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UTILIZATION OF MEDICINAL PLANTS BY WALUGURU PEOPLE IN EAST ULUGURU MOUNTAINS TANZANIA

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Abstract

A study was done to assess utilization of medicinal plants in Nyachilo village situated in eastern Uluguru Mountains, Tanzania. Semi-structured questionnaires were administered and informal discussions conducted to traditional healers and midwives. The respondents were selected from Changa, Mselelo, Tanana, Mitamba, Kimeza, Mandani and Kibundi subvillages. Within the subvillages random sampling was used to determine the number of respondents to be interviewed. The study found that plant medicines utilized in the area can be categorized into groups for treating convulsion, pain killers, rituals and casting evil spirits, treating diseases, relieving respiratory complications, and treating skin eruptions. Many medicinal plants are collected from the forests (37.3%) and farms (37.3%). However, 16.4 % of the medicinal plants are not easily accessible. The community perceives modern medical system far advanced in comparison with traditional healing system. Both systems however, are useful in their sights. The study also revealed that in most medicinal plants, leaves are used as medicines (31.7%), followed by roots (29.6%), then barks (20.7%). The community proposed that in order to sustain conservation of medicinal plants, the traditional healers should be trained on appropriate harvesting and utilization techniques of the medicines. It is recommended that appropriate agronomic techniques that will ensure cultivation of medicinal plants should be taught to the community so as to guarantee sustainable utilization in future.

Key words: medicinal plants, traditional healers, midwives, diseases, sustainable utilization

Introduction

According to World Health Organization (WHO) up to 80% of the world's population, mostly in developing countries, depend mainly on traditional medicines for their primary health care needs. Traditional healers and medicines play an important role in

the health of millions of people (Debie LeBeau, 1998). The greater dependency on traditional medicines in developing countries is due to easy access and cheap cost of traditional medicines compared with the modern ones (GTZ, 2001).

In Africa, one of the developing countries regions, the traditional medicines have been used for many years (Hirt and M'Pia, 1995). Many African countries have rich medicinal plants resources. Tanzania, for example, has almost 11000 plant species and over thousands of them are used for human and veterinary medicines (Pergola, 2003). Medicinal plants have been a reliable source of both preventive and curative medicines (Dery et al, 1999) and have been a reliable source of raw materials to modern medicinal industries (Lambert et al, 1997). Contribution of medicinal plants to human health is now widely appreciated and understood, and a demand for many species is growing thereby endangering many important medicinal plant species (Leeman et al, 1999).

Problem statement and justification

Lack of modern health care services such as dispensary and clinical units in Nyachilo village, situated in Eastern Uluguru Mountains, makes the community highly depend on traditional medicines for primary health care for many years now. Plant medicines are harvested from forests, farms, wetlands and home-garden to cater for medicinal products demands. Traditional medicine is the closest medicine to the rural community in the village because a dispensary is located about 7.5 km away from the village.

The higher dependency on the traditional medicines can have a direct impact, positive or negative, on medicinal plants and forest resources in general as well as to the community both within and outside the study area. It may lead to over-exploitation and even extinct of the utilized resources if they are not been exploited in a sustainable way. Besides, since the ecological resources are interdependent, over-exploitation of some species can result into imbalanced and improper functioning of other resources. On the other way, if the community has rich ethnobotanical knowledge accumulated over a long time of use and dependence on medicinal plants, such knowledge can be collected, documented and disseminated to other communities, thereby obtaining for similar complications in a raw form or as industrialized products.

This study aimed at assessing and documenting utilization practices of the medicinal resources by Waluguru ethnic group in Nyachilo village situated on eastern Uluguru Mountains so that to uncover ethnobotanic knowledge in the area and recommend strategies for sustainable utilization, based on the existing situations, especially where danger of depletion of the resources under question was evidenced. Specifically, the study aimed at identifying medicinal plants utilized and diseases they cure, identify collection sites for medicinal plants in the study area, determine medicinal organs harvested and their mode of preparation, determine community's perception of traditional healing in comparison with modern medication system, and find out the community perspectives on sustainable utilization of medicinal plants. Based on the findings of this study, priorities could be assigned to conserve the most endangered plants.

