2020). The concept of secrecy for posterity can either be in the sharing of traditional medicine knowledge and practice characterised by scanty documentation, poor dissemination of knowledge and intentional transmission of knowledge to close relatives and dependants (Ozioma and Chinwe, 2019). Secrecy is a form of protection by itself; it is regulated by local customary ethics and is largely esoteric (Tong, 2010).

Climatic variability is known to affect plant phenology, alter habitat, floral distribution, change individual species population, and disrupt collection periods of some medicinal plant species (Maikhuri et al., 2017). Biopiracy and few academic publications targeting local plant resources for profit making or patent rights threatens sharing of traditional knowledge systems and cultural innovations of the local communities (Ageh and Lall, 2019). This notion heightens suspicion and exacerbates the decline in the wealth of indigenous or traditional medicine knowledge, decreased cultural practices and affect transfer of TM knowledge to future generations (Ens et al., 2016). The decline in cultural-based conservation measures has been associated with the ever changing societal dynamics due to religious influence, migration, education, westernization or modernization. These factors among others have been linked to the continued weakening of the present traditional natural resource management practices (Abugiche et al., 2017).

It has also been reported that lack of a robust and a supporting scientific knowledge, rising poverty, ignorance, unsustainable land development, unemployment and total disregard of public participation requirement continue to threaten the TM conservation agenda (Khan et al., 2019). Other notable threats in the conservation of medicinal plant species include: pollination inadequacies,

lack of sufficient potential seed dispersers and unproductive scattered plant distribution. Efficacious conservation efforts should be directed at saving the endemic, economic and endangered plant taxa (Chen et al., 2019). Unfortunately, most areas of the developing world lack adequate capacity to effectively assess the conservation status of medicinal plants and thus lack informed guidance on the prioritization of actual species for conservation and protection (Rajasekharan and Wani, 2020). Without affecting the extraction and use of the medicinal plant species, sustainable harvesting is one of the reliable means of ensuring that the growing demand matches to a considerable extent the supplies (Susanti and Zuhud, 2019; Gakuya et al., 2020). Sustainable harvest was noted as the most important conservation strategy particularly for wild harvested medicinal plant species. However, major hurdles for a sustainable wild collection include ambiguous land use rights, ignorance on appropriate harvest practices, poverty, absence of relevant laws and policies, and weak traditional controls (Schippmann et al., 2006). In most instances, the attitudes of local community members are largely dictated by their ecosystem needs and their cultural-religious beliefs that help conserve their forest resources (Talukdar and Gupta, 2018).

Dwindling medicinal plant resources and the attempts to restore their sources should be the main focus of TM practitioners and conservationists. Therefore a holistic sustainable management and conservation efforts must be an all-inclusive venture that draws in all stakeholders (Sen and Bhakat, 2020). Holistic conservation of vital natural resources calls for a multipronged approach that factors the economic, ecological, ethical, social-cultural and political strategies in reversing a declining biodiversity (Pati, 2017). This paper therefore aims to lay out all traditional and modern conservation strategies that will ensure sustainability of medicinal plant sources and resources. The paper therefore laid down the possibility of integrating both traditional and modern conservation strategies particularly for most sought, rare, and slow growing medicinal plant species.

METHODOLOGY

Twenty one traditional medicine traders plying their trade in the seven surveyed counties of the Western Kenya (Uasin Gishu, Elgeyo Marakwet, Trans Nzoia, Kakamega, West Pokot, Siaya and Vihiga). Their respective GPS coordinates and elevation in metres above sea level were recorded using a Garmin etrex 20x instrument (Table 1). All the respondents were purposively selected based on their expertise in TM knowledge and willingness to be interviewed followed an oral prior consent after a short brief on the study objective. A semi-structured questionnaire was used in the face-to-face interviews (February – September, 2019) where respondents were more recruited using a snow ball sampling technique. Major sociocultural and conservation responses collated were qualitatively and quantitatively processed using MS excel spreadsheet. In

Table 1. Traditional medicine practitioners interviewed on socio-conservation approaches in the Western Kenya traditional medicinal markets.

