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Research Article

The role of traditional management practices in enhancing sustainable use and conservation of medicinal plants in West Usambara Mountains, Tanzania

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Abstract
The study on importance of traditional practices in conservation of medicinal plants in West Usambara Mountains, Tanzania was conducted by using focus group discussions, interviews, participant observation, and botanical survey. Nine traditional practices for conservation of wild plants were identified as domestication; beliefs in sacredness of trees; beliefs in sacred forests; respect of cultural forests; protection of plants at the burial sites; selective harvesting; secrecy; collection of deadwood for firewood, and use of energy-saving traditional stoves. Through botanical surveys of sacred forests, cultural forests, farms/homesteads, and burial sites, some 1,518 wild plants belonging to 100 species were identified. A large proportion (85%) of these plants had medicinal value. Of the 173 respondents, 82%, 81%, 74%, and 71% believed that sustainable use and conservation of medicinal plants can be achieved through secrecy, plant protection at burial sites, sacredness of plants and domestication, respectively. About 89% of the respondents pursued domestication (at least five plants each) and 70% had retained sacred trees (at least one tree each), of which the majority had medicinal value. Few respondents were aware of the positive role played by sacred forests and cultural forests (38% and 21%, respectively) in conservation of medicinal plants. It is concluded that the traditional management practices have a significant role in the conservation of biodiversity. This conservation role has a direct connection with human health since most of the plant species have medicinal value, which a majority of the rural people rely on. The paper recommends that traditional management practices should be encouraged since they serve a dual purpose as important conservation strategy and as an essential component of primary health care.

***Key words*:** Traditional practices, sustainable use, conservation, medicinal plants, West Usambara Mountains, Tanzania.

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Introduction

Medicinal plants are essential components of primary health care, especially for rural communities in developing countries. High reliance of rural communities on medicinal plants for health care has become imperative due to the imbalance ratio between rural population and the number of medical doctors. The number of traditional healers surpasses that of medical doctors by far. For example, in Malawi, for every traditional medicine practitioner there were 138 people against one university-trained doctor for 50,000 people in the past two decades [1]. In Mozambique, the ratio of traditional healers to patients was 1:200 while the ratio of University-trained doctors to patients was 1:50,000 [2]. In Uganda, the ratios of traditional healers and of medical doctors to patients were 1:708 and 1:25,000, respectively [3]. This imbalance has been increasing, mainly because the pace of population growth is not the same as the increase of medical doctors. For example, in Tanzania, the ratio of doctors to patients had decreased from 1:22,600 in 1970 to 1:24,880 in 1990 [4].

It has been observed that even where modern medical services are available, use of medicinal plants has remained a more feasible option due to their affordable prices, relative accessibility, local availability, trust in the efficacy of medicinal plants, and emergence of new and incurable diseases such as HIV/AIDS, cancer and diabetes [5, 6]. Some literature [2, 7, 8] considers the western medical system to have failed in Africa. Some of the reasons advanced for this failure include inaccessibility of the facilities for much of the population, poorly trained and unmotivated staff, inadequate technical services leading to poor quality care, unaffordable medical and hospital costs (even in state-run hospitals and clinics) and the tendency to divorce treatment from the patient's culture, family, and community. The failure is also attributed to the fact that patients are frequently not told the nature and cause of their illnesses; governments spend a large proportion of their per capita gross national products on western health care; patients are removed from the family and community, stripped of their identity and forced into a sterile hospital setting, and the treatment only addresses a patient's biological manifestation of the illness and does not attempt to heal the spiritual aspects of illness.

The heavy dependency on medicinal plants renders them vulnerable to overexploitation, triggering increased scarcity and even loss of certain species. Trade and deforestation are the major factors threatening medicinal plants in Tanzania as exemplified by 13 medicinal plants reported to be traded locally and internationally [6, 9]. The Wildlife Trade Monitoring Network (TRAFFIC) evaluation of priority plant species in East/Southern Africa identified nine medicinal plant species in Tanzania most in need of conservation, management, and research due to their endangered status caused by overexploitation. These include *Dioscorea dumetorum*, *Cadaba farinosa*, *Milicia excelsa, Acalypha fructicosa, Harrisonia abyssinica, Steganotaenia araliacea, Acacia melifera, Ehretia amoena, and Wedelia mossambicensis [*10].

The important role that medicinal plants play in peoples' health and the increasing threat of extinction facing them call for immediate and proactive conservation measures. Promotion and revival of traditional management practices is one of such measures. These traditional practices, which are mostly based on cultural norms and religious beliefs, are the basis for sustainable use and conservation of biodiversity. Although they have long been neglected by official conservation policies, they have proved effective, as acknowledged in literature [11-18].

The social organizations that control access to resources within the community [19], the customary norms and procedure for control, acquisition, maintenance and transfer of the resources [11], and the traditional utilization and conservation practices [20] are the three key features used to characterize the traditional natural resources management practices. Information on traditional management practices is important for conservationists. The practices are additional conservation strategies that can complement the contemporary conservation strategies in ensuring conservation and sustainable utilization of natural resources. Official recognition of these practices is a milestone in conservation following decades of marginalization of these practices by colonial and post-colonial conservation policies. The reality that the communities have regular interactions and are familiar with resources in their environment compared to other potential actors makes them the best managers of these resources. Research on traditional management practices has become imperative as a way of identifying and analyzing the potentials and challenges of these practices. This article seeks to contribute to this subject using medicinal plants as a resources and the West Usambara Mountains as a case study. The ultimate goal of the article is to inform policy-makers and conservation practitioners, thereby enriching their management options.