Materials and methods

The study was conducted in Nyachilo village situated in eastern Uluguru Mountains. The Uluguru Mountains stretch between 06°51' and 07°12' south and between 37°36' and 37°45' east and form one of the component blocks of Eastern Arc Mountains of Kenya and Tanzania (Lovett, 1988; Lovett, 1990). The area is inhabited by the Waluguru people.

Purposive sampling was used where traditional healers and midwives from Changa, Mitamba, Tanana, Mselelo, Kimeza, Mandani and Kibundi subvillages were interviewed using semi-structured questionnaires and informal discussions. Random sampling design was used to select traditional healers and midwives in the sub-villages for the purpose of obtaining the number of persons to be interviewed in each subvillage visited. Sampling was done in such a way that sampling fraction was greater or equal to 5% (Boyd et al., 1981). A total of 10 midwives and 40 traditional healers, making a total of 50 respondents, were interviewed. Ethnographic methods were employed which involved observation of plants in their natural habitats and discussing their distribution, use and importance with members of the community who had a long history and closest interaction with resources.

The actual data collection was preceded by a preliminary survey to determine total number of sample sub-villages and households required based on variability of the area. Information on plant medicines including vernacular names was collected from traditional healers and midwives. Later on, the plants were scientifically identified using the books according to Mbuya et al (1984) and Ruffo et al (2002).

Data analysis

The data collected through semi-structured questionnaires were coded to facilitate data entry in the computer. The data pertaining to type of plants used for medicinal including their vernacular names, scientific names, and collection sites were tabulated into meaningful patterns. Information collected through informal discussions were synthesized and summarized into meaningful units. Data analysis for coded information was done using the Statistical Package for Social Science (SPSS) computer programme. Descriptive statistics such as frequencies, in percentages, were computed.

Results

Medicinal plants utilized in the study area

Medicinal plants utilized in the study area are presented in Tables 1 to 7 in their vernacular and scientific names (except for some few whose scientific names could not be identified). The Tables summarize information on sites the plants were collected from, diseases cured, mode of preparation and parts harvested as well as their current status. The medicinal plants are categorized into groups for treating convulsion (21%), for rituals and casting evil spirits (6.5%), diseases and trauma of digestive system (37.1%), respiratory problems (12.9%), skin eruptions (3.2%), relieving pains (21%), and urogenital diseases (14.5%).

Key for Tables 1 to 7 below:

i) Plant kind	ii) Part harvested	iii) Collection	iv) Accessibility	v) Scientific name
T = Tree	L = Leaf	F = Forest	D = Difficult	NI = could not be identified
C = Climber	R = Root	Fa = Farm	E = Easy	
Hb = Herb	B = Bark	W = Wetland	M = Moderate	
S = Shrub		H = Home garden		

Table 1: Medicinal plants which treat convulsion

Luguru name	Scientific name	Plant kind	Part used	Preparation	Source	Accessi-bility
Chidusa	NI	Hb	L	Burn in the fire then breath in smoke	Fa	D
Kibandagala Ruhunduhundu Runganyuki	<i>Memordica foetica</i>	C C Hb	L L R	Crushed together and juice prepared	Fa, H	E
Kinamatira Ruhunduhundu Runganyuki	<i>Memordica foetica</i>	Hb C Hb	L L R	Crushed together and juice prepared	Fa, F	E
Lagasa/Fifi	<i>Rubus pinnatus</i>	T	R	Boil and drink	W	E
Mazelu		C	R	Boil and drink	F	M
Mkuyu	<i>Ficus sycomorus</i>	T	L, R, B	Roots and bark boiled, leaf chewed raw		
Msada	<i>Vangueria infaustia</i>	T	R, L	Boil and drink	F, Fa	M
Msagalala	<i>Veronica abyssinica</i>	Hb	L	Dry and crush	H	D

