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ARTICLE

Local Perceptions on the Status, Values and Conservation and Ethnobotanical Implications of Medicinal and Multipurpose Plants in and Around Selected Church Forests in Central Ethiopia

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ABSTRACT

Societies have varied attitude and perception on the forest resources nearby them. Ethnobotanical knowledge should be integrated with biophysical studies in order to be used for managing and conserving forests. The objectives of the study were to assess the existing knowledge about the uses of plant species and to examine the plant species. Three sites were selected around central Ethiopia encompassing three church forests. Focus group discussion, questionnaire-based social survey and vegetation inventory were undertaken. The focus group discussants were selected from traditional healers, elders of the society, development agents, and people who are knowledgeable about the vegetation of the areas. Voucher specimens were collected for those species difficult to identify . The data analysis was done by descriptive statistics using Excel 2010 and SPSS v20. The results indicated agricultural expansion, charcoal making and fuel wood as the major causes of deforestation in Site 1, Site 2 and Site 3 respectively. Religious preaching was stated by group discussants as the most effective solution to reverse the degradation and to protect the church forests. The plant species have varied uses as traditional medicine, food, construction wood, household utensils, and firewood but higher percent of the mentioned species were used either for human or livestock medicine. Sørensen similarity index indicated Site 1 and Site 2 have 12.5%, Site 1 and Site 3 have 10.9% and Site 2 and Site 3 have 43.5% similarities. Documenting the wealth of indigenous knowledge and in situ conservation of the plant species are key recommendations.

1. Introduction

Rural households in developing countries are dependent on environmental resources and this understanding is commonly shared among researchers, policy makers and development practitioners [1]. Both the biophysical and social perceptions are required to gain more understanding of the socio-cultural situations of the rural households comprising their impact on the environment [2]. Societies have a diversified attitude towards forests ranging from the constructive, even holy, to the destructive [3]. When people take forests as sacred they see them as protecting protector spirits or as being a gift from God [3]. Therefore, the

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support of local people is indispensable to warranty conservation in the long term particularly in Africa [4,5].

Forests are one of the environmental resources whose interaction to rural people should be investigated to improve policy planning and execution [6,7]. Hence, the socio-cultural contributions of forest products (whether timber or non-timber) to rural livelihoods should be understood clearly [8]. Non Timber Forest Products are crucial to augment the income of the rural poor [9]. For example, fuel wood is used for both subsistence and for sale [10,11]. Other uses obtained from forests include medicinal plants, food, gum and resin, grass and twigs, honey, bamboo and reeds [12-14].

Indigenous knowledge of the society accumulated during prolonged interactions with the natural world remains fundamental for the society's physical, spiritual and social well-being and local development [15,16]. Hence, the interaction of people with their physical environment including plants through indigenous knowledge is studied by a science known as Ethnobotany [17,18].

Traditional medicine is the sum total of the knowledge, skills and practices used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and social imbalance [19, 20]. Historical accounts of traditionally used medicinal plants depict that different medicinal plants were used as early as 5000 to 4000 BC in China and 1600 BC in Syria, Babylon, Hebrew and Egypt [21].

Ethiopian geographical and habitat diversity and vegetation types favors medicinal plants' growth and utilization [18]. The geographical diversity coupled with multi-ethnic groups make the country home for wide range of traditional medicine [22-24]. With the enormous increment of the global utilization of medicinal plants over the past, traditional medicine still remains the main supply for a large majority of 80% of human population and 90% of livestock in Ethiopia [25].These traditional medicine are used for treating health problems and as traditional medical consultancy with the lower cost than modern medicine [19,26-28]. The wide spread use of traditional medicine among both urban and rural population in Ethiopia could be attributed to cultural acceptability and effectiveness [22,29].

The vast knowledge on traditional uses of plants is not fully documented in Ethiopia [30]. Either the knowledge from herbalists is passed secretively from one generation to the next through the words of mouth or their descendants inherit the medico-spiritual manuscripts [15,30,31]. The distribution of this knowledge is hierarchically placed and services are obtained from the family, the neighborhood, the village or beyond [32]. Additionally, it is confronted with irreversible loss because of the numerous language that mostly lack written scripts, ageing of the healers, displacement of communities due to drought and urbanization [33]. Influence of modern veterinary medicine and exotic cultures further complicate the loss of ethnobotanical knowledge in Ethiopia [34, 35].

Documenting the remaining traditional medicinal knowledge is vital to facilitate discovery of new sources of medications and promote sustainable use of natural resources [36]. The current loss of medicinal plants in Ethiopia due to natural and anthropogenic factors is accompanied by a loss in indigenous knowledge on medicinal plants [37] demanding ethnobotanical research to document the knowledge. In this regard, church forests are essential sources of indigenous remnant plant species and knowledge of their diversified uses including traditional medicine [37]. As part of the afroalpine vegetation, most of the church forests include medicinal plants of all the vegetation types in Ethiopia which should be studied for their future conservation [38].

The present study aims to examine local perceptions and opinions about the status, values and suitable conservation strategies among the church forest communities, to assess the existing knowledge about the uses of plant species and to examine the plant species that provide the various uses. The following research questions are posed:

(1) What are the perception and attitude of the local people about the management and conservation of church forests?

(2) What are the major problems driving the degradation of the church forests and their adjacent croplands?

(3) Is there traditional knowledge about the diverse uses of plants in and around the church forests?

(4) What are the different plant species found in the church forests that provide the various uses?

(5) Is there a difference in plant species richness along altitudinal gradient among the studied sites?

2. Materials and Methods

2.1 The Study Areas

The study sites are selected areas of Ethiopian Orthodox Tewahdo Church forests and croplands and villages adjacent to the church forests that are approximately surrounding 1km radius from the edge of the forests. Site 1(Assela Teklehaymanot) is 175 km far from the capital Addis Ababa (AA) and have an area of 25 hectares. The elevation range was from 2521-2581 m.a.sl. As adopted from [39], highland areas are found in altitudinal range of 2300-3200m a.s.l., midlands from 1500-2300m a.s.l. and lowlands from 500-1500. Therefore, Site 1 is in the highland agro climatic zone accordingly. Site 2 (Etisa Teklehaymanot) is found 75 km far from AA and have an area of 23 hectares. The elevation range was from 1500-2301

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m a.s.l. and hence, it is in the mixed midland and lowland agro climatic zone. Site 3 (Saramba Kidanemhret) is found 200 km far from AA and have an area of 22 hectares. The elevation range for Site 3 is from 2164-2251 m a.s.l. showing midland agro climatic zone (Figure 1).

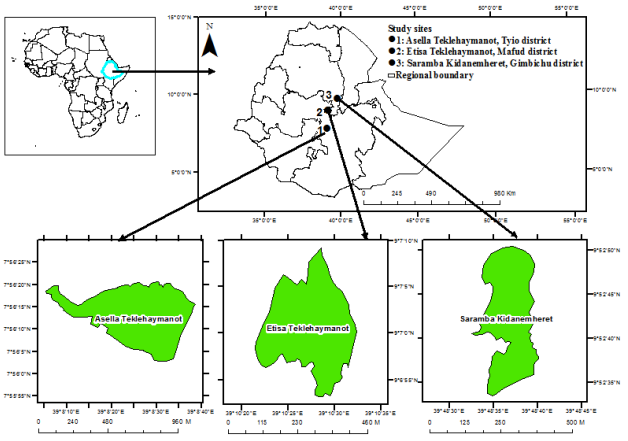

Figure 1. Location of the study sites in central Ethiopia

2.2 Focus Group Discussions

A focus group discussion and structured interviews were conducted following [40] in each church forest site. The focus group discussion members included both male and female participants. A checklist (Appendix, Checklist A-1) was prepared for focus group discussion. A questionnaire was prepared and tested on household respondents selected for this purpose based on the ideas obtained from the group discussion. The focus group discussion members were selected from traditional healers, clergies, development agents (DAs) and others who have some leadership positions in the churches and their surrounding areas. Eight male and eight female respondents were selected at each site based on their knowledge on the traditional uses of plant species for various purposes.

2.3 Household Survey

The reconnaissance survey conducted for questionnaire-based social survey contained the questions for ethnobotanical study too and undertaken at the same time (Appendix, Table A-1). Hence, a focus group discussion and a questionnaire-based sociological surveys were carried out from 15-23 July 2017 in Site 1, from 28 July to 4 August 2017 in Site 2, and from 8-16 August 2017 in Site 3. For questionnaire-based sociological survey interviewers were first trained how to undertake the interview (5 interviewers at each site) for two hours at each site. Guided field walks and questionnaire-based sociological survey was undertaken following [41].

Respondents were selected within approximately 1 km distance (radius) from the edge of the church forest at each site. Thus a total of 120 HHs (40 at each site) were randomly selected from the church compounds and surrounding villages of the 3 sites. A structured questionnaire composed in the 'Amharic' (Ethiopian language) to interview the household respondents (HHs) included questions addressing issues of deforestation trends, plant species found in the area and the uses of plants for various purposes comprising traditional medicine (Appendix, Table A-1), the number and type of livestock in the HH, and the forest conservation and management. The questionnaire also solicited the data on HH characteristics including age, occupation and education level of the HHs.

The survey conducted in the same 120 HHs included traditional healers, elders of the society, knowledgeable people about vegetation, and clergies to elicit ethnobotanical information. The questionnaire also included questions about local names of the medicinal and multi-purpose plants, sites where the plants can be found, ailments treated by the plants and plant parts used for the treatment, condition of the plant material (dried or fresh), and modes of preparation and administration of plant-based medicine.

2.4 Vegetation Survey

To collect data on vegetation transect lines were laid 100 m apart based on altitudinal variations. Plots were established with a dimension 20 m x 20 m along the transect lines. The distance between consecutive plots within transect lines was also 100 m. Site 1 had three transects with transects 1 and 2 having 4 plots each and transect 3 having 3 plots. Site 2 had only two transects (one longer and the other shorter). The longer transect had 6 plots and the shorter one had only 1 plot. The third site (Saramba Kidanemhret) similarly had 2 transects with transect 1 and 2 having 4 and 2 plots respectively. After the plots were established the collection of vegetation sample was immediately started. All the transect lines and plots were established for tree inventory and plant specimen collection in the manner described by [42].