County	Medicine market	Market GPS coordinates		Altitude (m asl)	Number interviewed
Uasin Gishu	Eldoret	N 00° 31.010'	E 035° 16.364'	2080	3
Elgeyo Marakwet	Arror	N 00° 57.838'	E 035° 36.967'	1049	2
Trans Nzoia	Kitale	N 01° 01.206'	E 035° 00.087'	1898	3
West Pokot	Makutano	N 01° 15.425'	E 035° 05.549'	2060	4
Kakamega	Kakamega	N 00° 17.231'	E 034° 45.206'	1556	3
Vihiga	Luanda	N 00° 01.427'	E 034° 35.167'	1505	5
Siaya	Yala	N 00° 05.301'	E 034° 32.387'	1389	1
Total					21

Source : Authors

In addition, a systematic literature review on the conservation of medicinal plant species was conducted on carefully selected peer reviewed scientific papers published online on Google scholar, Scopus, Scimago and Web of Science databases. The selection was conducted using a google search engine using the following key words: sociocultural, conservation, sustainability, traditional medicine and medicinal plants. The search was thematic driven and not location specific so as to develop a universal theory applicable to conservation of medicinal plants.

RESULTS

The traditional healers favored esoterism perpetuated by sharing traditional medical knowledge within a small circle of traditional experts, their close relatives and dependants as a local means of regulation. Secretive collection expeditions (90%) were most cited as a way of protecting the medicinal plants from over-exploitation or misuse. Some traditional healers operate on a closed-diary manner and organize collection expeditions at night, dawn or even at dusk to prevent unnecessary exposure of the medicinal plant species. This secrecy or limited disclosure of traditional medical knowledge (86%) was extended to control sharing of the medicinal plant's folklore identity, botanical name or even its trade name to clients, researchers and formal regulators. Traditional healers believe that secrecy for posterity is the most viable conservation principle and acts as a local patent or IPR. Conservation takes several forms and one being the protection of local means of treatment of diseases by a group of people or community and prevented from being exposed to other groups as regulated by local customs or social taboos. Therefore, most traditional healers favored the conservation of traditional health systems and environment (86%) and the preservation of indigenous medical knowledge (81%).

Sociocultural conservation strategies also cited by traditional healers include responsible harvesting practices that bar uprooting of lone medicinal plant species (76%), promote covering of exposed roots (81%),

sociocultural ban on excessive debarking (67%) and preclude harvesting of plant primary roots (Table 2).

Sociocultural conservation strategies are conspicuous and also evident in all the surveyed traditional medicine markets. The display of well dried and powdered herbal remedies in packets, bottles and cartons or boxes free from contamination or moulds. The perpetuation of secrecy as a strategy to regulate flow of traditional medical knowledge can be seen in the TM markets (Figure 1) in the absence of complete labeling to conceal the folklore or botanical name, and to some extent not writing exact dosage prescription and excluding the exact mode of preparation and ethics of administration.

DISCUSSION

Sociocultural aspects of medicinal plants conservation

The conservation efforts of rural communities are more inclined to community perceptions rather than evidence-based conservation. An advantage attributed to conservation based on community perceptions is the inclusion and understanding of deep seated sociological beliefs, ecological outcomes and positively improve conservation policies, actions and outcomes (Bennett, 2016). For decades, local communities have survived on their cultural innovations, traditions and practices that also dictated the type of medicine used in treatment of various diseases (Ageh and Lall, 2019). Despite lacking the conventional grasp of modern species concept, there exists a wealth of indigenous knowledge on species use and diversity although the sustainable utilization of medicinal plants is largely dependent on sociocultural protocols. Cultural-rich societies demonstrate an intricate and dependent relationship with nature and tend to value conservation and preservation of traditional medicine and other invaluable natural resources. Notable sociocultural protocols important in conservation include but not limited



Figure 1. A display of a diverse TM in the Luanda medicine market in the Vihiga County.
Source : Authors

Table 2. Leading sociocultural conservation strategies of the traditional medicine practitioners in the surveyed medicine markets of Western Kenya.