Table 2: Medicinal plants for rituals and casting evil spirits

Luguru name	Scientific name	Plant kind	Diseases treated	Part used	Preparation	Source	Accessi-bility
Mkangazi	<i>Khaya anthotheca</i>	T	Evil spirits	B	Boiling then drink	F	D
Mlawila	NI	T	Rituals	B	Its rope tied in spherical pattern then pray	F	D
Moza	<i>Allophylus abyssinicus</i>	Hb	Evil spirits	L	Rub between palms, add water then drink	F, Fa	E
Tindimka	<i>Crassocephalum spp</i>	Hb	Evil spirits	L	Crush the leaves, mix with water then drink	H	E

Table 3: Medicinal plants for relieving pains

Luguru name	Scientific name	Plant kind	Diseases treated	Part used	Preparation	Source	Accessibility
Kisasu	<i>Dissotis rotundifolia</i>	C	Toothache	L	Chew and rinse	Fa	E
Mavumbula	NI	T	Fever	R	Boil and drink	F	M
Mnyunya		T	Cramp	R	Boil and drink	F	M
Msada	<i>Vangueria infaustia</i>	T	Fever	R, L	Boil and drink	F, Fa	M
Mseli	<i>Ocotea usambarensis</i>	T	Headache	B, L, R	Dry and crush the root, boil the leaf and bark	F	E
Mtomokwe	<i>Annona senegalensis</i>	T	General body pains	B, L	Boil and drink	F, Fa	M
Muarobaini	<i>Azadirachta indica</i>	T	Toothache	R, L	Boil root and leaves together	Fa	D
Mvumbasi	NI	S	Toothache, joint pain and tiresome	L	Boil and drink	F, Fa	E
Mzekozeko	<i>Hoslundia opposita</i>	T	Swollen limbs	B	Dry and crush the bark then cut through a swollen limb using a razorblade and introduce the dust	F	D
Nung'anung'a	<i>Ocimum suave</i>	IIb	General body pains	L	Boil then soak a cloth and press over the body	F	E
Nyangudi/Nyaweza	<i>Bidens pilosa</i>	IIb	Arthritis Wounds	L, L	Boiling Crush and apply over the wound	H, Fa	E
Mnyemba	<i>Ricinus communis</i>	T	Headache, Dizziness	R, L	Boiling	Fa	M

Table 4: Medicinal plants for treating respiratory diseases

Luguru name	Scientific name	Plant kind	Diseases treated	Part used	Preparation	Source	Accessibility
Mgama	<i>Mimusops abtusifolia</i>	T	Pneumonia	B	Boil and drink	F	E
Mnguti	<i>Maesa lanceolata</i>	T	Pneumonia	B, R	Boil and drink	F	E
Msembe		T	Pneumonia	B	Boil and drink	F	E
Msunguti	<i>Kigelia africana</i>	T	Pneumonia	B, R	Boil and drink	F	E
Msada	<i>Vangueria infaustia</i>	T	Pneumonia	R, L	Boil and drink	F, Fa	M
Mvumbasi		S	Cough	L	Boil and drink	F, Fa	E
Mnyemba	<i>Ricinus communis</i>	IIb	Cough	R, L	Boil and drink	Fa	M
Tangawizi	<i>Zingiber officinale</i>	IIb	Cough	R	Press, add salt then drink	Fa	M

Table 5: Medicinal plants for treating urogenital diseases

Luguru name	Scientific name	Plant kind	Diseases treated	Part used	Preparation	Source	Accessibility
Kumwambuko	NI	T	Bilharzia, STDs	B	Boil then drink	F	D
Mgama	<i>Mimusops obtusifolia</i>	T	Bilharzia	B	Boil and drink	F	E
Mkulagembe	<i>Rhus vulgaris</i>	T	Bilharzia	R, L, B	Boil the roots and bark, add salt, dry the leaves then crush to get dust	Fa	E
Mkunde	<i>Senna petersiana</i>	T	Bilharzia	R, L	Boil then drink	Fa, H	E
Mnyalanyala	NI	Hb	Bilharzia	R	Boil then drink	F, Fa	E
Msumba	NI	T	Bilharzia	R	Boil then drink	F	E
Mzagozago Mchicha mwekundu	NI	Hb	Bilharzia	R, L	Leaves mixed and crushed to make juice. Roots are boiled	Fa	E
Nyaweza	<i>Bidens pilosa</i>	Hb	Bleeding in women after giving birth	L	Boil and give to the patient to eat as vegetable	H	E