The plants found in each of the church forests and their surroundings were surveyed and examined from April-August 2018 and identified using keys of written floras (books) such as "Flora of Ethiopia and Eritrea" [43-49] "Useful Trees and Shrubs for Ethiopia" [50], and for those plant species difficult to identify, voucher specimens were collected, pressed and dried and then taken to herbarium laboratory of Addis Ababa University (Ethiopia) and identified.

2.5 Similarity of Species in the Three Sites

The Sørensen similarity coefficient was chosen to measure the

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similarity in the species composition of the three sites since it gives more weight to the species that are common to the samples rather than to those that only occur in either sample [51].

2.6 Statistical Analysis

The data collected through the HH surveys were analyzed based on different parameters of causes of deforestation (family size, education level, number of livestock, wealth status, etc.), comparison of the different sites for the observed characteristics and future needs. Descriptive statistics was used for the analysis. The ethnonobotanical knowledge collected from both group discussion and questionnaire-based social survey was analyzed based on degradation, distribution, vernacular and botanical names, life forms, purpose and mode of use of the medicinal and multipurpose plants. The similarity of the various plant species among studied sites was also analyzed. Excel 2010 and SPSS v.20 software were used for the analysis.

3. Results

3.1 Questionnaire-based Sociological Survey

The members of the surveyed HHs were found in similar age range at each site. Respondents were 24-80, 29-73, and 28-88 years old in Site 1, Site 2, and Site 3 respectively (Appendix, Table A-2).

The respondents assessed the disturbance status of the church forest according to three categories guided by the survey, namely "Jungle (pristine)", "Moderately disturbed" and "Same as now".

According to the interviewees, in all three study sites the vegetation cover declined starting from 30 years ago. The HHs used the term pristine to refer to well-populated forest with decent diversity and richness, moderately disturbed a forest with acceptable population and diversity, and same as now to refer a very much reduced population with low species richness and diversity. Specifically in Site 1, 98% of the HHs stated that the church forest was pristine jungle 30 years ago, 95% of the HHs stated moderate forest disturbance between 20-30 years ago, and 93% judged the condition as almost same as present 10-20 years ago. In Site 2, 88% of the HHs mentioned the church forest was pristine jungle 30 years ago, 78% mentioned moderate coverage between 20-30 years ago and 88% almost same coverage as today 10-20 years ago. In Site 3 similarly, 75% of the HHs mentioned the church forest was undisturbed 30 years ago, 70% moderate coverage between 20-30 years and 58% almost same as today 10-20 years ago (Table 1).

Major causes of deforestation and degradation were also stated by the surveyed HHs in the study areas. In Site 1, agricultural expansion was mentioned as the most important cause of deforestation by 63% of HHs followed by illegal cutting and urban settlement by 15% of HHs, fuelwood collection by 8% of HHs. The rest 14% of HHs did not know the cause of the deforestation. The most mentioned cause of deforestation in Site 2 was wood harvesting for charcoal making as mentioned by 57% of HHs followed by fuel wood collection by 10% of HHs, agricultural expansion by 7% of HHs and the rest 26% of HHs did not know the cause of deforestation. HHs in Site 3 mentioned fuelwood (57% of HHs) followed by agricultural expansion (38% of HHs) and charcoal making (5% of HHs) as the main cause of deforestation (Figure 2).

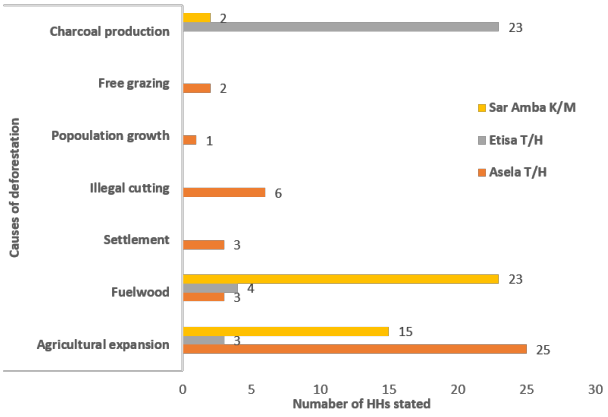

Figure 2. Causes of the forest disturbance stated by the household respondents in the study churches and their surrounding at highland (Site1, Assela Teklehymanot), mixed

Table 1. Opinions of the interviewed household respondents about the status of forest disturbance at the three selected churches at highland (Site1, Assela Teklehyamanot), mixed midland and lowland (Site 2, Etisa Teklehyamnot) and midland (Site 3, Saramba Kidanemhret), central Ethiopia

Church forest	Status of the church forest											
	30 years ago				Between 20-30 years				Between 10-20 years			
	Jungle	Moderately disturbed	Same as now	Total	Jungle	Moderately disturbed	Same as now	Total	Jungle	Moderately disturbed	Same as now	Total
Site 1	39	0	1	40	0	38	2	40	1	2	37	40
Site 2	35	5	0	40	6	31	3	40	3	2	35	40
Site 3	30	6	4	40	1	28	11	40	5	12	23	40
Sub total	104	11	5	120	7	97	16	120	9	16	95	120

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midland and lowland (Site 2, Etisa Teklehymanot) and midland (Site 3, Saramba Kidnemhret), central Ethiopia

There was a high number of livestock owned by HHs in the three study sites. The number of sheep (5.2 sheep/ HH) owned was highest in Site 1 (highland) while the number of goats was very high in Site 2 (4.4 goats/ HH) and Site 3 (3.6 goats/ HH) which were mixed lowland and midland and midland respectively (Table 2.).

Table 2. Livestock owned by HHs at highland (Site1, Assela Teklehymanot), mixed midland and lowland (Site 2, Etisa Teklehymanot) and midland (Site 3, Saramba Kidanemhret), central Ethiopia as mentioned by the HHs

Type of animal	Site 1 (Assela)	Site 2 (Etisa)	Site 3 (Saramba)
Oxen	77	95	76
Cows	65	45	55
Sheep	208	8	93
Goats	3	176	143
Horses	17	0	1
Donkeys	47	68	28
Chicken	225	185	338

According to focus group discussions at each site the high number of livestock owned by the church forest surounding villages and also by the churches themselves coupled with the presence of free grazing likely impacted the forest by trampling and grazing and browsing of the vegetation particularly at seedling stage.

From the group discussion in the selected three church forests it was found that the church administration and the community around the churches use a variety of methods to protect and conserve the church forests. Some of these methods included community based institutions (locally known as "Idir", "Mahiber" and "Ekub"), hiring forest guards and fencing. Preaching by priests of the church not to dare the church forest and other wise to curse the alienators so that they are not allowed to participate in the holly mass and other worshiping ceremonies of the churches were also the other solutions. The regulations by community based institutions included punishment of the alienators, out casting the law breakers from the society, and handing over the law breakers to government administration bodies. The group discussants recommended religious preaching for protection of the church forests based on formerly observed success.

HH respondents suggested a number of solutions in response to the decline of the forest cover. Large number of respondents in the 3 sites (62.5% HHs) mentioned awareness creation and setting of local rules and regulations as an immediate strategy. Protecting and conserving the remnant plant species was also indicated as key solutions by (19.2% HHs). Enrichment planting, protecting from domestic and wild animals, weed and pest control was also stated by 10% HHs. Weed control and planting of some endangered species in protected areas were also mentioned by 5.8% and 2.5% HHs (Appendix, Figure A-1).

3.2 Ethnobotanical Knowledge

The group discussion members which included traditional healers, elders and knowledgeable members of the society pointed out the importance of the indigenous ethnobotanical knowledge in the areas and the use of the medicinal plants. According to the group discussants, the knowledge is mostly transferred orally from father to child or to a clan very secretly based on the accepted belief that the healing power of the plant would be lost once it becomes a common knowledge. However, the group discussants have also pointed out that some people argue for the wide dissemination of the ethnobotanical knowledge among the entire community. Hence, community members use the medicinal plants by themselves without contacting the traditional healers. Generally, the local experts believe that the indigenous ethnobotanical knowledge should be supported by the wise use of medicinal plants.

A dramatic decrease in the number of species and population size of plant species especially medicinal plants was stated by 75%, 65%, and 97% of the HHs in Site 1, Site 2, and Site 3 respectively. In all the three sites, HHs mentioned the occurrence of the mismanagement of the plant species, free grazing, climate change, the absence of replanting after plant harvest, and attributed these factors as the major causes of the deforestation. Consequently, the HHs suggested setting of local by-laws and replanting to increase the population of the diminishing useful plant species. Local people have stated traditional medicine as the major use of forest plants in all the three sites.

3.3 Distribution and Use of Plant Species

A total of 35 plant species belonging to 26 families were found in and around Site 1. Among the plant families, the predominant ones were the Asteraceae which have 4 species followed by Myrsinaceae and Lamiaceae which have 3 species each, and Solanaceae and Urticaceae with two species each. The remaining 21 families have one species each. Most of the plant species were found in the church forest than its surroundings. The direct observation of the researcher in the study area indicated *Maytenus gracilipes*, *Mikaniopsis clematoides (A.Rich), Clematis simensis* Fresen., *Allophylus abyssinicus* (Hochst.) and *Osyris quadri-*

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partite Salzm. ex Decne as the most dominant species in Site 1 church forest.

The plant life forms comprised 34% tree, 29% herb, 26% shrub and 11% climbing species. The elevation where these species were found ranged from 2521-2581 m a.s.l. The uses of the species included cultural medicine for both humans and livestock, human food, fodder, construction wood, and making house utensils among others (Table 3).

Table 3. Number of plant species used for various purposes by the HHs interviewed in highland church forest (Site 1, Assela Teklehymanot), central Ethiopia

Use type	Number of plant species stated by HHs
Human medicine	10
Livestock medicine	7
For tying	4
Fodder	3
Construction and firewood	2
Human and livestock medicine	2
Food and fodder	1
Construction	1
Food	1
House utensils	1
Firewood	1
Firewood	1
Food and livestock medicine	1

More than half (57%) of the species are used for human medication, livestock medication and/or both, signifying the supreme importance of the plant-based medicine. Hence, of the 35 plant species, 20 predominantly used for medicinal purpose. The rest of the plant species (43%) found in Site 1 are used for various purposes such as tying and fastening material, fodder, and construction wood, indicating the diversity forest plant use by the local people.