Sociocultural conversation strategy	Frequency number of citations	% response
Avoid multiple harvesting of the same medicinal plant and allow recovery	15	71
Limited disclosure of traditional medical knowledge	18	86
Discourage harvesting of the primary plant roots	15	71
Covering exposed roots with soil mounds	17	81
Bars uprooting of a solitary whole plant	16	76
Discourage excessive debarking of a medicinal plant	14	67
Secretive collection expeditions, sometimes at odd times(dawn, dusk, night)	19	90
Need for domestication of overexploited, rare or slow growing wild medicinal part species	10	48
Conservation of tradition health system and environment	18	85
Conservation of intellectual property rights and preservation of indigenous medical knowledge	17	81

Source: Authors

to taboos, customs, traditions, rituals, ceremonies and organized festivals with a deep emotional attachment and veneration of ancestors. This places traditional healers at the centre of rural conservation approach being the principal custodians of the rich indigenous knowledge (Ssozi et al., 2016; Singh et al., 2017). Local community social rituals, customs, myths and taboos constitute the Traditional Ecological Knowledge (TEK) and can be passed from one generation to another (Sinthumule and Mashau, 2020).

Local communities often conduct prudent governance of their natural resources and biodiversity through set norms and practices as dictated by strong traditional and largely informal community-based institutions. Sociocultural norms therefore help in the harmonious reconciliation and integration of human needs in the conservation agenda (Janaki et al., 2021). Harnessing of medicinal plants locally are mainly controlled by management procedures that include taboos, seasonal and social constraints. Social taboos normally controls who is allowed to harvest or manage medicinal plants, at what time and at which suitable location (Sen and Bhakat, 2020; Janaki et al., 2021). The needs, worries, social relations, ethical and spiritual values of the local communities help shape conservation management strategies and decisions. Where the laid strategies respond to uncertainty and enables realization of customs, emotions and curiosity and forms part and parcel of management decisions (Rangel-Landa et al., 2017). The conservation of medicinal plants may take place consciously or intentionally on available spaces among local communities. Environmentally conscious conservation can be exercised directly by effecting conservation measures from the grassroots to the national level (Doffana, 2017).

Conservation of medicinal plants revolves around protection, maintenance, exploitation and sustainable utilization of natural resources (Rajasekharan and Wani, 2020). In a holistic conservation approach, the traditional ethno-ecological knowledge should be promoted in the silvicultural management that is applied mostly to over-exploited medicinal plant species. A shift from a pure ecological and sociological fashion to an ideal environment that integrates societal values into conservation enjoys prioritization in the global conservation agenda (Beltrán-Rodríguez et al., 2017). An effective collaborative engagement or partnership should integrate management strategies with the development needs of the local communities and fully embrace bottom-up collaborative approaches (Lake et al., 2018). Conservative traditional practices combined with cultural and seasonal restrictions particularly in the harvesting of medicinal plants have contributed immensely to the conservation of medicinal plants (Khan et al., 2018). Ironically, the most dominant players in the traditional medicine trade are partially educated or holders of basic

education but not illiterate as widely perceived (Isiko, 2019). In essence, they imbibe most of their wealth of experience from a largely uneducated and gifted traditional healers who are mostly based in the village settings (Susanti and Zuhud, 2019). Regarding consumption and utility of TM, the less educated tend to consume more traditional medicine than the educated lot (Aabdousse et al., 2020).