Methods

Study area description

The West Usamabara Mountains are a part of the Eastern Arc Mountains located in north-eastern Tanzania (4^{o} 24' – 5^{o} 00' S and 38^{o} 10' – 38^{o} 36' E) [Fig. 1]. The mountains cover an area of 4,500 km^2, which is 90% of the total area of Lushoto district [21]. Climatically, the area is characterized by two rain seasons, short rains (November-December) and long rains (March-May), with annual rainfall ranging between 600 and 1,200 mm per annum. Temperatures are higher on the lower parts (25-27^{o}C mean monthly) and lower on the plateau (13-18^{o}C mean monthly). The minimum and maximum temperatures are 13^{o}C and 27^{o}C, respectively. Extreme temperatures (7^{o}C during cold seasons and 30^{o}C during hot seasons) have been recorded. Three types of natural forests are found in the West Usambara Mountains; these include lowland, intermediate (sub-montane) and highland (montane) evergreen forests.

According to the Tanzania human population census of 2002, these mountains had 419,970 inhabitants with an annual growth rate of 1.8% [22]. The main ethnic groups are Shambaa, Pare, and Mbugu. The Shambaa is the predominant tribe (78% of the population) followed by the Pare (16%). The Mbugu (5%) is the minority [9]. Other small groups are also found in this area accounting for 1% of the population. The Pare, Mbugu, and other tribes are the immigrants to the study area. People's livelihood depends on subsistence farming. The food crops grown are maize, beans, wheat, Irish potatoes, yams, bananas, and cassava, while cash crops include coffee, tea, cardamom, sugarcane, fruits (plums, pears and apples), and vegetables.

Sampling design and data collection

The study covered six villages: Irente, Kwemakame, Viti, Mwangoi, Lwandai-Mlola, and Kiluwai. The selection of the villages was purposive based on the distance from the forest reserves. Three villages—Irente, Kwemakame and Viti—are located adjacent to the Mkussu and Shume-Magamba forest reserves. The other three villages—Mwangoi, Lwandai-Mlola, and Kiluwai—are located far (over 10 km) from the forest reserves. The distance from the forest reserves was assumed to be an important factor that probably influences the use of traditional management practices. Although the

villagers used forest and savanna resources, forests provided over 90% of the medicinal plants. Factors like seasonal variability, among others, have influence on the availability of the plant resources.

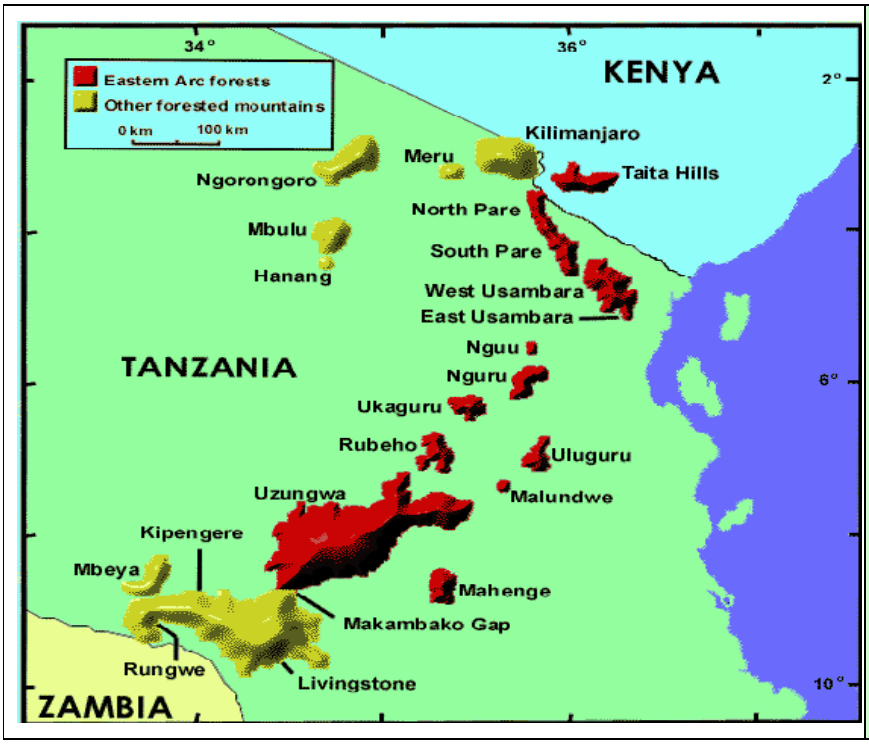

Fig. 1. Location of the West Usambara Mountains within the Eastern Arc Mountains

Data were collected in three phases. Phase 1 involved focus group discussions (FGDs) in which 30 people of different age groups and gender from each sampled village participated. The selection of participants for FGDs was based on the depth of their knowledge of medicinal plants. The identification of these participants was made possible by the assistance of village leaders.

Phase 2 involved semi-structured interviews (SSI) and the structured questionnaire was administered to 173 households. For the purpose of this study, a household was defined as a group of one or more persons living together under the same roof or in several rooms within the same dwelling and eating from the same pot or sharing a common provision of food and other living arrangements. The sample consisted of 25 households from Irente, 38 from Kwemakame, 15 from Viti, 35 from Mwangoi and 30 each from Lwandai-Mlola and Kiluwai villages, at a sampling intensity of 5%. These sample sizes were based on the recommendation by Boyd *et al.* [23] that for a sample to be representative enough it should form at least 5% of the total population. The key informants interviewed (using SSI) included district government officials, village leaders, village elders, ritual leaders, and traditional healers.