The medicinal plants were mostly represented by Lamiaceae and Myrsinaceae families which included 3 species each; followed by Asteraceae and Solanaceae families with 2 species each. The other 10 families of medicinal plants included 1 species each. Out of the 20 medicinal plant species, 10 were used as human medicine, 7 as livestock medicine, 2 were used for both human and livestock medicine and 1species (*Osyris quadripartite*) was used as food and livestock medicine (Table 3).

In Site 2 a total of 49 species were found having various purposes. These plants belong to 30 families. Among these families, Asteraceae was found to be the most dominant containing 8 species, followed by Malvaceae and Fabaceae families each containing 4 species, followed by Solanaceae family with 3 species. The other 11 families included 1 species each.

The vegetation survey revealed the most dominant species *Euclea divinorum* Hiern, *Gladiolus candidus* (Rendle) Goldblatt, and *Allophylus abyssinicus* (Hochst.) as the most widespread native species in this mixed midland and lowland church forest site (Site 2). The life forms included 52% herbs, 30% shrubs, 10% climbers and 8% trees. The elevation where these species were found ranged from 1500-2301 m a.s.l. A larger number of plant species was revealed in Site 2 than in Site 1, possibly because of the sites' altitudinal differences. The use of plant species was also greater in Site 2 with 3 additional use types, specifically for food preparation, charcoal making and oil for local tannery that are not mentioned by respondents in Site 1 (Table 4).

Table 4. Number of species used for various purposes by the households interviewed in mixed midland and lowland church forest (Site 2, Etisa Teklehymanot), central Ethiopia

Use type	Number of plant species stated by HHs
Human medicine	20
Human and livestock medicine	2
Livestock medicine	3
Fodder	6
Food	3
Food and fodder	2
Fodder and tying up	2
Fodder and firewood	2
Oil for local tannery	1
Fence and firewood	1
Charcoal making	1
For food preparation	1
Farm tools	1
For washing utensils	1
Ornamental	1
Supporting sticks	1
House utensils	1

Similar to site 1, human and livestock medicine took the lion's share among the plant uses in Site 2. Precisely, 51% of the 49 mentioned plant species were used for human, livestock or for both human and livestock medicine followed by fodder and food (Table 4). In Site 2, 20 plant families and 25 plant species were found being used for medicinal purpose. The Asteraceae family was represented by 4 species while Boragnaceae and Malvaceae families included 2 species each. The other 17 plant families comprised 1 species each. The plant life forms

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were predominated by herbs (72%), followed by shrubs (20%) and climbers (8%). No tree species were mentioned by the HHs as having medicinal value in this study site. Of the 25 plant species used as traditional medicine, 20 were used as human medicine, 3 were used as livestock medicine and 2 were used for both human and livestock medicine (Appendix, Table A-4).

In Site 3, the survey identified 47 plant species. Most of these species were found in the church compound and belonged to 32 families. Of these families, the Asteraceae family have 6 species followed by Fabaceae and Solanaceae families (with three species each) and Boraginaceae, Euphorbiaceae, Lamiaceae, Malvaceae, Poaceae, and Verbenaceae families represented by 2 species each. The remaining 8 families have one species each. The vegetation survey in the study area revealed *Jasminum grandiflorum* L., *Combretum aculeatum* Vent., *Lagenaria siceraria* (Molina) Standley and *Grewia ferruginea* Hochst. ex A. Rich as the most dominant native species. The plant life forms were 49% species herbs, 32% species shrubs, 13% species climbers and 6% species trees. The elevation where these species were found ranged from 2164-2251m a.s.l. (Midland).

The survey of Site 3 has shown that 40% of the species were used as human and livestock medicine. Fodder and food took the share of 13% and 6% of the species respectively. Similar to Site 1 and Site 2, the local people tended to use the plants primarily for traditional medicine and to a lesser extent for fodder (Table 5).

Table 5. Number of plant species used for various purposes by the households interviewed in midland church forest (Site 3, midland, Saramba Kidnemhret), central Ethiopia

Use type	Number of plant species stated by HHs
Human medicine	15
Human and livestock medicine	2
Livestock medicine	2
Fodder	6
Food	3
Food and fodder	2
Fodder and tying up	2
Fodder and firewood	2
For washing utensils	2
Fence and firewood	1
Charcoal making	1
For food preparation	1
Farm tools	1
Ornamental	1
Supporting sticks	1
House utensils	1
Oil for local tannery	1
Fodder and ornamental	1
Fodder and construction	1
Construction and furniture	1

Of the 47 plant species found in Site 3, 19 species were predominantly used for medicinal purpose. Of these species, 15 are used for human medicine, 2 are used for livestock medicine and 2 are used for both human and livestock medicine (Appendix, Table A-5).

The most representative family for the medicinal plants in Site 3 was Asteraceae (3 species), followed by Boragnaceae (2 species). The remaining 14 families comprised 1 species each. The medicinal plant species included 14 herbs, 3 shrubs and 2 climbers. Similar to Site 2, tree species were not mentioned as being used for traditional medicine.

3.4 Similarity of Plant Species

There are 4 species commonly shared among the three studied sites in both the church compounds and their adjacent surroundings. The species are namely *Combretum aculeatum* Vent., *Guizotia scabra* (Vis.) Chiov., *Maesa lanceolata* Forssk. and *Stephania abyssinica* (Dillon & A. Rich.) Walp. The Sørensen similarity index have shown the similarity between Site 1 and Site 2 was 12.5%, between Site 1 and Site 3, 10.9%, and between Site 2 and Site 3, 43.5%. The higher similarity between Site 2 and Site 3 may be attributed to their similar altitudinal ranges.

4. Discussion

4.1 Causes of Deforestation

The present study identified forest clearing for agriculture, feulwood collection and charcoal making as the major causes of deforestation and land degradation. In line with the present findings, [52] underlined agricultural land expansion, population growth, fuel wood collection and other related activities as the main cause of deforestation. The findings of the present study have some common causes though the specific results differ among the three study sites. Similar causes like clearing for agricultural use, free grazing (overgrazing), and exploitation of existing forests for fuel wood, fodder, and construction materials were also reported in northeast African Studies [53]. Therefore, similar causes were used as indicators to extract information from the HHs on deforestation and land cover change in the study areas. Additionally, other causes such as charcoal making, illegal cutting, and settlement were also stated in some of the present study sites.

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Grazing and tree harvesting activities are among the human-induced disturbances that influence the regeneration success of woody species and in turn control the vegetation structure and composition of forests [54]. In the present study, the presence of high number of livestock especially sheep and goats is likely to have a detrimental impact on the regenerative capacity of the church forests, as suggested by the observed grazing and browsing by both domestic and wild animals in the church forests. The wild animal influence was more pronounced in the highland area (Site 1) where monkeys debark live *Podocarpus* and *Cupresus* trees and uproot seedlings of all tree species in search of edible insects, specifically during summer season when neither fruits nor crops are available (personal observation during data collection). Personal observation has also revealed that goats graze and browse on every plant species whether seedling or sapling and also debark the live trees and shrubs in Site 2 and Site 3.

The constrained regeneration and small population size of different tree species due to free grazing and associated causes was shown by previous pilot studies in Ethiopian church forests [51,55,56]. Continuous and intensive grazing and browsing may cause permanent damage [57] due to soil compaction and erosion, consumption of tree seeds, and grazing and browsing of seedlings and saplings [58] ultimately leading to withdrawing out and declining of forest canopies [59, 60].

According to [52, 56] most church forests are used for grazing, browsing and as a shelter from sun's heat and storms, especially when the surrounding landscape is devoid of tree cover. Therefore, disturbances by livestock can be included among the major factors constraining regeneration of woody species and ultimately contributing to the decline of woody and other plant species populations in the Ethiopian church forests [61].

4.2 Conservation and Management Solutions

Religious preaching and using local by-laws and regulations were the most mentioned management solutions by both group discussants and HHs in the present study. The suggested solutions were accordingly tested by the local people and are effective means of protecting the forests. However, [62] have suggested to focus on participatory approaches for forest management, appealing associated land users in decisions about controlled grazing, browsing and tree cutting. Management within the church forest areas should focus on safeguarding healthy populations of tree species [62]. This could be accomplished by supporting their natural regeneration and eliminating livestock grazing, by planting nursery-raised seedlings or targeted seeding of species vanishing from the area, thus improving their distribution among the forest patches [62-64] also concluded that controlling livestock grazing is essential to achieve indigenous tree species regeneration in church forests based on observations of a more successful tree regeneration in forest interiors versus open fields experiencing higher grazing pressure.

Community-based watching [65] and other forms of public commitment required for conservation planning was believed important for manifold stakeholders [66,67]. The study by [56] undertaken in northern Ethiopia has shown the importance of community-based organizations and local rules of the society as effective conservation practice in church forests. The present study results also approved the same in central Ethiopia. Hence, HHs in approved by-laws merit a high degree of acceptance than government rules.

4.3. Ethnobotanical Knowledge

The ample knowledge about the uses of the different plant species was evident among the church forest community. The use of medicinal plants was the likely choice, especially in sites 2 and 3 located farther from the urban and peri-urban centers. Although Site 1 is found near a town Asela which have a bigger hospital, some local people (at least 20%) preferred to use medicinal plants than resorting to the hospital treatment as stated by focus group discussants. In all the three study sites, the group discussants acknowledged the importance of the Ethnobotanical knowledge and approved of its dissemination by the word of mouth. A similar study by [68] showed ethnomedicinal knowledge is usually passed verbally from one generation to the next through family members and most of this knowledge has not been formally documented. This brings knowledge gap as the knowledgeable people pass away and restrict the transfer only to family members. Additionally, there is a continuous decline in the use of traditional medicine, because of reduced interest in the younger generation towards traditional treatment systems, coupled with rural depopulation, mass deforestation, and migrations of traditional medicinal healers to other jobs [69]. These factors have contributed to the rapid loss of the rich knowledge.