Sociocultural factors that have been reported to cause a decline in traditional indigenous knowledge and practices include the distance to TM sources, age, family member ill health, access to modern medicine and agricultural intensification (Atreya et al., 2018). Traditional knowledge should factor in the most important facets of a community structure including the natural, cultural, usefulness or/and even religious or spiritual aspects, customary laws and traditions critical for biodiversity conservation (Duguma and Mesele, 2019; Susanti and Zuhud, 2019). Susanti and Zuhud (2019) documented the role played by three pro-conservation stimuli critical in TEK namely: natural, usefulness and religious stimuli. Natural stimuli is inclined more to sustainable agriculture, usefulness stimuli touches on the utilization of the individual species in meeting human basic needs, whereas the religious stimuli appreciates the role of customary laws by communities for sustainable extraction of plant species products and their respective conservation (Susanti and Zuhud, 2019).

Regarding sex and gender roles in conservation, women are motivated to participate in more environmental activities because of the benefits they draw from it, whereas the elderly and women attach some cultural and religious importance to some medicinal plants and thus impose stricter conservation customs towards their protection (Ondiba and Matsui, 2021). Men are favoured as architects of a more diverse medicinal plant gardens whereas women were identified as leading broadcasters of traditional ecological knowledge to the next generation (Caballero-Serrano et al., 2019).

Traditional conservation strategies

Sustainable harvesting and cultivation methods are still ranked as leading conservation strategies applied by most conservationists. With cultivation, the debate shifts to organic farming which should be prioritized because of improved quality, maintenance of natural attributes, heightened production, genetic diversity, enhanced biosynthesis of bioactive compounds, improved growth rates and biomass. Economically, organic farming help improve prevailing market prices, economic growth and attainment of social stability among the traditional healers, collectors, farmers and suppliers (Shahrajabian et al., 2019). Major significant cultural and traditional practices critical in TM conservation include: totemism,

maintaining sacred and protected areas like shrines, evil forests, sacred groves and burial grounds for the conservation of natural resources. (Xego et al., 2016; Eneji et al., 2019). The use of local knowledge in conservation in combination with the use of customary rules and regulations, customs and rituals, taboos and totems, application of metaphors and proverbs positively promote local conservation efforts (Mavhura and Mushure, 2019).

Totemism and deities in conservation

Totemism or holding in high regard totems (forbidden items) is defined as a belief system where humans have a mystical or spiritual relationship with plants or animals (Eneji et al., 2019). Totemism can be further explained as a practice where some communities believe that certain animals, plants or physical features have some ancestral significance or mythical relevance and hence cannot be harmed but protected (Singhal et al., 2021). Totemism and deity worship in many traditional communities help conserve both the revered plants and animals even though it is not conventionally supported by any environmental consciousness or pragmatism.

The baobab (*Adansonia digitata* L.) is revered in most parts of the African continent (Benson, 2021). *Euphorbia ingens* E. Mey ex Boiss has also been documented to enjoy protection due to the associated beliefs, emotions and ethical societal controls in order to serve as traditional lightning arrester (Reniko et al., 2018). Other totemic plant species include: *Croton oblongifolius* Roxb., *Ficus benghalensis* L., *Tamarindus indica* L. and *Ficus religiosa* L. (Singhal et al., 2021). Other infamous and protected plant species in the Indian sub-continent include *Butea monosperma* (Lam.) Taub. And *Mangifera indica* L. which serve as popular cremation zones (Talukdar and Gupta, 2018). Reverence to supreme deities, ancestors, spirits and strong beliefs in animism, sorcery and witchcraft has contributed immensely to conservation of forests and plant resources. The conservation is in tandem with the calling to preserve natural resources and biodiversity in order to please the supernatural beings and not to attract a curse, wrath and punishment from the spirit world (Adom, 2018).