Phase 3, which utilized information obtained from the previous phases, involved botanical survey and identification of sacred plants. This was conducted in 13 traditionally protected habitats (sacred forests and cultural forests), 30 burial sites, and domesticated plants on farms and areas around homesteads. The medicinal plants were reported during the key informant interviews, FGDs and in the questionnaire. Three local people in each village and a botanist from the Tanzania Forest Research Institute Herbarium in Lushoto were involved in the identification and marking of medicinal plants. The role of local people was to show the plants which were reported in the above mentioned methods and the botanist assigned the plants by giving them the scientific names. The role of

researchers was to record and count the plants accordingly. One transect was established in each of the 13 traditionally protected habitats. In each transect, one or two plots of 0.1ha were demarcated and all plants found in each plot were identified and medicinal plants delineated. All wild plants found in burial sites, farms, and homesteads were also identified and medicinal plants were marked. Although the botanist was highly skilled and experienced in plant identification, two field guides for identification of tropical plants [24, 25] were used to verify the identified species. Species which could not be identified immediately in the field were pressed using old newspapers and taken to the herbarium for identification by using special taxonomic keys. Participant observation and secondary data collection were undertaken in all phases.

Data analysis

Data collected through FGDs were analyzed qualitatively through content analysis technique and findings formed the basis for better understanding of the study area and the theme under study. Data collected in the second and third phases were analyzed quantitatively by the Statistical Package for Social Science (SPSS) and Microsoft Excel spreadsheet. Chi-square tests were used for comparing people's responses in relation to the distance from the forest reserves.

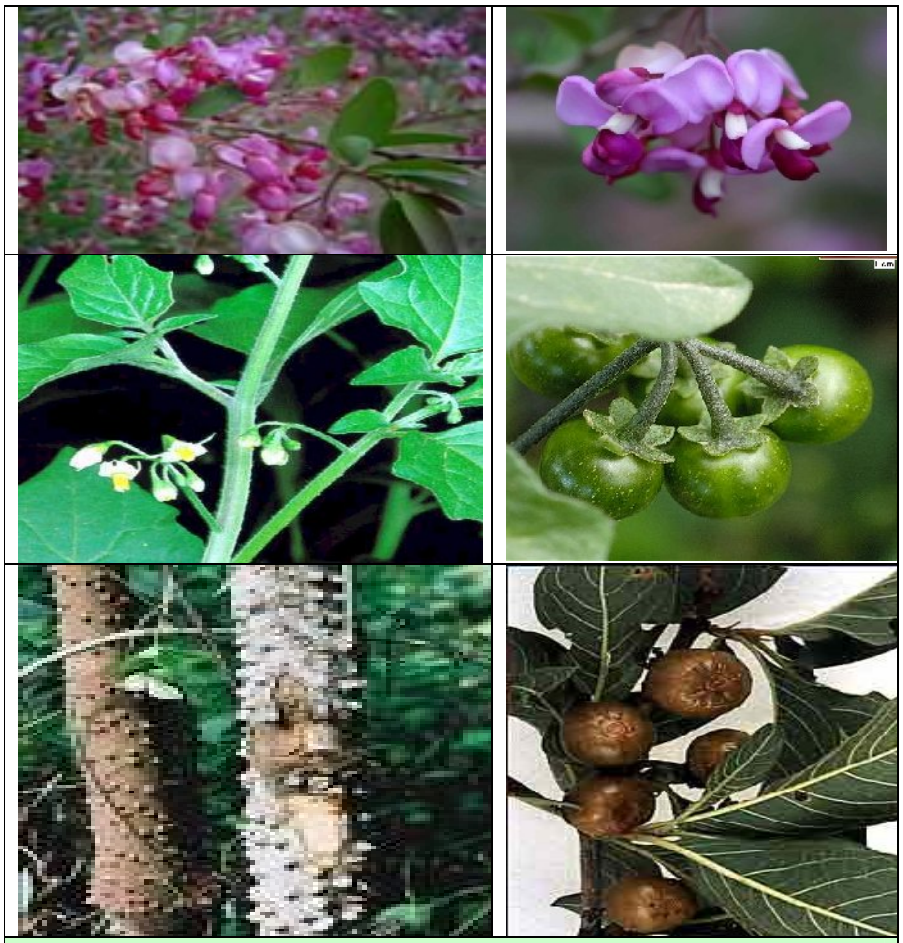

Fig. 2. Medicinal plants found in West Usambara Mountains. Top two: leaves and flowers of *Securidaca longependinculata (*Family Polygalaceae). Middle two: leaves, flowers and fruits of *Solanum nigrum* (Family: Solanaceae). Bottom left*: Zanthoxylum chalybeum* (Family: Rutaceae). Bottom right*: Vangueria infausta* (Family: Rubiaceae).

Results

The study identified some nine traditional practices used to ensure sustainable use and conservation of plant species (Table 1). The proportion of practitioners of these practices is summarized in Table 1. Through botanical surveys, a total of 1,518 wild plants distributed in 100 species were identified. This number came from plants protected through domestication, sacredness of plants and forests, respect to cultural forests, and burial sites, and about 85% had medicinal value (Appendix 1).

Table 1: The traditional plant conservation methods, proportion of practitioners, and the number of species and plants conserved by these methods in six villages of west Usambara Mountains, Tanzania (NQ = Not quantified)

Method	% of Respondents practicing indigenous methods (n = 173)	Total	
		Species	Plants
Selective harvesting of plant parts	32	NQ	NQ
Secrecy on name, location, and use of medicinal plants	23	NQ	NQ
Deadwood collection	56	NQ	NQ
Use of energy-saving traditional stoves	56	NQ	NQ
Domestication of forest plants	89	46	780
Sacredness of plants	70	27	65
Sacred forests	37	20	104
Cultural forests	15	43	381
Protection of plants at the burial sites	31	8	188
Total	-	100*	1518

**The species total to 100 instead of 144 because some appeared in different sites more than once*

Response on whether the traditional management practices had positive impacts on the sustainable use and conservation of medicinal plants is shown in Table 2. Of the 173 respondents, 42% felt that selective harvesting had positive impact. The majority attributed the positive impact to secrecy (82%), plant protection at the burial sites (81%), use of energy-saving traditional stoves (79%), sacredness of plants (74%), and domestication (71%). Only a few respondents attributed conservation of medicinal plants to sacred and cultural forests.