The local people also expressed that the degradation of the medicinal plants due to unwise use and absence of replacement planting for the utilized medicinal plants also minimizes the knowledge. In a similar way [70] expressed degradation of natural vegetation makes it impossible to learn about plants that no longer exist in the area. This loss of information about plants means the loss of information based on traditional cultural experiences about the use of plants with negative implications for the sustainable

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local development [69,70]. Therefore, ethnobotanists should describe, analyze, and conserve traditional knowledge and hence have to play their important role in sustainable development [70].

4.4. Distribution and Uses of Medicinal and Multi-purpose Plants

The result of this study showed there are various uses of the plant species. This is supported by a study in Northern Ethiopia by [71], who explained that rural communities in general depend on plant resources especially for food, forage, constructions, household supplements, beds and sleeping mattresses, firewood or as shade providing plants. In addition to the mentioned uses of the species indigenous people all over the world are still using medicinal plants for treatment of various diseases and the practice of traditional medicine indicates to be continued [72,73].

In all sites of the present study the number of species used for traditional medicine whether for human medication or livestock treatments was by large greater than other uses as mentioned by HHs. The most representative life forms of the observed medicinal species were herbs followed by shrubs. Climbers were mentioned the list in Site 2 and Site 3. In Site 1 the number of medicinal shrubs and trees was equal while there are no still climbers mentioned as traditional medicine. A similar study by Moravec et al. 2014 recorded the different life forms as herbs (59%) followed by shrubs (21%) being used in traditional medicine in Tigray (mixed midland and lowland), northern Ethiopia.

The uses of the surveyed plant species in the present study sites included treatment and cure of different diseases of both humans and livestock in addition to other uses such as food, fodder, construction. The mentioned diseases treated by the surveyed plants were sudden-sickness, stomachache, hemorrhoids among others. The plant species common to at least two of the sites were compared with findings of other similar studies by the diseases they are treating (Appendix, Table A-8) shows the comparison of those species and their respective ailments treated.

Most of the comparisons show a difference in the diseases treated in different localities. These also indicate the presence of a huge and diversified indigenous knowledge which may differ from locality to locality even within the same geographic areas. This idea is supported by a study of quantitative ethnobotany undertaken in the Amazonia, by selecting four indigenous group of people who speak different languages [74]. The research finally concluded the majority of tree species from four different plots of 1 hectare each were useful to four respective indigenous groups in different use categories. The result of our study also approves the presence of varied knowledge in different localities that initiate further research on the issues.

There were two more plant species in Site 2 (1500-2301m a.s.l.) which have an ecotone nature mixing both midland and lowland than Site 3. According to [75-77] the characteristic of ecotones is that they have higher biological diversity than adjoining areas and thus hold high conservation value. It has been mentioned again agro ecological zonation such as altitudinal differences may cause differences in plant species composition and species richness. For example, a study by [78] showed there was a maximum number of plant species richness at 1000 m elevation. There is a very fast increase from sea level to 400 m, and then a moderate increase up to 1,000 m a.s.l. At higher altitude, there is a marked linear decrease of species richness from 1,400 m to 3,000 m, with an average reduction of 90 species approximately per 100 m interval. However, such phenomena would be worth further investigation.

The HHs stated a noticeable decline of valuable plant species in all 3 sites. A similar result was found in a study by [79] in Kenya which explained medicinal plants are at increasing risk from destruction of their habitats due to agricultural expansion, fire, construction, overgrazing, and urbanization and over harvesting of known medicinal species. It has also been shown that about 15,000 medicinal plant species may be threatened with extinction worldwide due to habitat loss and over harvesting and it is estimated that the earth is losing one potential major plant-based drug every two years [79]. In the study area, it is clearly seen that the local people rely on medicinal plants to use them also for other purposes like fodder, charcoal, firewood, construction, food and tying. The major threat to medicinal plants in the study sites are unsustainable use of the medicinal plants followed by presence of free grazing and overgrazing. Similarly, a study undertaken in Gozamin district of East Gojjam, in Ethiopia indicated overgrazing was the major threat to medicinal plant devastation [80].

The unwise use of medicinal plants even for their assumed purpose is devastating them intensively. For instance, when using roots of the plants for medicinal purpose uprooting is the only mechanism which destroys the plant as a whole without replacement planting. Therefore the influences of human on the natural habitat of medicinal plants are the problems for the conservation of same. The effort to conserve medicinal plants in the present study sites is very law in the villages surrounding the church forests according to the group discussants. However, the group discussants appreciate the contribution of the church forest to conserve the remaining useful medicinal

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plant species. The local people can get permission from the church administration and church forest guards to collect and extract some medicinal plants while there is no replacement for the medicinal plants extracted. The group discussion members also expressed there is no any attempt to domesticate the medicinal plants in their surroundings. In the contrary, studies in Mena Angetu district of Western Ethiopia showed there was some conservation practice by the local people for the medicinal plants [81]. Here some participants have started to conserve medicinal plants by cultivating them in home gardens as much as 13.8% of the medicinal plants were found there [81]. [37] also indicated that at least 5.7% of medicinal plants were cultivated in the highland area home gardens in Mena Angetu district of Ethiopia, indicating some attempts to the forest-derived medicinal plant conservation in the country.

Natural resources could be utilized best in a sustainable way if management activities are practiced [82]. The requirement of appropriate action to do such valuable activities is irrefutable and so is the involvement of the full range of societies and stakeholders in the conservation, production and management as well as use of medicinal plants. This indicates the conservation and sustainable use of medicinal plants requires the greater involvement of various sectors and greater public support and the need of a continuous task to create public awareness [83]. The present study also found the need of creating awareness among stakeholders and users of these medicinal plants as stated by the HHs survey in major church forests in central Ethiopia. Also, according to the presented results, the church forest trees and other plants are harvested, often in unsustainable way for other purposes besides medicinal use thus intensifying their destruction. This indicates there must be a serious concern for conservation of these plants since they are being widely exploited.

5. Conclusions

The result of the study of perception and attitude of local people revealed that church forests provided diversified uses both for the church society and for the residing in the church surroundings. It has been asserted that there is local awareness about the gradual degradation of church forests ongoing for the last 30-50 years. Agricultural land expansion, fuel wood collection and charcoal making were recognized as the major causes of deforestation in the studied church forests. The causes varied among the sites. In addition, free grazing and browsing by livestock and wild animals are likely to contribute to the forest degradation.

Of the possible solutions suggested, awareness creation and setting of locally acceptable rules and regulations were proposed in addition to governmental sanctions. Hence, conserving the remaining forests and other plant species using local by-laws and support of the government in promulgating the rules and additional planting to increase the plant population is crucial in all the studied sites for sustainability of the church forests.

The plant species found in all the present study sites serve diverse uses including medicinal, food, fodder, construction wood, and firewood. The medicinal application of the plants was by large greater than the sum of all other uses in all the three sites. Comparisons of the medicinal uses of the plant species in the central Ethiopian church forests with the plant uses reported in published researches showed that the same plant species were often applied to treat different illnesses or were not used as medicine at all in other areas. The discrepancy may be attributed to differences in Ethnobotanical knowledge among various ethnic groups and geographical locations and should be further investigated. The presence of ample indigenous Ethnobotanical knowledge in all the present study sites is acknowledged. However, the means of transferring the rich Ethnobotanical knowledge through the verbal communication from generation to generation, in most cases secretively within families or clanship has its own drawbacks. Hence, the lack of documentation exacerbates the loss of the unique ethnobotanical knowledge in the remaining church forest communities. Integrated approach (integration of different solutions and professionals) and documenting the wealth of indigenous knowledge and *in situ* conservation of the plant species are key recommendations for sustainable conservation and management of studied church forests and their surroundings.

Appendixes

Checklist

Checklist for assessment of perception and attitudes and ethnobotanical knowledge

1. What was the forest cover of your locality before years (30yrs, 10-20 yrs, and 10 yrs)?

2. What is the forest cover nowadays?

3. Is the forest cover increased or decreased as you compare it with the one before?

a/ Number of trees in your kebele(locality): Reduced / Increased

Reason:……

b/ Number of trees on communal land: Reduced / Increased

Reason:……

c/ Number of trees on grazing land: Reduced / Increased

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Reason:……

d/ Number of trees on cultivated (farm) land): Reduced / Increased

Reason:……

e/ Amount of forest land in general: Reduced / Increased

Reason:……

4. Can you suggest any general cause for the cover change?

5. What solutions do you suggest to conserve the remaining forests and to recover the deforested area?

6. Do you know the church forest in your surrounding? a.yes b.No

7. If yes, what can you say about this church forest regarding deforestation/conservation?

8. How old is the church forest found in your surrounding?

9. What was the reason to conserve this church forest in the area?

10. Do you realize some benefits of this church forest?

11. Do you get some specific advantages from the church forest?

12. Can you mention some of these advantages from the church forests?

13. Is the church forest always conserved as before? a.Yes b.No

14. If your answer for question 13 is yes, what are the ways to conserve the church forest?

15. If your answer for question 13 is no, what are the reasons for the cover change?

Table A-1. Part of the questionnaire to collect information on medicinal plants, Central Ethiopia

Name of the plant	Nature	Location(Church cpd, Cropland, Grazing land, Riverside)	Purpose(use) (Medicinal, Food, Fodder, others)	Parts used (Leaf, Roots, Stem, Fruits, Seeds)	Mode of use (Juice, Chewing, Fried, Chopped etc.)	For a.Human b.livestock c.Both human and livestock	Season of collection	Type of disease treated	Remark

Table A-2. Social characteristics of the HH respondents in Site 1 (Highland, Assela Teklehymanot), Site 2 (mixed medland and lowland, Etisa Teklehymanot and Site 3 (midland, Saramba Kidanemhret), central Ethiopia

Socio-economic characteristics of HH members	Category	Site 1	Site 2	Site 3	Number (%age) of respondents
Sex of the HHs	Male	36	36	34	106 (88%)
	Female	4	4	6	14 (12%)
Age of the HHs	24-40	14	10	1	26 (22%)
	41-60	21	24	31	76 (63%)
	61-80	5	6	7	17 (14%)
	81-88			1	1 (1%)
	Average	47.4	49.7	54.5	
Literacy status of the HHs	High school	23	0	5	27 (22%)
	Middle school	7	0	5	12 (10%)
	Elementary school	5	4	15	25 (21%)
	Basic education	5	31	15	51 (43%)
	Church singer	0	1	0	1 (1%)
	Preachers	0	4	0	4 (3%)
Marital status of the HHs	Married	37	35	36	108 (90%)
	Not married	2	3	0	5 (4%)
	Widowed	0	0	2	2 (2%)
	Divorced	1	2	2	5 (4%)
Wealth status	Poor	4	6	4	14 (12%)
	Moderately endowed	32	27	30	89 (74%)
	Rich	4	7	6	17 (14%)
Average family size	1-3people	8	10	12	30 (25%)
	4-7 people	20	29	25	74 (62%)
	8-10 people	12	1	3	16 (13%)

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16. What do you suggest for the conservation of this church forest for the future?