Other than the prevailing religious undertones, totemism has helped conserve plants by ascribing some spiritual importance and are thus immune to exploitation (Marumo, 2019). Religious beliefs and worshipping of some identified and revered god trees is reported to have positively contributed to conservation and regeneration of valuable plants. In the Gairsain region of Chamoli of Uttarakhand, *Quercus leucotrichophora* A. Camus., *Prunus cerasoides* D. Don, *Celtis australis* L. and *Myrica esculenta* Buch.-Ham. ex D. Don. among others are totemic and therefore revered by the villagers (Khasim et

al., 2020).

Social taboos and conservation

Traditionally, access to natural resources was controlled by stringent beliefs, taboos and customs as regulated by community leadership structure. It is believed that complete devolution of natural resources to the grassroots community level enhances the conservation agenda by instilling some ownership values (Chigonda, 2018). Social taboos have succeeded in preventing local communities from cutting down trees in sacred natural forests. These taboos are passed through generations as part of local practices, indigenous beliefs, customary laws and a host of prohibition systems (Maru et al., 2020). The traditional medicine practitioners, particularly the local herbalists need to be properly trained on how to practice sustainable harvesting and ensuring safe use of medicinal plant species (Mugomeri et al., 2016). Some of the documented and sustainable harvesting practices include avoiding girdling, encouraging collection of minimal number of roots, restrained debarking, covering exposed roots with soil mounds (Mbinile et al., 2020).

Modern conservation strategies

Efficacious conservation strategies for medicinal plant species are mainly classified in four main areas mainly *in situ* conservation and *ex situ* conservation strategies whereas education and research components were added into the category. *In situ* habitats simply refer to where plant species are found naturally and they include: biosphere reserves, sacred groves and forests whereas *ex situ* habitats are areas outside the species natural habitat and they include: field gene banks: botanical or herbal gardens, kitchen gardens, arboreta and seed banks (*in vitro* seed and gene banks, DNA banks, cryobanks) that enable storage and preservation of seeds and propagules essential for propagation of the marked plant species.

In addition, species inventory, botanical checklists and databases are key decision making tools that guide the conservation of threatened medicinal plants (Rajasekharan and Wani, 2020). Prudent keeping of historical records backed by good and reliable data is invaluable in the conservation of medicinal plant resources (Jamshidi-Kia et al., 2018). New and modern cultivation strategies and domestication of the medicinal and aromatic plants are considered improved methods for biodiversity conservation in their natural habitat and their adoption is highly encouraged. These modern progressive cultivation strategies are mostly aimed to grow threatening wild medicinal plants or improving their growth rates and yields, increase the concentration of

active ingredients or even improved plant part quantities to meet the growing market demands and enable sustainable industry (Phondani et al., 2016; Xego et al., 2016). The extent and limits of domestication have been found to be largely influenced by a number of socioeconomic, cultural and gender factors which include age, wealth, ethnic affiliation, household size and land acreage (Kideghesho and Msuya, 2010).

Botswana's republic capitalized on their semi-arid and sub-tropical climate to domesticate her most sought and threatened medicinal plant species that include an *Harpagophytum procumbens*, antimalarial *Artemisia afra*, , appetite suppressant *Hoodia gordonii* and highly nutritive *Sclerocarya birrea*. These domesticated plants boosts income generation of the local traders and reduces claws of poverty (Daniel and Shimane, 2011). The fast growing and multipurpose medicinal plant species should always be prioritized for cultivation (Ibrahim et al., 2016). With the increasing human populations, cultivation is mostly constrained by decreasing land sizes, competing land uses, uncontrolled harvesting, slow growing or long maturation species, low value monetary value species and practitioners lacking adequate knowledge on modern silvicultural practices (Ebifa-Othieno et al., 2017). These ultra-modern conservation priority should be assigned to endangered plant species that has the potential to cure or treat many of diseases (Khan et al., 2018; Dadjo et al., 2020). However, these modern conservation strategies are beyond the grasp of most traditional healers but can be complemented alongside traditional conservation strategies. The traditional medicine practitioners should progressively employ new technologies that would realize an increase in the TM quantity and quality in order to meet the market needs. These technologies should be designed to influence sustainable extraction, quality development of the herbal products, exquisite packaging and prevent any forms of contamination of medicinal products (Cahyandito and Oktasari, 2019).