Table 6: Medicinal plants for treating skin eruptions

Luguru name	Scientific name	Plant kind	Diseases treated	Part used	Preparation	Source	Accessibility
Chavi	NI	C	Body itching	B	Crush and boil then drink	F	D
Mwiza	<i>Bridelia micrantha</i>	T	Skin eruption	R	Boil then drink	F	D

From the Tables above it can generally be observed that most medicinal products are collected from natural forests (37.3%) and farms (37.3%), followed by those collected from both natural forests and farms (11.3%) and those collected from home-garden (6.3%). Few products are collected from both forest and home-garden (2.1%). Water is used as medium where boiling was the preparatory method, and for some diseases (e.g. Table 1, rows 2 and 3) more than one plants were used jointly to treat the same disease. The information on sources for plant medicines is summarized in Figure 1.

About 34% of medicinal plants are easily accessed, 12.8% moderately accessed and 16.4% are difficult to obtain. Moreover, for most of medicinal plants (31.7%), leaves are used as medicines: followed by roots (29.6%) and barks (20.7%). For some plants, more than one plant part can be harvested for medicinal purposes (Figure 2).

Table7: Medicinal plants for treating diseases and trauma of the digestive system

Luguru name	Scientific name	Plant kind	Diseases treated	Part used	Preparation	Source	Accessibility
Luzuwana	<i>Landolphia buechananii</i>	C	Hernia	B	Boil then drink	F	M
Mavumbula		T	Stomachache	R	Boil and drink	F	M
Chibelubelu	<i>Chassalia pavifolia</i>	T	Stomachache Diarrhea	R	Boil and drink	F	D
Mdugutusungu	<i>Vernonia hymenolepis</i>	S	Stomachache	L	Dry the leaves and grind and apply the dust in water, stir up then drink or make juice then drink	H	E
Mhangehenge	<i>Dodonaea viscosa</i>	T	Hernia	R	Chew raw or boil and drink	Fa	M
Mjarabu	NI	T	Diarrhea, vomiting	R, L	Boil roots and leaves	Fa	E
Mkenge	<i>Albizia lebbek</i>	T	Stomachache	R, L	Boil and drink	F, Fa	E
Mkulagembe	<i>Rhus vulgaris</i>	T	Dysentery	R, L, B	Boil the roots and bark, add salt; dry leaves and crush to get dust add in tea	Fa	E
Mlengol-Engo	<i>Tabernaemontana pachysiphon</i>	T	Stomachache	B, R	Boil root and bark then drink	F	E
Mnyunya		T	Stomachache	R	Boil	F	M
Mpera	<i>Psidium guajava</i>	T	Diarrhea	R, L	Crush and add water	F	E
Msada	<i>Vangueria infaustica</i>	T	Hernia, Dysentery	R, L	Boil then drink	F, Fa	M
Msegelo	NI	IIb	Diarrhea, vomiting	L	Crush and press the leaves to get juice	Fa	E
Msewe	<i>Brachystegia speciformis</i>	T	Hernia	R	Boil then drink	F	M
Mtomokwe	<i>Annona senegalensis</i>	T	Stomachache, Dysentery	B, L	Boil then drink	F, Fa	M
Muarobaini	<i>Azadirachta indica</i>	T	Stomachache, Toothache	R, L	Boil roots and leaves together then drink	Fa	D
Mugegeba	<i>Toddalia asiatica</i>	C	Stomachache	R	Crush the roots and mix with cold water, stir up then drink	F	E
Mvumbasi	NI	S	Stomachache	L	Boil then drink	F, Fa	E
Nyungu nyupe	NI	T	Stomachache	L	Boil, soak a cloth in boiled liquid and press over the stomach	F	E
Rwengele	<i>Cyphostemma adenocaula</i>	C	Stomachache	B	Boil then drink	Fa, F	E
Sungumilu	<i>Vernonia hymenolepis</i>	S	Stomachache	R	Boil and drink	Fa, H	E
Tangawizi	<i>Zingiber officinale</i>	II	Hernia	R	Press, add salt then drink	Fa	E
Mubala-wala	NI	T	Worms	B	Boil and drink	F	M