17. What are the rules concerning trees in the kebele? To what type of land do these rules apply? Are these rules normal governmental rules or kebele by-laws and since when?

Ethnobotany

1. What wild plants (trees/shrubs/herbs) do you know in your locality used for different purposes?

2. Do you use the wild plants for food, fodder, medicine, etc. found in your locality? a.yes b.No

3. Can you mention some of the plants used for various purposes with their uses?

Participant information

Church forest (Site) …… Date ……

Focus Group discussion members' general Information

1.Name……Age……Occupation……

2.Name……Age……Occupation……

3.Name……Age……Occupation……

4.Name……Age……Occupation……

5.Name……Age……Occupation……

6.Name……Age……Occupation……

8.Name……Age……Occupation……

Appendix, Table A-3. Plant species and their medicinal uses in Site 1(Highland, Asela Teklehaymanot Church forest and surrounding)

R.No.	Local name	Botanical name	Family	Nature	Uses	Parts used	Preparation and mode of use
1	Dhoqona(Tatessa)	*Rhus glutinosa* Hochst. ex A.Rich.	Anacardiaceae	Shrub	Livestock medicine (Leech infestation)	Leaf	Leaf juice is given orally
2	Seriti/yeset kest	Asparagus africanus Lam.	Asparagaceae	Herb/grass	Human medicine (Protects evil eye)	Root	Powder is sprinkled on burning charcoal and smoke is inhaled nasally
3	Gomena Osole/ Yeshikoko gomen	*Solanecio gigas (Vatke) C.Jeffrey*	Asteraceae	Herb	Both human and livestock medicine	Leaf	Leaf decoction
4	Weynagift	*Inula confertiflora* A. Rich.	Asteraceae	Herb	Livestock medicine (Leaf heals livestock eye)	Leaf	Young leaf chewed with *A. aspera*
5	Didigsa	*Combretum aculeatum* Vent.	Combretaceae	Tree	Human medicine (Wound healing)	Leaf	Fresh leaf is boiled in water
6	Sotira/Fyelefej	*Clutia abyssinica* Jaub.	Euphorbiaceae	Tree	Livestock medicine (Leech infestation)	Leaf	Juice of crushed leaf given orally
7	Checketa/Digitta	*Calpurnia aurea (Ait.) Benth.*	Fabaceae	Shrub	Human and livestock medicine	Fruit & leaf	Fruit for rabis & crushed leaf stirred with water to wash cattle
8	Bekolu/Raskimir	*Leonotis ocymifolia (Burm. F.)*	Lamiaceae	Shrub	Human medicine ('mich" or 'girfat' febrile illness)	Leaf	
9	Yemich medhanit	*Hoslundia opposita* Vahl.	Lamiaceae	Herb	Human medicine (For infection)	Leaf & stem	Leaf and stem boiled in water and inhaled
10	Tontono	*Pycnostachys abyssinica* Fresen.	Lamiaceae	Shrub	Human medicine (febrile illness)	Leaf	Leaf boiled in water and inhaled
11	Hanku/Inkoko	*Embelia schimperi* (Vatke)	Myrsinaceae	Tree	Human medicine (Expel tape worm and for veneral diseases)	Fruit	Ponded fruit taken orally with water
12	Kelewa	*Maesa lanceolata* Forssk.	Myrsinaceae	Shrub	Human medicine (Fruit expel tape worm)	Fruit	Pounded fruit taken orally
13	Tula	*Myrsine melanophloeos (L.) R. Br.*	Myrsinaceae	Tree	Livestock medicine(blackleg)	Seed	Crushed and mixed with water
14	Dalecho/Guna/ Tife	*Olinia rochetiana A.Jussieu*	Oliniaceae	Tree	Human medicine (Parasites & Toothache)	Root	Root boiled and decoction taken orally
15	Shulti/Tult	*Rumex nepalensis* Spreng.	Polygonaceae	Herb	Human medicine (Stomachache)	Fresh root & leaf	Crushed root and leaf taken orally
16	Keret	*Osyris quadripartite* Salzm. ex Decne.	Santalaceae	Tree	Food & Livestock medicine	Leaf	Juice of crushed leaf
17	Rejii	*Allophylus abyssinicus* (Hochst.)	Sapindaceae	Shrub	Livestock medicine	Leaf	Pounded leaf mixed water and applied on wounds
18	Menji/Atefaris	*Datura stramonium L.*	Solanaceae	Herb	Livestock medicine	Leaf	Fresh leaf juice is applied topically
19	Nechembuay	*Solanum marginatum* L.f	Solanaceae	Herb	Human medicine (For tonsillitis and cough)	Fruit	Fruit pierced and the liquid and seeds given nasally
20	Dobbi	*Girardinia bullosa* (Steudel) Wedd.	Urticaceae	Herb	Livestock medicine (retained afterbirth)	Leaf	Decoction of leaves given orally

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Appendix, Table A-4. Plant species and their medicinal uses in Site 2(mixed lowland and midland, Etisa Teklehaymanot Church forest and surrounding)

R.No.	Local name	Botanical name	Family	Nature	Uses	Parts used	Mode of use
1	Seteeret	*Aloe debrana* Christian	Aloaceae	Herb	Human medicine (Hemorrhoids)	Leaf sap	Cover the affected area
2	Telenj	Achyranthes aspera L.	Amaranthaceae	Herb	Human medicine (Sudden sickness)	Leaf and stem	Pounded, mixed in water and taken orally and rubbed on skin
3	Inslal	*Ferula communis* L.	Apiaceae	Herb	Human & livestock medicine(Intestine pain & fertility of LS)	Root	Pounded root mixed with water and taken orally
4	Ras Kebdo	*Laggera crispata (Vahl) Hepper & Wood*	Asteraceae	Herb	Human medicine (body temperature rise)	Leaf	Leaf juice given orally or nasally
5	Gimi	*Tagetes minuta L.*	Asteraceae	Herb	Livestock medicine	Leaf	Fresh shoot is boiled with water and inhaled
6	Yemidr berbere	*Acmella caulirhiza Del.*	Asteraceae	Herb	Human medicine (Toothache)	Leaf	Fresh flower is chewed
7	Unknown	*Conyza flabellata* Mesfin.	Asteraceae.	Herb	Human medicine	Fruit & leaf	Fruit for rabis
8	Fikrutena	*Cynoglossum coeruleum Hochst. exA.DC. in DC.*	Boraginaceae	Herb	Human medicine (Febrile illness)	Whole part	Crushed and mixed with small amount of water to wash ill part
9	Chigogit	*Biedens prestinaria* (Sch. Bip.) Cufod.	Boraginaceae	Herb	Human medicine (Bleeding after cut)	Leaf	Leaf juice is applied on cut body
10	Weha ankur	*Commelina subulata* Roth.	Commelinaceae	Herb	Human medicine (Avoidance of bad spirit)	Leaf	Dried leaf is fumigated
11	Dedeho	*Euclea divinorum Hiern*	Ebenaceae	Shrub	Human and livestock medicine (Bone fracture maintenance)	Leaf	Leaves are dressed on the fractured body
12	Aleblabit	*Tragia doryodes* M Gilber	Euphorbiaceae	Climber/ Liana	Livestock medicine	Root	The root grinned and bandaged on hand (Dermal)
13	Shimbrut	*Indigofera arrecta* Hochst. ex A. Rich.	Fabaceae	Herb	Human medicine (Stomachache)	Root	Pounded root taken orally
14	Milas leblib/ golgul	*Gladiolus candidus* (Rendle) Goldblatt	Iridaceae	Herb	Human medicine (Cancer healing)	Root	powdered root applied on the tumor or it is taken orally mixing it with water
15	Etse-Meaza	*Satureja abyssinica (Benth.) Briq.*	Lamiaceae	Herb	Human medicine (febrile illness & constipation)	Leaf	Leaf juice is taken orally
16	Gebresid	*Sida rhombifolia L.*	Malvaceae	Herb	Human medicine/ swellings/	Leaf	Pound leaves and the mix with butter and paint
17	Koskuase	*Hibiscus boranensis* Cufod.	Malvaceae	Herb	Human medicine (Stomach ache)	Root	Chewed to be swallowed
18	Engochit hareg	*Stephania abyssinica (Dillon & A. Rich.) Walp.*	Menispermaceae	climber/ liana	Human medicine (Against snake bite)	Fruit	Chewed and swallowed
19	Kelewa	*Maesa lanceolata* Forssk.	Myrsinaceae	Shrub	Human medicine (colds)	Leaf and fruit	Boil fresh leaves and wash the body
20	Kortebe	*Plantago lanceolata* L.	Plantaginaceae	Herb	Human medicine (wounds)	Leaf	Fresh leaves squeezed and juice is applied on the wound
21	Fyelefej	*Pavetta oliveriana Hiern*	Rubiaceae	Shrub	Human medicine (Gonorrhoea and urinary problem)	Leaf	Juice of fresh leaves drunk
22	Embuay	*Solanum incanum L.*	Solanaceae	Herb	Human medicine (Toothache, tonsillitis and stops bleeding nose)	Fruit	Fresh fruit dissected and juice and seeds applied on the sick body
23	Yejartamoch	*Tacca leontopetaloides* (L.) 0. Ktze.	Taccaceae	Shrub	Human medicine (Dysentery)	Tuber and leaf	Pounded and taken oraly
24	Alenquatea	*Grewia ferruginea* Hochst. ex A. Rich.	Tiliaceae	Shrub	Livestock medicine (Expelling leech)	Leaf	Pounded leaf mixed with water given orally
25	Atuch	*Verbena officinalis L.*	Verbenaceae	Herb	Human medicine (stomachache & febrile illness)	Leaf	Leaves are chewed to swallow the juice and residue is dropped