Conservation and protection of medicinal plants

Conservation measures are crafted to ensure a continuous supply of traditional medicine for the present and future, and at the same time facilitate perpetuation of species (Barata et al., 2016). Traditional methods of harvesting among world communities are subjected more to social controls and taboos than conventional regulations. Fundamentally, most of the traditional medicine and herbal practitioners follow cultural gathering restrictions (Monica et al., 2016). Restrictions on harvesting some plant species and plant parts can be imposed by local communities as a management method.

These restrictions can be extended to cover seasons or periodic harvesting of a plant or plant parts with close

emphasis on multi-purpose species. *In situ* management strategies calls for harvesting of plant parts right in their natural habitat (Rankoana, 2016).

Medicinal species that are not easy to domesticate or manage are most often conserved *in situ*. Conservation can also take place in well managed smaller spaces or even informal protected areas including farm-back or front-yards.

Although those medicinal plants conserved *in situ* are often vulnerable to overharvesting or over-exploitation and must be protected well to preclude decline in wild populations (Xego et al., 2016; Bizuayehu and Assefa, 2017; Doffana, 2017; Pati, 2017). The major bottleneck in the establishment of home gardens among the rural-based or local medicine practitioners is the cost of production as compared to the cheaper collections from the wild (van Wyk and Prinsloo, 2018). Agronomically tested management practices for a well-groomed diverse home garden include intercropping and crop rotation. Diversity can be achieved through cultivation of more annual and perennial herbs and shrubs (Amsalu et al., 2018). The urge and the need to exploit unregulated common plant resources for individual gain or profit overrides the need to conserve the resource. Recapitulation of the Hardin's tragedy of commons, game theory logic and the Prisoner's Dilemma theories can lead to the common assertion that the private incentive to exploit a common resource is way stronger than their sustainable utilization and conservation. (Rath and Ormsby, 2020).

The creation and realization of an indigenous conservation policy serves a boost in the quest for a cultural and biodiversity conservation and matches the benefits drawn from the medicinal plant species (Ens et al., 2016). Therefore the contribution of traditional indigenous, tribal and cultural practices cannot be underscored in the conservation agenda, although the pressure from industrialization, over-exploitation and the expansion of agricultural activities is a glaring reality and should be properly contained (Rath and Ormsby, 2020).

Sociocultural governance and management of TM

Public policies should enhance the traditional community practices that are effective in the conservation of the medicinal plants. Efficacious regulations should promote good harvesting and ensure sustainability of medicinal plants trade and practice (Beltrán-Rodríguez et al., 2017). Four criteria and several indicators have been developed to achieve long term economic and environmental sustainability of medicinal plants trade and practice and they include governance, sociocultural, environmental or ecological and an all-inclusive economic criterion that considers cultivation, marketing, industry, research and development (Negi et al., 2018).

Sustainability hiccups emerges from a host of biological factors which include low reproductive rates, slow growth, endemism and sensitivity to climate change. On a broader scale, government can impose trade and consumption restrictions on endangered medicinal plant species (Cheung et al., 2021). The efficacy of governments enforcing trade bans is still widely contested since illicit trade of vulnerable species are still carried out informally. The regulatory institutions usually effect bans on collection of plant species or ban the actual trade of the listed plant species. The effectiveness of a top down conservation approach is also a debatable issue, it is imperative to cushion marked plant species from wanton harvesting by devolving management rights to the local communities other than overly relying on formal collection and trade bans (Pyakurel et al., 2019). Conventionally, local users may be asked to obtain a permit first in order to extract forest resources or face a fine for any recorded breach. Regardless of its informal nature, customary laws impose restrictions to preclude over-exploitation of forest resources (Susanti and Zuhud, 2019).