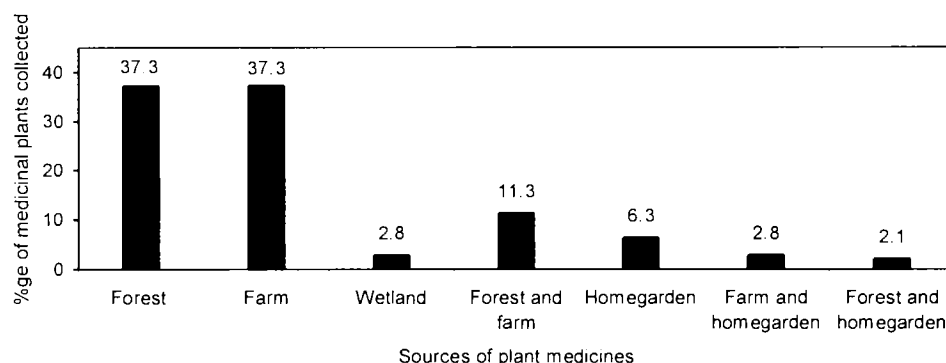


Figure 1: Percentages of medicinal plants according to plant part harvested

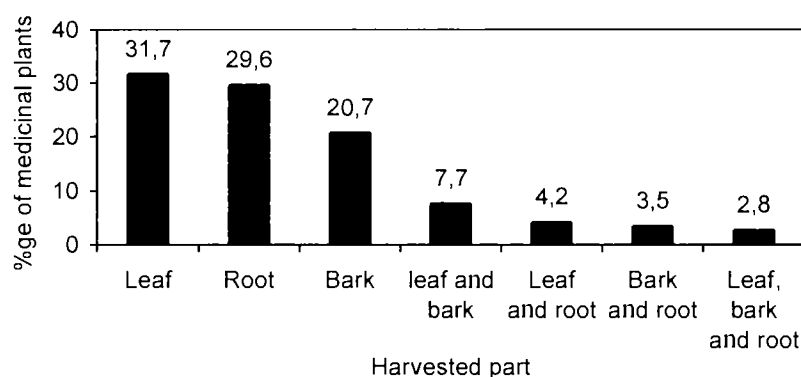


Figure 2. Plant parts harvested for medicinal purposes

Some medicinal plants are used for rituals and casting evil spirits. *Khaya anthotheca*, *Allophylus abyssinicus* and *Crassocephalum spp.* are used for the former while *Mlawila* is used for the latter (Table 2). According to the respondents, evil spirits are common in the area and are mostly related to superstition. If someone is struck by evil spirits, the bark of *K. anthotheca* and leaves of *A. abyssinicus* and *Crassocephalum spp* are collected and prepared in combination or separately, then the victim drinks the medicine and the spirits are cast away. Similarly, traditional beliefs and functions are strongly respected in the society. A tree species which was locally identified as *Mlawila* is used during initiation ceremonies and rituals such as praying for rainfall after prolonged dry seasons. A rope is peeled from the stem and tied in a spherical fashion then a prayer team comes around it and prays for a specific issue.

Community's perception of the traditional healing

Usefulness, availability and legacy

The community perceives traditional healing as their important, useful and readily available primary health care. Both traditional medicines and healers are in the proximity of the

community at any period of time. Practices of traditional healing are also perceived as a way of perpetuating the past indigenous healing knowledge. However, on the legacy, informants commented that some traditional healers hesitate to pass on their knowledge to their descendants in fear of competing for clients which would lower their income. Ultimately, the healers die without passing the knowledge to their descendants. On the other side however, some youth, especially those who out-migrate to towns in search of jobs, do not wish to inherit traditional healing knowledge from their parents as they regard it outdated.