Table 2: Response on the positive impact of traditional methods and practices on sustainable use and conservation of medicinal plants in relation to the distance from the forest reserves in the study area

Method	Response in relation to the distance from Forest Reserves (%)		Mean (%)	χ^2
	Close to reserves (n=78)	Far from reserves (n=95)		
Selective harvesting	53	30	42	6.720**
Secrecy on name, location, and use of medicinal plants	77	87	82	2.096 NS
Domestication	75	67	71	1.768 NS
Deadwood collection	58	32	45	8.620 **
Use of energy-saving traditional stoves	85	73	79	2.476 NS
Sacredness of plants	68	80	74	2.131 NS
Sacred forests	21	55	38	17.368***
Cultural forests	38	3	21	22.282***
Protection of plants at burial sites	75	87	81	2.636NS

*** Means significant at 0.1% level ($P < 0.001$); ** Means significant at 1% level ($P < 0.01$); * Means significant at 5% level ($P < 0.05$); NS Means not significant; n Sample size

Selective harvesting and secrecy on name, location, and use of medicinal plants

For sustainable use of medicinal plants, harvest is targeted to specific parts of the plants in such a way that damage to the plant is avoided. It is believed that the medicine obtained from the eastern and western sides of the tree are more effective than those from southern and northern. This method, commonly practiced for two species—*Albizia* sp and *Erythrina abyssinica* DC—was reported by few respondents as shown in Tables 1 and 2. However, proximity to forest reserves tended to influence the use of this method significantly ($\chi^2 = 6.720$, $P < 0.01$).

Secrecy, a tendency to retain anonymity by a few traditional healers in order to control/regulate access to such resources, featured as an alternative traditional method for conserving medicinal plants. About 82% of the respondents were familiar with the method although only a few practiced it (23%). The method was more popular among villagers who lived far from the reserves than those who lived closer to the reserves, but the difference was insignificant (Table 2).

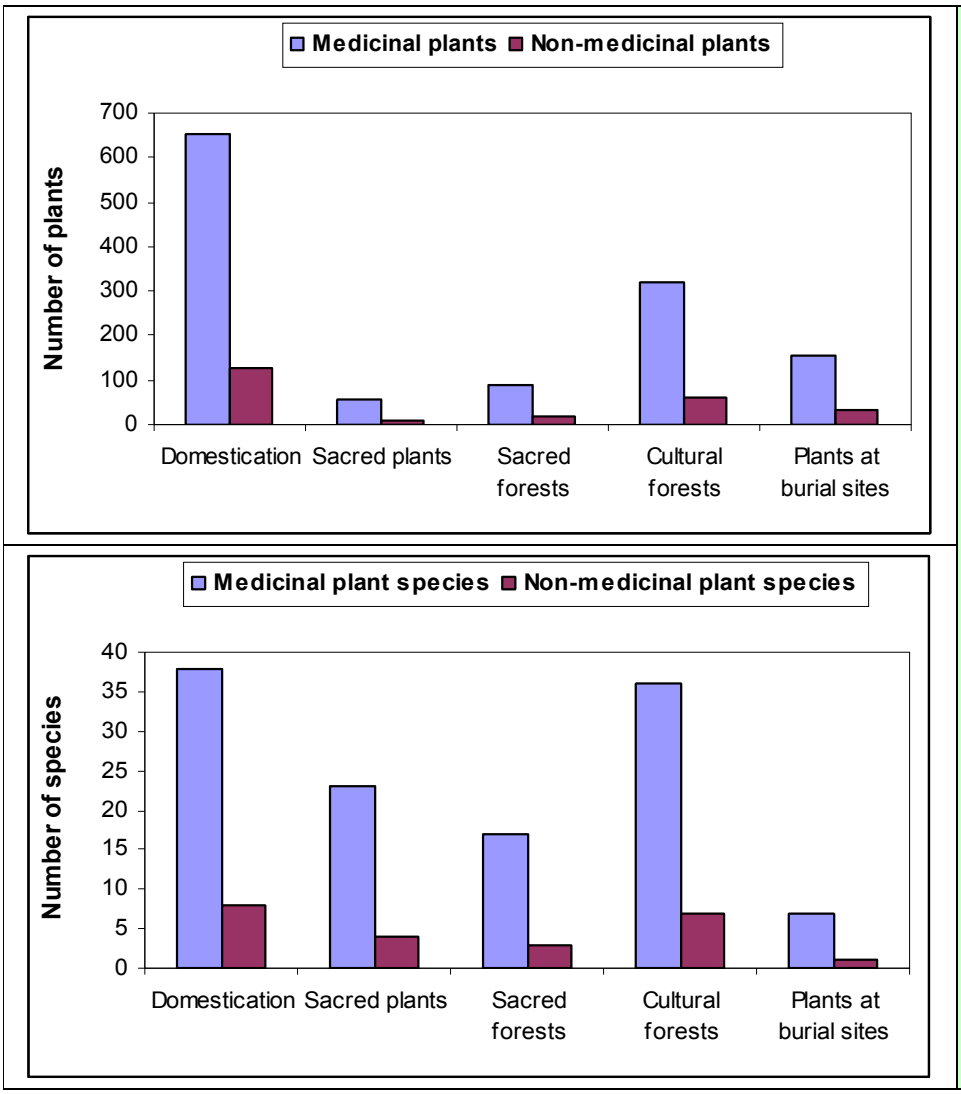

Fig. 3. Comparison of number of medicinal and non-medicinal plants and species conserved through traditional management practices in the West Usambara Mountains, Tanzania

Domestication

Domestication, the practice of retaining plant species of forest origin on the farms during the process of opening up land for cultivation and/or bringing forest plants to the farms or homesteads for the purpose of either reducing the exploitation pressure of wild stocks or protecting threatened plants, had enhanced conservation of 780 plants belonging to 46 species (Table 1). Of these plants, 655 from 35 species (Fig. 3; Appendix 1) had medicinal value. This practice was reported to have positive conservation impact by 71% of respondents (n = 173) (Table 2). The majority of the respondents, 89%, had domesticated wild plants (at least five plants each) on their farms and around their homesteads.