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Appendix, Table A-5. Plant species and their medicinal uses in Site 3 (midland, Sarambakidanemhret Church forest and surrounding)

R.No.	Local name	Botanical name	Family	Nature	Uses	Parts used	Preparation and mode of use
1	Seteeret	*Aloe debrana* Christian	Aloaceae	Herb	Human medicine (Hemorrhoids)	Leaf	Cover the affected area with the sap
2	Telenj	*Achyranthes aspera L.*	Amaranthaceae	Herb	Human medicine (Sudden sickness)	Leaf and stem	Pounded, mixed in water and taken orally and rubbed on skin
3	Inslal	*Ferula communis L.*	Apiaceae	Herb	Human & livestock medicine (To induce fertility of cows)	Root	Pounded root mixed with water and taken orally
4	Ras Kebdo	*Laggera crispata* (Vahl) Hepper & Wood	Asteraceae	Herb	Human medicine (febrile disease)	Leaf	Leaf juice given orally or nasally
5	Yekuakucha medhanit	*Xanthium strumarium* L.	Asteraceae	Herb			
6	Yemidr berbere	*Acmella caulirhiza Del.*	Asteraceae	Herb	Human medicine (Toothache)	Leaf	Fresh flower is chewed
7	Chigogit	*Biedens prestinaria* (Sch. Bip.) Cufod.	Boraginaceae	Herb	Human medicine (stop bleeding after cut)	Leaf	Leaf juice is applied on cut body
8	Fikrutena	*Cynoglossum coeruleum* Hochst. exA.DC. in DC.	Boraginaceae	Herb	Human medicine (Febrile illness)	Whole part	Crushed and mixed with small amount of water to wash ill part
9	Dedeho	*Euclea divinorum* Hiern	Ebenaceae	Shrub	Human and livestock medicine (Bone fracture maintenance)	Leaf	Leaves are dressed on the fractured body
10	Aleblabit	*Tragia doryodes* M Gilber	Euphorbiaceae	Climber/ Liana	Livestock medicine	Root	The root grinned and bandaged on hand (Dermal)
11	Milas leblib/ golgul	*Gladiolus candidus* (Rendle) Goldblatt	Iridaceae	Herb	Human medicine (Cancer healing)	Root	powdered root applied on the tumor or it is taken orally mixing it with water
12	Etse-Meaza	*Satureja abyssinica* (Benth.) Briq.	Lamiaceae	Herb	Human medicine (febrile illness & constipation)	Leaf	Leaf juice is taken orally
13	Gebresid	*Sida rhombifolia* L.	Malvaceae	Herb	Human medicine/ swellings/	Leaf	Pound leaves and the mix with butter and paint
14	Engochit hareg	*Stephania abyssinica* (Dillon & A. Rich.) Walp.	Menispermaceae	Climber / liana	Human medicine (Against snake bite)	Fruit	Chewed and swallowed
15	Kelewa	*Maesa lanceolata* Forssk.	Myrsinaceae	Shrub	Human medicine (common cold)	Leaf and fruit	Boil fresh leaves and wash the body or fumigate nasally
16	Kortebe	*Plantago lanceolata L.*	Plantaginaceae	Herb	Human medicine (wounds)	Leaf	Fresh leaves squeezed and juice is applied on the wound
17	Gemer-Embuay	*Solanum incanum L.*	Solanaceae	Herb	Human medicine (Toothache, tonsillitis and stops bleeding nose)	Fruit	Fresh fruit dissected and juice and seeds applied on the sick body
18	Alenquatta	*Grewia ferruginea* Hochst. ex A. Rich.	Tiliaceae	Shrub	Livestock medicine (Expelling leech)	Leaf	Pounded leaf mixed with water given orally
19	Atuch	*Verbena officinalis L.*	Verbenaceae	Herb	Human medicine (stomachache & febrile illness)	Leaf	Leaves are chewed to swallow the juice and residue is dropped

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Appendix, Table A-6. Comparison of use diversity of medicinal and other multiple use plants in the study area and other similar studies

R.No	Plant species	The present study	Similar studies	
1	*Achyranthes aspera L.*	Sudden sickness(Site 2 & 3)	stomach ulcer, Scorpio's bite, wound, cold, sprain and eye ache (I Moravec *et al*.2014)	Eye problem (Getnet Chekol, 2015)
2	*Acmella caulirhiza Del.*	Toothache (Site 2 & 3)	Swelling (Getnet Chekol, 2015)	Liver disease (Haile Yineger, 2008)
3	*Aloe debrana* Christian	Hemorrhoids (Site 2 & 3)	Hemorrhoids (Getaneh Gebeyehu *et al*., 2014)	Fire burn (Fikru Ayana, 2017)
4	*Biedens prestinaria* (Sch. Bip.) Cufod.	To stop bleeding after cut (Site 2 & 3)	?	?
5	*Combretum aculeatum* Vent.	Wound healing(Site 1)	Ascariasis (Berhane Kidane *et al.,*2014)	
6	*Cynoglossum coeruleum Hochst. exA.DC. in DC.*	Febrile illness (Site 2 & 3)	Febrile sickness (Miruts Giday, 2006)	Febrile illness (Getaneh Gebeyehu *et al*., 2014)
7	*Euclea divinorum Hiern*	Bone fracture maintenance (Site 2 & 3)	Gonorrhoea, pyelonephritis, Impotence, malaise, fever and cancroid (Ermias *et al*., 2013)	Gonorrhea (Balemi *et al*. 2004; Tadesse and Demisew, 2000)
8	*Ferula communis* L.	For fertility of cows (Site 2 & 3)	Intestine pain, to indorse fertility of cows (Misganaw *et al*., 2016)	Impotence (Getnet Chekol ,2015)
9	*Gladiolus candidus* (Rendle) Goldblatt	Cancer healing (Site 2 & 3)	edema and cancerous tumor (Limenh and Umer Sh, 2015)	Anthrax (Getu Alemayehu, 2010)
10	*Grewia ferruginea* Hochst. ex A. Rich.	Expelling leech (Site 2 & 3)	Eye injury, removal of placenta and leech infestation (Misganaw *et al*, 2016)	Placenta retention (Nigussie Amsalu *et al*., 2018)
11	*Guizotia scabra* (Vis.)	Fodder and food (Site 1,2 & 3)	Febrile illness('Mich') (Ermias Lulekal, 2014)	Liver problem. (Fikru Ayana, 2017)
12	*Laggera crispata (Vahl) Hepper & Wood*	Febrile disease(Site 2 & 3)	Excessive manustration (Mesfin *et al*., 2009)	Gastric, stomachache (Getnet Chekol, 2015)
13	*Maesa lanceolata* Forssk.	common cold (Site 2 & 3)	Tick infestation, dermatophilosis, helminthiases and parasitic leech (Ermias Lulekal, 2014)	Leprosy (Getaneh Gebeyehu *et al*., 2014)
14	*Plantago lanceolata L.*	Wounds (Site 2 & 3)	Cut body (Nigussie Amsalu *et al*. 2018)	Open wound, wart (Yerga and Zeraburuk, 2011)
15	*Satureja abyssinica (Benth.) Briq.*	febrile illness & constipation (Site 2 & 3)	Constipation (Berhane Kidane *et al.,*2014)	Epilepsy (Muluken Wubetu *et al*., 2018)
16	*Sida rhombifolia* L.	Swellings and tumers (Site 2 & 3)	Jundice (Fikru Ayana, 2017)	Swelling (Berhane Kidane *et al.,*2014)
17	*Solanum incanum L.*	Toothache, tonsillitis and stops bleeding nose (Site 2 & 3)	Attention deficient disorder and psychosis (Muluken Wubetu *et al*. 2018)	Twinge (Kalayu Mesfin *et al*., 2013)
18	*Stephania abyssinica (Dillon & A. Rich.) Walp.*	Against snake bite (Site 2 & 3)	To increase mental Activity (Nigussie Amsalu *et al*., 2018)	Stomachache (Tilahun Tollosa and Moa Megersa, 2018)
19	*Tragia doryodes* M Gilber	Dermal disease (Site 2 & 3)	?	?
20	*Verbena officinalis L.*	stomachache & febrile illness (Site 2 & 3)	Dysentery and stomachache (Getaneh Gebeyehu *et al*., 2014)	Evil eye (Muluken Wubetu *et al*. 2018)

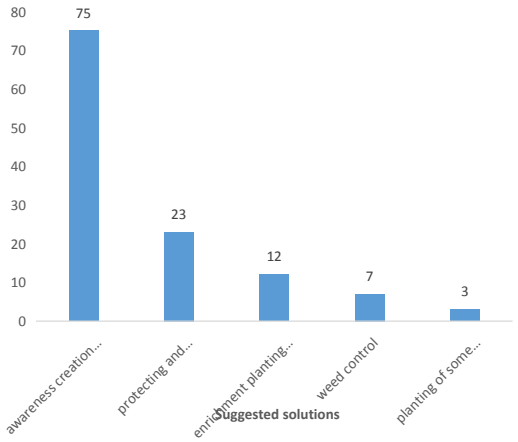

Figure A-1. Suggested solutions for the mentioned problems in the three study site, central Ethiopia

References

[1] Getachew, M. Sjaastad, E., Vedeld, P. Economic dependence of forest resources, A case from Dendi district, Ethiopia. Forest Policy and Economics, 2007, 9: 916-927.