Medicinal plant diversity and conservation

Some plant families have a disproportionately high number of medicinal plant species and some have more threatened species. Based on a scientific determination of commonly used or traded taxa, more attention can be directed in the conservation and protection of the highly ranked or prioritized taxa (Chen et al., 2016; Bizuayehu and Assefa, 2017).

The multipurpose medicinal species are more threatened than the single use species; this applies mostly in commonly used taxa or those used in drug combinations or drug synergies (Bizuayehu and Assefa, 2017). Species diversity and abundance are always affected by over-exploitation, uncontrolled deforestation, poor harvesting practices and general habitat destruction (Chen et al., 2016). Assessment of the conservation status of most frequently used medicinal plants based and constant update on their IUCN status based on field evidence helps conserve threatened, rare, vulnerable and endangered plant species (Dapar et al., 2020). The importance of accurate botanical identification of the traded medicinal plants points out at the appropriate conservation of the exploited species based on their use frequency (Lima et al., 2016). Proactive conservation measures starts with plant inventories, correct identification and prioritization of medicinal plants and geographic hotspots for conservation. Local communities should be educated through a series of awareness campaigns in the creation of robust legislations, development of seed banks and importance of modern germplasm repositories (Ouedraogo et al., 2020). Some

governments, for instance, India, has enforced measures to promote *in situ* conservation of medicinal plants through creation of somewhat special medicinal plants conservation development areas (Biswas et al., 2017). *In situ* conservation not only allows for conservation of threatened medicinal plants in their habitat but help reduce pressure on our forest ecosystems (Sanwal et al., 2017). Other than cultivation or sustainable agriculture, substitution of root plant parts with parts having same empirically tested biochemical and pharmacological activity aid in the conservation and protection of bioresources. This is exemplified by substituting roots or root barks with leaves as seen in the *Premna latifolia* Roxb (Jena et al., 2017).

A viable conservation vision and future perspective

The traditional systems of conservation have a role to play in the modern conservation agenda. Blending the existing myths, rituals and perceptions with the present conservation measures and legislations by involving the traditional healers and local communities in the conservation of their natural resources is the most promising avenue (Abugiche et al., 2017). An effective conservation approach for medicinal plant sources should adequately follow both the conservation and resource management strategies. Modern biotechnological approaches should be observed in the quest to improve yield and the quality of medicinal plants (Chen et al., 2016). The development of medicinal germplasm and gene banks also are invaluable in the conservation of the rare and endangered medicinal plants (Pati, 2017). Basic training of traditional medicine practitioners in seminars or workshops assist in the conservation of highly valued or exploited species can be conducted using their indigenous knowledge rather than the elite taxonomic language. The trained or sensitized traditional healers in turn will train their apprentices in key processes like collection, administration of rituals, and in the inspiration of young members of society to embrace traditional medicine (Mathibela et al., 2015; Tilahun, 2018). Adopting an integrated ecological and socioeconomic approach help minimize species loss and realize sustainable utility of biodiversity, prioritized conservation and high regard for urgent research attention (Tali et al., 2019).

There is need to advance learning and emphasize on the importance of traditional knowledge and important plant species to be prioritized for conservation (Aabdousse et al., 2020).

Conclusion

The conservation of medicinal plants for sustenance of

the TM industry needs a multidisciplinary approach that encompasses both the least published traditional conservation strategies and most researched modern conservation strategies. The harmonization of these two strategies will make conservation of medicinal plants an all-inclusive venture and a huge success devoid of major push and pull of the major players. The role of traditional healers and local communities should not be underestimated, the modern conservationists and policy makers should include local players in the conservation efforts. The only difficulty in integration of traditional conservation strategies in the modern conservation approach lie in their secrecy and are mostly limited by social taboos and customary regulations.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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