Deadwood collection and use of traditional energy-saving stoves

Collection of dead trees for firewood was also widely practiced. Over half of the respondents reported this practice (Table 1). The positive impact of this practice on conservation was perceived more by villagers bordering the forest reserves than those located far from the reserves, a variation that was significant at the 5% level ($\chi^2 = 8.620$, $P < 0.05$: Table 2). Use of traditional energy-saving stoves—known locally as *Majiko ya Kisambaa* or Shambaa people's cookers (Fig. 4)—was popular among the respondents and many admitted that the practice was environment-friendly and hence had a positive conservation effect (Tables 1 and 2). Although the method was reported more in villages bordering the forest reserves (85%) compared to those located far from the reserves (73%), the difference was not significant (Table 2).

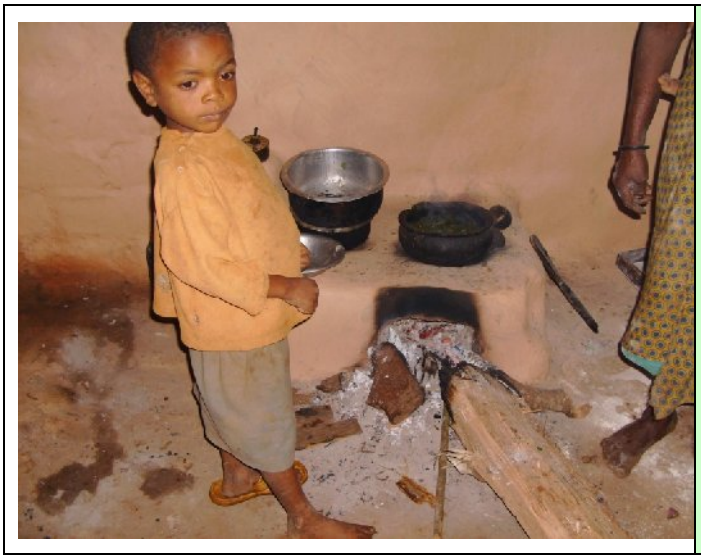

Fig. 4. Use of traditional mud cooking stove with two cooking plates.

Sacred plants and forests, cultural forests and plant protection at burial sites

A total of 65 sacred plants belonging to 27 species were identified in the study area (Table 1). Of these, 55 plants (from 22 species) had medicinal value (Fig. 3, Appendix 1). Discussions with key informants and focus groups revealed that sacred plants were important for: ritual purposes including worshipping; ceremonies such as marriage, childbirth, sacrifice, and circumcision; and meeting places. Examples of sacred trees mentioned to possess some medicinal value were *Ficus sycomorus* L., *F. thorningii*, *E. abyssinica*, and *Bombax rhodognaphalon* K. Schum. About 70% of the respondents had retained at least one plant species each on their farms and around their homesteads due to their sacredness.

The distance from the forest reserves had no significant influence on people's perceptions about the impact of the sacredness of plants and their conservation and sustainable use. The practice, however, was reported more by villagers living far from the reserves than those living closer to these sites (Table 2). As for sacred forests, 104 plants belonging to 20 species were documented from three sacred forests in the study area (Table 1), of which 87 of the plants from 17 species (Figure 3, appendix 1) had medicinal value. Table 2 indicates that this type of traditional practice was more reported to have an impact on conservation and sustainable use in villages located far from the forest reserves than in those bordering the reserves (χ^2 = 17.368, P < 0.001). The impact of cultural forests was cited more by the villagers bordering the forest reserves than by those living far from the reserves (Table 2). Despite their small size (with the area ranging from 0.08 to 0.4 ha) most of these forests harbor a large number of plants (381) and a high diversity of species (43) (Table 1). Results also show that the majority of these plants (320) belong to 36 species that have medicinal value (Fig. 3; Appendix 1).

Likewise, the protection of plants at the burial sites in the study areas was an important practice in the preservation of medicinal plants. For example, seven of the eight species identified from these sites had medicinal value (Table 1; Fig. 3; Appendix 1). This method is practiced by relatively few respondents (Table 1), but many reported that it had a positive impact on conservation and sustainable use of resources (Table 2). In spite of these observations, the distance from the forest reserves had no significant impact on the role played by this method in the conservation of medicinal plants (Table 2).

Discussion

The reliance on the medicinal plants for health care is growing due to several reasons [1- 6]. This reliance, along with the reality that most medicinal plants have multiple uses beyond treatment, subjects them to overexploitation, and consequently to scarcity. The situation is made worse by habitat loss caused by increasing land clearing for agriculture, settlements, and urbanization.

Despite the minimal recognition rendered to traditional management practices by the official conservation policies, local communities have for centuries employed these practices to ensure the survival of a variety of plant species. These practices are motivated by the spiritual, economic, and ecological values of these species, among other factors. Some medicinal plants are conserved intentionally for their medicinal value, others are conserved by coincidence since the motivation for their conservation is not due to their medicinal value, but rather for different purposes (e.g., timber, firewood, shade, or spiritual needs).