[2] Hurni, H. Solomon, A. Amare, B. Berhanu, D. Ludi, E. Porctner, B. Birru, Y. Gete, Z. Land degradation and sustainable land management in the highlands of Ethiopia, In Hurni H, Wiesmann U (ed) with an international group of co-editors, Global change and sustainable development, A synthesis of regional experiences from research partnerships. Georaphica Bernensia, 2010, 5: 187-201.

[3] Warner, K. Patterns of farmer tree growing in eastern Africa, A socioeconomic analysis in East Africa.

 DOI: https://doi.org/10.30564/re.v2i3.2367

Oxford: Oxford Forestry Institute and International Centre for Research in Agroforestry, 1993.

[4] Cock, J. Koch, E. Going green, people, politics and environment in South Africa, New York. NY, Oxford University Press, 1991.

[5] IIED. Whose Eden? An overview of community approaches to wildlife management. International Institute for Environment and Development, London, UK, 1994.

[6] Cavendish, W. Empirical regularities in the poverty-environment relationship of rural households, evidence from Zimbabwe. World development, 2000, 28(11): 1979-2003.

[7] Timko, J.A. Waeber, P.O. Kozak, R.A. The socio-economic contribution of non-timber forest products to rural livelihoods in Sub-Saharan Africa, knowledge gaps and new directions. International Forestry Review, 2010, 12(3): 284-294.

[8] Sjaastad, E. Angelsen, A. Vedeld, P. Bojo, J. What is environmental income? Ecological Economics, 2005, 55(1): 37-46.

[9] Horning, N.R. The limits of rules, when rules promote forest conservation and when they do not-insights from Bara country, Madagascar. Ph.D. Thesis, Cornell University, New York, 2004.

[10] Belcher, B. Ruiz-Perez, M. Achdiawan, R. Global patterns and trends in NTFP development, Paper presented at The International Conference on Rural Livelihoods. Forests and Biodiversity, 19-23 May 2003, Bonn, Germany, 2003.

[11] Cunningham, A.B. Wild plant use and resource management, In The Center for Biodiversity, Bennun, L. A. Aman, R. A. and Crafter, S.A. Eds., 109-126. National Museums of Kenya, Nairobi, Kenya, 1992.

[12] Hornings, N.R. How rules affect conservation outcome, In Goodman, S. M. and Benstead, J.P. editors, The Natural History of Madagascar 146-153. The Chicago University Press, Chicago, USA, 2003.

[13] Ndam, N. Marcelin, M.T. Chop, but no broke pot, the case of Prunus africana on Mount Cameroon, In Sunderland, T. and Ndoye, O. (eds.), Forest products, livelihoods and conservation, case studies of non-timber forest product systems. Centre for International Forestry Research, 2004, 2: 37-52. Bogor, Indonesia.

[14] Harrison, G.W. Hypothetical bias over uncertain outcomes. Using experimental methods in environmental and resource economics, 2006: 41-69.

[15] Cotton, C.M. Ethnobotany, Principles and Applications. John Wiley and Sons Ltd, New York, USA, 1996.

[16] Agrawal, A. Dismantling the divide between indigenous and scientific knowledge. Development and Change, 1995, 26(3): 413-39.

[17] Carlson, T. Maffi, L. Ethnobotany and conservation of biocultural diversity, Advances in economic botany (15). New York, Botanical Garden Press, New York, USA, 2004.

[18] Gebeyehu, G. Asfaw, Z. Enyewu, A. Raja, N. An ethnobotanical study of traditional medicinal plants and their conservation status in Mecha Woreda, West Gojjam Zone of Ethiopia, International Journal of Pharmaceutical and Healthcare Marketing, 2014, 2: 137-154.

[19] World Health Organization, (WHO). WHO policy perspective on medicines - Traditional medicine - Growing needs and potential 6, World Health Organization, Geneva, Switzerland, 2002.

[20] World Health Organization, (WHO). Traditional medicine. Fact sheet No. 134, 2003.

[21] Dery, B.B. Ofsynia, R. Ngatigwa, C. Indigenous knowledge of medicinal trees and setting priorities for their domestication in Shinyanga region, Tanzania Nairobi, Kenya, International Center for Research in Agroforestry, Farnsworth, N.R. Ethno pharmacology and drug development 42-59, In Ethnobotany and the search for new drugs, Ciba Foundation Symposium 185 Chichester, Uk, 1999.

[22] Abebe, D. and Ayehu, A. Medicinal plants and enigmatic health practices of northern Ethiopia, B.S.P.E. Addis Ababa, Ethiopia, 1993.

[23] Giday, M. An ethnobotanical study of medicinal plants used by Zay people in Ethiopia. CBM Shikrftserie, 2001, 3: 81-99.

[24] Asfaw, Z. The role of home gardens in the production and conservation of medicinal plants, In: Conservation and sustainable use of medicinal plants in Ethiopia, Medhin Zewdu and Abebe Demissie (Eds.), Proceedings of the National Workshop on Biodiversity Conservation and Sustainable Use of Medicinal Plants in Ethiopia, IBCR, Addis Ababa, Ethiopia, 2001.

[25] Zewdu, M. Gebremaraim, T. Asres, K. Global perspectives of medicinal plants, In: Zewdu, M. and Demissie, A. (eds) Conservation and sustainable use of medicinal plants in Ethiopia, proceedings of the national workshop on biodiversity conservation and sustainable use of medicinal plants in Ethiopia, 28 April - 01 May 1998, Addis Ababa, Ethiopia, 2001.

[26] Asfaw, D. Abebe, D. Urga, K. Traditional medicine in Ethiopia, perspectives and developmental efforts. Journal of Ethiopian Medical Practice, 1999, 1(2): 114-17.

[27] Addis, G. Abebe, D. Urga, K. A survey of tradition-

DOI: https://doi.org/10.30564/re.v2i3.2367

al medicine in Shirka District, Arsi Zone, Ethiopia. Ethiopian Pharmaceutical Journal, 2001, 19: 30-47.

[28] Iqbal, Z. Jabbar, A. Akhtar, M. Muhammad, G. Lateef, M. Possible role of ethno veterinary medicine in poverty reduction in Pakistan, Use of botanical anthelmintics as an example. Journal of Agriculture and Social Sciences, 2005, 1(2): 187-195.

[29] Seyoum, A. Killeen, G.F. Kabiru, E.W. Knols, B.G. Hassanali, A. Field efficacy of thermally expelled or live potted repellent plants against African malaria vectors in western Kenya. Tropical Medicine & International Health, 2003, 8: 1005-1011.

[30] Fassil, K. The status and availability of oral and written knowledge on traditional health care in Ethiopia, In: Conservation and sustainable use of medicinal plants in Ethiopia (Medhin Zewdu and Abebe Demissie eds), Proceeding of the national workshop on biodiversity conservation and sustainable use of medicinal plants in Ethiopia 107-119, 28 April- 01 May 1998, IBCR, Addis Ababa, Ethiopia, 2001.

[31] Weldegerima, B. Review on the importance of documenting ethnopharmacological information on medicinal plants. African Journal of Pharmacy and Pharmacology, 2009, 3: 400-403.

[32] Hareya, F. Beyond plants, professionals and parchments, The role of home-based medicinal plant use and traditional health knowledge in primary health care in Ethiopia, Ethnobotany Research and Applications, 2005, 3: 037-049.

[33] Abebe, D. The role of medicinal plants in healthcare coverage of Ethiopia, In: Zewdu M, Demissie A (eds), Conservation and sustainable use of medicinal plants in Ethiopia, proceedings of the national workshop on biodiversity conservation and sustainable use of medicinal plants 6-2, held in Addis Ababa, Ethiopia 28 April - 01 May 1998. 2001: 6-21.

[34] Tafesse, M. Mekonnen, L. The role of traditional veterinary herbal medicine and its and its constraints in animal healthcare system in Ethiopia, In: Conservation and sustainable use of medicinal plants in Ethiopia (Medhin Zewdu and Abebe Demissie eds), Proceedings of the national workshop on biodiversity conservation and sustainable use of medicinal plants in Ethiopia, 22-28, 28 April-01 May 1998, IBCR, Addis Ababa, Ethiopia, 2001.

[35] Wassie, A. Sterck, F.J. Bongers, F. Species and structural diversity of church forests in a fragmented Ethiopian Highland landscape, Journal of Vegetation Science, 2010, 21: 938-948.

[36] Regassa, R. Assessment of indigenous knowledge of medicinal plant practice and mode of service delivery in Hawassa city, southern Ethiopia, Journal of Medicinal Plants Research, 2013, 7(9): 517-535.

[37] Lulekal, E. Kelbessa, E. Bekele, T. Yineger, H. An Ethnobotanical study of medicinal plants in Mana Angetu District, southeastern Ethiopia, Journal of Ethnobiology and Ethnomedicine, 2008, 4: 10.

[38] Endashaw, B. Study on actual situation of medicinal plants in Ethiopia, Prepared for JAICAF (Japan Association for International Collaboration of Agriculture and Forestry), 2007. http://www.jaicaf.or.jp/publications/ethiopia_ac.pdf

[39] Ministry of Agriculture, (MoA). Agroecological Zonations of Ethiopia. Ministry of Agriculture, (MoA), Addis Ababa, Ethiopia, 2000.

[40] Fontana, A., Frey, J.H. The interview: From neutral stance to political involvement, In Denzin N.K.& Lincoln Y.S. (Eds.), The Sage handbook of qualitative research, (2nd ed., pp. 695-727). Thousand Oaks, CA: Sage, 2005.

[41] Grenier, L. Working with indigenous knowledge, A guide for researchers, International development research Centre, Ottawa, Canada, 1998.

[42] Kent, M. Coker, P. Vegetation Description and Analysis, A practical approach 363, BPPress, London, UK, 1992.

[43] Edwards, S. Tadesse, M. Hedberg, I. Flora of Ethiopia and Eritrea 2 (2), Canellaceae to Euphorbiaceae, The National Herbarium, Addis AbabaUniversity, Addis Ababa and Uppsala, 1995.