Treatment cost

The respondents uncovered that they normally charge Tsh 2,000 to 3,000 for treating all diseases except situations like asthma, arthritis and lung complications which could not even be cured in modern medical clinics, where Tsh 35,000 to 40,000 can be charged due to long duration taken to treat a patient under such situations. The charge can be paid in installments, either in money form or in kind. Usually, some advance is paid before a patient receives treatment and the remaining would be paid after the patient has recovered. In the dispensary that is situated about 7.5 km from the study area, a patient has to pay Tsh 1,000 regardless of disease he suffers from. However, the informants remarked that though the charge at the dispensary is relatively lower, there is neither a room for paying in installments nor in kind.

Equipment available for the healers

The informants said they wrap the medicines on papers, banana leaves and/or pack it in bottles picked from the fields and around homestead areas, and that this is a primitive way of storing medicine compared to the modern medical system where advanced equipment like refrigerators are used for medicine storage. They perceive that the medicine stored in this way can not be suitable for long. Additionally, they do not have ways of judging whether that medicine has expired or not. They also added that when a patient comes they don't have equipments to confirm his/her sickness but start prescription just based on the patient's description. The situation is different for modern medical system where equipment such as thermometers and x-rays can be used to confirm the sickness.

Training of the healers

This study also realizes that traditional healers perceived their knowledge as based on legacy because most of them have never attended schools. It was uncovered that 10% of respondents had achieved standard four while the rest (90%) did not attend school at all. The respondents think that lack of education can be an obstacle towards sustainable utilization of medicinal plants in their vicinity, and that training on sustainable ways of harvesting the medicinal resources could be useful tool to them.

Community's perspectives regarding sustainable utilization of medicinal plants

It was noted that 93.8% of respondents did not have or know any methods/ways of conserving medicinal plants while 6.2% said they harvest some greater amounts and those which

can be stored through drying are stored for future use. They in this context do not go to the forests to collect the medicine for sometimes, thereby allowing natural regeneration of the medicinal plants to occur. However, 81.2% of interviewed traditional healers said the use and conservation of medicinal plants could be improved through training of traditional healers on sustainable harvesting and conservation techniques since most of them have inherited the knowledge without a clear understanding of proper management and utilizations procedures. On the other hand, 18.8% of the respondents said research could improve sustainable utilization of medicinal plant resources (Figure 3).

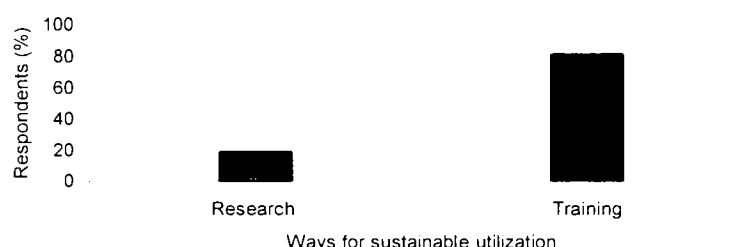


Figure 3: Ways for sustainable utilization of medicinal plant resources

Discussion

The higher importance of traditional healing in the sight of rural people in the study area is due to reliable accessibility and supply of traditional medicines, and unavailability of modern health care in the village. Besides, another good quality is the possibility to pay in kind and installments. This situation is similar to that reported by Goldman et al (2000) that traditional curers would accept payments in kind, credit and installment if the patients could not pay. According to (Weller et al., 1997) the need to pay health care in cash at the time it is provided is a major obstacle to seeking care for many families in rural areas in developing countries. Nevertheless, the current hesitation of some traditional healers to pass on their knowledge to their offsprings as well as despise of traditional healing by youth, especially with increasing out-migration to urban areas, can render most traditional knowledge unavailable for the future generations

Despite higher dependency on traditional healing by rural clients, there is much to be examined for efficacy and safety of the medicine to consumers. For example for all traditional healers surveyed preparation of plant medicines through boiling is not clearly stated because it doesn't specify the standardized water-medicine ratios. There were variations amongst traditional healers on water-medicines ratio ranging from half a cup to two cups in preparation of same medicine and even the sizes of cups differed significantly. Also in some instances two or more plants are used jointly but the respondents could not clearly explain the reasons. According to Igoli et al (1999) the joint use of multiple medicinal plants could be due to historical observation of synergistic or additive effects of constituents. Besides, for all plant medicines standard dosage were not established among the healers. There is therefore a danger of either overdosing or under-dosing the patients and this could be critically dangerous to consumers.