The value of selective harvesting as an important strategy of ensuring survival of the medicinal plants in the study area can be attributed to the fact that not all the structural parts (roots, barks or leaves) are removed during collection. Secrecy on name, location, and use of medicinal plants is another useful conservation practice. Although very few people practice it (Table 1), the majority trust and rely on it for enhancing conservation (Table 2). Traditional healers are often considered to be spiritually talented and are, therefore, familiar with many medicinal plant species. Notwithstanding this recognition, their knowledge is barely shared with other people. For example, even when they receive patients, they never expose the species and their locations. The patients receive the ready-made medicines and prescriptions on how to use them. This secrecy partly explains the difficulties faced in the quantification of the number of plants and species conserved. Only some sons or daughters of the traditional healers can inherit and practice the knowledge. On some occasions, a person may acquire knowledge of a particular medicinal plant if he pays a domestic animal (e.g. cow or goat) to a traditional medicine practitioner. There is a belief that sometimes knowledge of a medicinal plant alone may not suffice because the success and efficacy of a particular medicine in curing some ailments depends on who dispenses it. By restricting the knowledge and practice of medicinal plants to a few people, the problem of overexploitation is forestalled. However, it is tricky to ascertain if this is done intentionally as a conservation measure or

for other reasons such as economic ones. Results show that there is a similarity in practicing secrecy by villagers living closer and those located far from the forest reserves. This can be attributed to the nature of traditional healing systems, which can be practiced everywhere regardless of the status of the natural resource.

Being one of the indigenous practices, domestication has played an important role in conserving medicinal plants and has existed in the West Usambara Mountains for over 2,000 years [26]. Domestication is practiced on a small scale (for subsistence use) in the study area compared to the large-scale domestication of single species as exemplified by *Prunus africana* in Cameroon and Madagascar [27].

Results also reveal that collection of deadwood for firewood instead of cutting live trees is more prominent among the villages bordering the forest reserves than those located far away. Probably this is the case because people living close to forest reserves are more aware of and benefit from the practice. In fact this practice is allowed for villagers bordering the West and East Usambara Mountains as an incentive for them to support conservation efforts [28, 29]. The collection of deadwood has generally reduced pressure on trees in the mountains. Customary law prohibits felling of forest trees for firewood. The use is, however, allowed for deadwood [9]. In most African countries, it is generally known that the gathering of deadwood for fuel is a customary user right [30].

The use of traditional two-pot energy-saving stoves (*Majiko ya Kisambaa*) is popular in virtually all study villages. Computation of data obtained through the questionnaire indicated that the use of these stoves has reduced firewood consumption in the study areas from 1.5 to 0.5 head loads (or from 0.045 m^3 to 0.015m^3) per household per day. The above computations are based on information from a key informant from the Ministry of Energy and Minerals, who equated one head-load to 0.03 m^3. Literature has indicated that this traditional practice increases efficiency in terms of firewood consumption by 20 to 24% [31]. The practice, along with deadwood collection, has implications on conservation of medicinal plants, since most of the trees used for firewood also exhibit some medicinal properties.

Few respondents in the study areas are aware of the conservation potential of sacred forests. Such awareness was reported only in two out of six study villages. The two villages, Kiluwai and Mwangoi are located far from the forest reserves. This may explain the positive conservation impact that was perceived more in villages that are located far from the forest reserves compared to those sharing immediate boundaries with the reserves. However, the belief in the sacredness of plant species is widespread in virtually all villages in the West Usambara Mountains, a fact that is also corroborated by other studies [9, 32, 33]. It is, therefore, not surprising to have a large number of people protecting them and acknowledging their positive conservation impact. Sacred plants are important for ritual purposes including worshipping, ceremonies (such as marriage, childbirth, sacrifice, and circumcision), and meeting places. Sacred plants are protected through local by-laws, customs, rites, and taboos. These institutions are associated with power that sustains the entire community [34].

Cultural forests are natural forests found around homesteads, which are not sacred but have other cultural values. These forests are linked mainly to the Mbugu ethnic group residing closer to the forest reserves in the study villages. The sizes of these forests, which were used by this tribe as toilets in the past, range from 0.08 to 0.4 ha. They represent a cultural heritage for this tribe and are therefore highly valued by the tribal members. However, very few respondents (21%) reported the conservation role of these forests, since the Mbugu tribe is a minority accounting for only 5% of the population in the study district [22].

Burial sites are sacred places in their own right and their role in biodiversity conservation is well acknowledged in literature. Furthermore, results from this study reveal that plant protection at the burial sites is one of the highly respected practices. Burial sites are kept under complete shade from planted or naturally regenerating plants, a practice common in other parts of Tanzania and Africa

[13, 17, 18]. Although this practice is not done intentionally for the purpose of conserving medicinal plants, it definitely augments their conservation.

Implications for conservation

As depicted in the results and experience gathered from elsewhere in Africa, traditional management practices have a huge potential in enhancing conservation and sustainable use of natural resources, including medicinal plants (Fig. 5). A high proportion of medicinal plants in the study area depicts an interesting relationship between the conservation of biodiversity and human health. This alone is a compelling reason justifying the need for more conservation efforts, since overexploitation of the plant species and degradation of their habitats will deny rural people of more affordable, available, accessible, and effective health services.

The traditionally protected forests (sacred and cultural forests) seem to harbor a high number of plants and species, most of them with medicinal value. This is not surprising since these places command high respect in many African societies due to the cultural and spiritual role they play as centers of worship, initiation rites, and burial sites for clan heads. These areas are protected through taboos and beliefs. Visits to these areas are often prohibited except with permission from the ritual priests. Furthermore, resource exploitation is not allowed and any removal of plant parts for medicinal purposes requires ritual performance. People's behavior is regulated by the belief that non-compliance with regulations or taboos governing sacred species and places may produce bad omens that can result in outbreaks of disease, deaths, severe droughts, and pests or loss of property [35]. Occasionally, in order to pacify the angered spirits, ritual priests or clan/tribal elders punish culprits caught breaching these taboos/rules or unlawfully using or entering the sacred places. For example, in East Usambara, a fine for cutting a sacred tree involved sacrificing a ram or white/black cock [36]. The sacred value attached to plants, therefore, improves their protection and reduces chances for extinction.