[44] Edwards, S. Mesfin, T. Sebsebe, D. Hedberg, I. Flora of Ethiopia and Eritrea, Part 1, Magnoliacea to Flacourtiacea. The National Herbarium, Addis Ababa University, Addis Ababa and Uppsala, 2000.

[45] Edwards, S. Sebsebe, D. Hedberg, I. Flora of Ethiopia and Eritrea, Vol. 6, Hydrocharitaceae to Arecaceae. The National Herbarium, Addis Ababa University, Addis Ababa and Uppsala, 1997.

[46] Hedberg, I. Edwards, S. Flora of Ethiopia, Pittosporaceae to Araliaceae. The National Herbarium, Addis Ababa University, Addis Ababa and Asmara/ Uppsala, 1989.

[47] Hedberg, I. Edwards, S. Sileshi, N. Flora of Ethiopia and Eritrea, Part 1, Apiaceae to Dipsacaceae. The National Herbarium, Addis Ababa University, Addis Ababa and Uppsala, 2003.

[48] Hedberg, I. Friis, I. Edwards, S. Flora of Ethiopia and Eritrea, Part 2, Asteraceae (Compositae). The National Herbarium, Addis Ababa University, Addis Ababa and Uppsala, 2004.

[49] Hedberg, I. Ensermu, K. Edwards, S. Sebsebe, D. Persson, E. Flora of Ethiopia and Eritrea, Gentianaceae to Cyclocheilaceae, The National Herbarium, Addis Ababa University, Addis Ababa and Uppsala,

 DOI: https://doi.org/10.30564/re.v2i3.2367

2006.

[50] Bekele, A. Useful trees for Ethiopia, Identification, propagation and management in 17 agro-ecological zones, RELMA in ICRAF project, Nairobi, Kenya, 2007.

[51] Sørensen, T. A method of establishing groups of equal amplitude in plant sociology based on similarity of species content and its application to analyses of vegetation on Danish commons. Biological Journal of the Linnean Society, 1984, 5(4): 1-34.

[52] Wassie, A. Opportunities, constraints and prospects of Ethiopian Orthodox Tewahido Churches in conserving forest resources, the case of churches in south Gonder, northern Ethiopia. M.Sc. Thesis, Swedish University of Agricultural Sciences, Skinnskatterberg, Sweden, 2002.

[53] Badeg, B. Deforestation and land degradation on the Ethiopian highlands, strategy for physical recovery, Northeast African Studies, 2001, 8 (1): 7-26.

[54] Cotler, H., Ortega-Larrocea, M.P. Effects of land use on soil erosion in a tropical dry forest ecosystem, Chamela watershed, Mexico, Catena, 2006, 65: 107-117.

[55] Bingelli, P. Desissa, D. Healey, J. Painton, M. Smith, J. Teklehaimanot, Z. Conservation of Ethiopian sacred groves, European Tropical Forest Research Network, Newsletter, 2003, 38: 37-38.

[56] Wassie, A. Teketay, D. Powell, N. Church forests in north Gonder administrative zone, northern Ethiopia, Forests, Trees and Livelihood, 2005, 15(4): 349-374.

[57] Mekuria, W. Aynekulu, E. Exclosure land management for restoration of the soils in degraded communal grazing lands in northern Ethiopia. Land Degradation and Development, 2011, 24: 528-538.

[58] Blackmore, M. Vitousek, P.M. Cattle grazing, forest loss, and fuel loading in a dry forest ecosystem at Pu‘u Wa‘aWa‘a Ranch, Hawai‘I, Biotropica, 2000, 32: 625-632.

[59] Opperman, J.J. Merenlender, A.M. Deer herbivory as an ecological restraint to restoration of degraded riparian corridors. Restoration Ecology, 2000, 8: 41-47.

[60] Ramirez-Marcial, N. Gonzalez-Espinosa, M. Williams-Linera, G. Anthropogenic disturbance and tree diversity in montane rain forests in Chiapas, Mexico, Forest Ecology and Management, 2001, 154: 311-326.

[61] Wassie, A. Ethiopian church forests, opportunities and challenges for restoration. Ph.D. dissertation, Wageningen University, Wageningen, The Netherlands, 2007.

[62] Wassie, A. Bekele, T. Frank, S. Teketay, D. Frans, B. Postdispersal seed predation and seed viability in forest soils, implications for the regeneration of tree species in Ethiopian church forests. African Journal of Ecology, 2009, 48(2): 461-471.

[63] Aerts, R. Van Overtveld, K. November, E. Wassie, A. Abiyu, A. Demissew, S. Daye, D.D. Giday, K. Haile, M. TewoldeBerhan, S. Teketay, D. Teklehaimanot, Z. Binggeli, P. Deckers, J. Friis, I. Gratzer, G. Hermy, M. Heyn, M. Honnay, O. Paris, M. Sterck, F.J. Muys, B. Bongers, F. Healey, J.R. Conservation of the Ethiopian church forests: threats, opportunities and implications for their management. Science of the Total Environment, 2016.
DOI: 10.1016/j.scitotenv.2016.02.034

[64] Mwendera, E.J. Mohamed Saleem, M.A. Infiltration rates, surface runoff, and soil loss as influenced by grazing pressure in the Ethiopian highlands. Soil Use and Management, 1997, 13: 29-35.

[65] Dickinson, J.L. Zuckerberg, B.J. Bonter, D.N. Citizen science as an ecological research tool: challenges and benefits. Annual Revision Ecology and Evolution, 2010, 41: 149-72.

[66] Githiru, M. Lens, L. Adriaensen, F. Mwangombe, J. Matthysen, E. Using science to guide conservation: From landscape modelling to increased connectivity in the Taita Hills, SE Kenya. Journal for Nature Conservation, 2011, 19: 263-268.

[67] Denier, L. Scherr, S. Shames, S. Chatterton, P. Hovani, L. Stam, N. The little sustainable landscape book. Global canopy programme, Oxford, England, UK, 2015.

[68] Nadembega, P. Boussim, J.I. Nikiema, J.B. Poli, F. Antognoni, F. Medicinal plants in Baskoure, Kourittenga Province, Burkina Faso: an Ethnobotanical study. Journal of Ethnopharmacology, 2011, 133: 378-395.

[69] Kadir, M.F. Sayeed, M.S.B. Mia, M.M. Ethnopharmacological survey of medicinal plants used by traditional healers in Bangladesh for gastrointestinal disorders. Journal of Ethno pharmacology, 2013, 147: 148-156.

[70] Mahunnah, R.L.A. Ethnobotany and conservation of medicinal plants in Africa, The way forward in the next decade. In: Adeniji, (ed.) Proceedings of the 15th Meeting of the Inter-African experts committee on African traditional medicine and medicinal plants, Arusha, Tanzania, 2002.

[71] Moravec, I. Fernández, E. Vlkova, M. Milella, L. Ethnobotany of medicinal plants of northern Ethiopia. Boletin, 2014, 13(2): 126 - 134.

[72] Akram, M. Siddiqui, M.I. Akhter, N. Waqas, M.K. Iqbal, Z. Akram, M. Khan, A.A. Madni, A. Asif, H.M.

DOI: https://doi.org/10.30564/re.v2i3.2367

Ethnobotanical survey of common medicinal plants used by people of district Sargodha, Punjab, Pakistan. Journal of Medicinal Plants Research, 2011, 5: 7073-7075.

[73] Ovesna, J. Kucera, L. Hornickova, J. Svobodova, L. Stavelikova, H. Velisek, J. Milella, L. Diversity of S-alk(en)yl cysteine sulphoxide content within a putative core collection of garlic (Allium sativum L.) and its association with morphological and genetic background assessed by AFLP. Scientia Horticulturae, 2011, 129: 541 - 547.

[74] Prance, G.T. Balee, W. Boom, B.M. Carneiro, R.L. Quantitative ethnobotany and the case for conservation in Amazonian. Conservation Biology, 1987, 1: 296-310.

[75] Risser, P.G. The status of the science examining ecotones-A dynamic aspect of landscape is the area of steep gradients between more homogeneous vegetation associations. Bioscience, 1995, 45: 318-325.

[76] Naiman, R.J. Johnston, C.A. Kelley, J.C. Alteration of North American Streams by beaver BioScience. 1988, 38: 753-762.

[77] Petts, G.E. The role of ecotones in aquatic landscape management, In: Naiman, R.J. & Décamps, H. (eds.). The ecology and management of aquatic-terrestrial ecotones, UNESCO, Paris, FR. 1990: 227-261.

[78] Grau, O. Castell, X.F. Ninot, J.M. Ferre, A. Trends in altitudinal distribution of plant diversity in the Catalan Pyrenees. Conference paper, Department of Biology, University of Bergen, Allégaten 41, N-5007, Bergen, Norway, 2011.

[79] Roberson, E. Medicinal plants at risk, A native plant conservation campaign report. Technical Report, Center for Biological Diversity, 2008. http://www.scribd.com/doc/75492242/ Medicinal-Plants-at-Risk

[80] Amsalu, N. Bezie, Y. Fentahun, M. Alemayehu, A. Amsalu, G. Use and conservation of medicinal plants by indigenous people of Gozamin Wereda, East Gojjam zone of Amhara region, Ethiopia: an Ethnobotanical approach. Evidence-Based Complementary and Alternative Medicine, 2018: 23.

[81] Tolossa, T.J. Megersa, M. Ethnobotanical Study of Medicinal Plants Used to Treat Human Diseases in Berbere District, Bale Zone of Oromia Regional State, South East Ethiopia. Evidence-Based Complementary and Alternative Medicine, 2018, 16: 1-33.

[82] Yineger, H. Kelbessa, E. Bekele, T. Lulekal, E. Plants used in traditional management of human ailments at Bale Mountain National Park, Southeastern Ethiopia. Journal of Medicinal Plant Research, 2008, 2: 132-153.

[83] Schippmann, U. Leaman, D. Cunningham, A.B. Impact of cultivation and gathering of medicinal plants on biodiversity: Global Trends and Issues. FAO, Rome, Italy, 2002.

 DOI: https://doi.org/10.30564/re.v2i3.2367