Since many medicinal products were harvested from the forests through barks (20.7%) and roots (29.6%), and large percentage of traditional curers did not know sustainable utilization methods there is a possible danger of killing and depleting those plants if training on sustainable utilization is not given to traditional healers and midwives. According to Musila et al (2004), outstanding harvest of roots and barks indicate that survival of species from which those parts are harvested is greatly endangered. Already medicinal plants namely *Mlawila* (Luguru name), *veronica abyssinica*, *Khaya anthotheca*, *Chassalia paviifolia*, Chavi and Chidusa (Luguru names) have shown signs of disappearance. However, the disappearance of some of these plants e.g. *Khaya anthotheca* is not exclusively due to medicinal exploitation but also because they are highly demanded for their timber (Mattee et al, 2005). So before planning any solution for improved and sustainable utilization of traditional medicines it is imperative to look at the problem from multidimensional angles.

Conclusion

- Medicinal plants are used for treating convulsion, pains, diseases and trauma of the digestive system, respiratory diseases, urogenital diseases, skin eruptions, and for rituals and casting evil spirits
- Most medicinal plants are collected from natural forests (37.3%) and farms (37.3%).
- About 54% of utilized medicinal plants are accessible, 23% moderately accessible but 23% are difficult to obtain.
- Traditional medicines are used as a primary health care because they are easily accessed and the lack of a dispensary in the proximity of the village.
- Most traditional medicines are harvested in form of leaves (31.7%), followed by roots (29.6%) and bark (20.7%).

Recommendations

It is imperative to identify priority medicinal plants, on the basis of their accessibility, for conservation and then appropriate agronomic techniques be adopted that will ensure cultivation, integration into farming systems and hence availability of these resources within the proximity of local people. This should however, be done after an awareness campaign on the importance of cultivating medicinal plants is carried out to the community

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Appendix 1: Questionnaire on utilization of medicinal plants to traditional healers and midwives in Nyachilo village

1) Personal information

NameGender..... Age.....

Education.....Occupation Subvillage

2) What plants do you utilize for traditional medicines in your village?

Plant name	Plant kind T = Tree C= Climber S=Shrub Hb= Herb	Disease s cured	Collection site F=Forest Fa=Farm W=wetland H=Homegarden Other (specify)	Part harvested L=Leaf R=Root B=Bark Other (specify)	Accessibility status D= difficult R=Root B=Bark Other (specify)	Mode of preparati on	Dosage

3) Why is traditional healing used in the village?

- villagers want traditional medicines
- villagers could not be cured at the dispensary
- there are no dispensaries close to the villagers
- other medicines are too expensive
- other reasons (specify)

4) Is the traditional healing used as alternative, complementary or primary health care? Give reasons to elaborate your answer

- Alternative
- Complementary
- Primary
- Other (specify)

5) How do you perceive traditional healing system from modern healing system?

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- 6) What is the average cost of a treatment per a patient? How many patients do you treat per day?
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- 7) How much cash do you earn daily, weekly or monthly from the services you conduct to your patients?
- a. Tsh 1- 10,000 per day/week/monthly etc
 - b. Tsh 10,000 – 20,000
 - c. Tsh 20,000 – 30,000
 - d. Tsh 30,000 – 40,000
 - e. > 40,000
- 8) Do your customers/patients afford to pay for the medicines and associated service costs? Explain
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- 9) What methods do you use for sustainable utilization of medicinal plants
- a. Pass the knowledge to the youth
 - b. Plant trees around the homestead
 - c. Rituals
 - d. Other (specify)
- 10) What should be done to ensure sustainable utilization of medicinal plants in your area?
- a. Training
 - b. Domestication
 - c. Nothing
 - d. Other (specify)