Fig. 5. Top left: a sacred forest in West Usambara from which medicinal plants are extracted. Top right: *Adansonia digitata* one of the sacred plants which is medicinal. Bottom: some of the medicinal plants domesticated around homesteads and a traditional healer displaying plant-based medicines.

There is ample literature acknowledging the role of traditionally protected forests as safe grounds for preserving threatened species including medicinal plants. For example, in Guinea-Bissau, the Bijago people consider the Boloma Bijagos forest as a holy place for ceremonies and initiation rites [37], while in Cameroon Kupe forest [38] has remained intact because of a belief that it is home for ancestors. Boabeng and Fiema societies of Ghana have maintained high plant species diversity in the Boabeng-Fiema monkey sanctuary because the site is a critical habitat for *Colobus polycomos* and *Cercopithecus mona*—primates which are sacred to these societies [18]. The conservation potential of traditionally protected forests is also well documented in Tanzania. For example, in Pare/Ugweno, sacred forests called *Mpungi* or *Mshitu/Mtiru* support more indigenous tropical tree species compared to the government-protected forests. The sacredness of these sites derives from the fact that the skulls and skeletal remains of ancestors were stored here [39 - 41]. The offerings, sacrifices, and initiation rites are also conducted in these sites, although not as frequently as in the past.

The argument that indigenous communities, under pressure of population growth, may overexploit the resources conserved through indigenous methods [42] is envisaged as less likely at the burial sites. These sites can be maintained even under high population pressure and tremendous demand for arable land. This is epitomized by the intactness of burial sites in many places despite the growing threat of encroachment taking place in many areas including some sacred places other than burial sites. Examples include *Mazimbo* (sacred groves) of central Tanzania and the Sankoantovo forest of Madagascar. The former are ritual and burial sites for chiefs among the Nyamwezi tribe [13], while the latter is a burial site for Mahafaly and Tandroy communities' ancestors [15].

Selective harvesting, secrecy, and use of energy-saving stoves regulate the use of and reduce pressure on resources. The fact that people practice and know the positive impact of these practices provides a degree of sanguinity for the survival of natural resources despite the growing challenges associated with human population growth, poverty, modernization, and other global economic pressures. This remains a fact to reckon with despite the disputes resulting from misconceptions among some conventional conservationists that local communities are potential threats to natural resources.

The reality that the traditional management practices exist and enhance conservation implies that the *protectionist model*, which prohibits access to resources by local communities in protected areas, is sometimes uncalled for. There is no point of prohibiting use of natural resources if that use is harmless to a resource. It is arguable that knowledge and the practice resulting from traditional management systems by local communities conform well to the philosophy of co-management, which advocates for sharing of power, responsibilities, rights, and duties between the state and local resource users [43]. The government and its agencies can, therefore, capitalize on this to implement the co-management approach which is a fast-growing policy throughout Africa.

As indicated in the results, most of the traditional management practices occur outside the government-protected areas, in such places as burial sites, farms, around homesteads, and in sacred and cultural forests. The conservationists could, therefore, consider these areas as alternative and ideal places for *in situ* conservation of biodiversity. Essentially, cultural forests and other forests around homesteads can be equated to a refuge camp for plants threatened in their natural habitats. Cultural forests have also acted as a sign for identifying certain ethnic groups in a given area. For example, they have been used as a sign for identification of the Mbugu tribe inhabiting this study area.

The great value that local communities attach to traditional management practices is an opportunity for conservation. The traditional management practices can complement the economic incentives that are currently pursued by the conservation policies as a motivation factor for people to refrain from actions that are destructive to resources. Policy interventions that will consider cultural and spiritual value of resources and habitats are more likely to succeed. This is exemplified by the Bagisu

communities bordering Mount Elgon National Park in Uganda. Their cultural and spiritual affiliation to a smoked bamboo (*Arundinaria alpina*) made them place access to these species at the top of the benefits that they would wish the park to support. Bamboo is a critical resource because its shoots are required during the biennial circumcision ceremonies — powerful spiritual events [44, 45]. Furthermore, official recognition of the traditional management practices can help undo the perceived notion, which was instilled by the colonial system among the local people, that nature belongs to the white man [46].

Despite all the potentials that can be realized from traditional management practices, there has been minimal recognition in the official conservation policies. It is, therefore, imperative for this policy flaw to be addressed so that the practices can complement the contemporary conservation efforts and help bridge the gap left by western health services.

Conclusion and recommendations

Traditional management practices have an immense contribution to conservation of the medicinal plants and other resources. Although the objective of traditional management practices may not necessarily be conservation of medicinal plants, the fact that most of these plants have medicinal value makes them automatically conserved. Given the high proportion of medicinal plants observed in the study area, it is logical to conclude that any conservation strategy has a direct connection to the improvement of human health, particularly for rural communities that have limited access to modern health facilities. These practices should, therefore, be promoted, since their role in conservation and ensuring sustainable utilization of plant species have positive impact in enhancing the primary health care. In line with this argument, it is imperative for natural resources management and health sectors to collaborate in research works that will generate sufficient information to guide the application of traditional practices in enhancing conservation of medicinal plants. Essentially, traditional management practices should be one of the priority areas for research. Adequate recognition from the policy level, something which has been lacking in the past decades, is extremely important. However, use of traditional management systems should not be construed as a panacea for mitigating the existing conservation problems. It should complement rather than substitute for the current state conservation strategies. Furthermore, efforts demonstrated by the local people through traditional management practices should be honored and supported. For example, domestication can be supported by establishing a seed bank and nursery for these seedlings. Where feasible, as a way of valuing their contribution in primary health care and inspiring local support to conservation efforts, traditional healing systems can be integrated with modern (western) systems. The communities should be supported to secure markets for traditional medicines in order to increase the value of the medicinal plants and, therefore, inspire their conservation. However, precaution is required to ensure that the guaranteed market will not lead to overexploitation, rather than conservation of the species. Another important point worth noting is that West Usambara, where this study was conducted, is just one case demonstrating the contribution of traditional management practices in the conservation of bio-resources. Similar or different management practices are found in other parts of Tanzania and Africa, but are seldom documented and hence poorly recognized. This study, therefore, should serve as an entry point and a prototype for further research in order to document more practices and their potential as viable strategies of achieving conservation and development goals. The information that will be generated by these researches will be very useful to policy-makers, conservationists, health practitioners and other conservation and development stakeholders.

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Appendix 1: A list of identified plant species protected through traditional practices (x = presence of a species; y = medicinal; n = not medicinal)

Species name	Domesticated	Sacred plants	Sacred forests	Cultural forests	Burial sites	Medicinal? (y/n)
1. *Acacia nilotica*	x	x		x		n
2. *Adansonia digitata*	x	x				y
3. *Adenia cissampeloides*	x					y
4. *Albizia gummifera*	x					y
5. *Albizia petersiana*		x				y
6. *Albizia schimperana*	x					y
7. *Artemisia afra*	x					y
8. *Asparagus setaceus*			x			y
9. *Aspilia mossambicensis*			x			y
10. *Basella alba*	x			x		y
11. *Bersama abyssinica*						y
12. *Bidens pilosa*			x			y
13. *Bombax rhodognaphalon*		x				y
14. *Bridelia micrantha*	x	x				y
15. *Bothriocline tomentosa*					x	y
16. *Catha edulis*	x			x		y
17. *Caesalpinia volkensii*			x			y
18. *Cissampelos pareira*				x		y
19. *Clausena anisata*				x		y
20. *Clerodendrum myricoides*	x					y
21. *Clerodendrum rotundifolium*				x		y
22. *Combretum molle*	x					n
23. *Commelina benghalensis*			x			y
24. *Commelina latifolia*	x	x	x			y
25. *Conyza newii*			x			y
26. *Commiphora eminii*	x					y
27. *Cordia Africana*	x	x				n
28. *Cussonia arborea*		x	x	x		y
29. *Dalbergia melanoxylon*	x					y
30. *Deinbollia borbonica*		x	x	x		y
31. *Dodonaea angustifolia*	x					y
32. *Dombeya rotundifolia*	x			x		y
33. *Dracaena usambarensis*					x	n
34. *Ehretia cymosa*	x			x		y
35. *Erythrina abyssinica*	x	x		x		y
36. *Euclea divinorum*	x			x		y
37. *Ficus natalensis*		x				y
38. *Ficus sycomorus*	x	x		x		y
39. *Ficus thorningii*	x	x		x		y
40. *Grewia forbesii*	x	x		x		n
41. *Grewia similis*	x					y
42. *Harrisonia abyssinica*	x					y
43. *Hibiscus fuscus*	x					y
44. *Hoslundia opposite*			x			y
45. *Jasticia engleriana*	x				x	y
46. *Juniperus procera*	x	x		x		n
47. *Justicia striata*				x		y
48. *Landlolphia kirkii*		x				y
49. *Kalanchoe glaberrima*				x		y

50. Lippia ukambensis			x			n
51. Lonchocarpus capassa	x					y
52. Maesa lanceolata				x		y
53. Manilkara discolour	x			x		n
54. Markhamia lutea	x					y
55. Microglossa densiflora	x					y
56. Microglossa oblongifolia	x			x		y
57. Milicia excels	x	x				n
58. Myrica salicifolia			x	x		y
59. Mystroxylon aethiopicum	x			x		n
60. Newtonia buchananii	x					y
61. Ocimum suave				x		y
62. Ocotea usambarensis				x		y
63. Olea europaea		x		x		y
64. Osyris lanceolata				x		y
65. Ozoroa insignis			x	x		y
66. Parinari excelsa	x					y
67. Plectranthus barbatus	x			x	x	y
68. Prunus Africana	x					y
69. Ptaeroxylon obliquum	x		x			y
70. Pycnostachys umbrosa					x	y
71. Rauvolfia cafra	x			x		y
72. Rhoicissus tridentate					x	y
73. Ritchiea albersii				x		y
74. Rumex usambarensis				x		y
75. Securidaca longependinculata				x		y
76. Sclerocarya birrea	x					n
77. Senna didymobotrya		x		x		y
78. Sida acuta				x		n
79. Senna singueana	x	x				y
80. Smilar krausiana				x		y
81. Solanecio angulatus			x			y
82. Solanum anguivi				x		y
83. Solanum nigrum	x					y
84. Spirostachys africana	x			x		n
85. Stereospermum kunthiamum	x					y
86. Syzygium cordatum		x	x			y
87. Syzygium guinensee		x				y
88. Tamarindus indica	x	x				y
89. Telfairia pedata	x					y
90. Tetradenia riparia				x	x	y
91. Toddalia asiatica				x		y
92. Trema orientalis		x	x			y
93. Trimeria grandfora				x		y
94. Turraea robusta	x			x		y
95. Uvaria acuminate		x				y
96. Vangueria infausta	x		x			n
97. Vernonia iodocalyx				x		y
98. Vernonia myriantha					x	y
99. Zanthoxylum chalybeum			x			y
100. Zehneria scarbra			x			n