A Participatory Assessment of Forest Biodiversity Resources and Level of Threat in Hararge Area, Eastern Ethiopia

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Abstract: Ethiopia was endowed with abundant and diversified flora and fauna. Especially, forest ecosystem is one the important habitats which provide as home of variety of life. Thus, wood vegetation that covered almost all of the area is reduced due to mismanagement, limited awareness of forest value and high population pressure. Particularly, the forest resources of Harari region, eastern and west Hararge zone has been degraded dramatically. The study was conducted in eastern part of Ethiopia in both east and west Hararge zones. The aim of the study was to collect and document threatened forest Biodiversity species found in the study area for conservation priority. Data were collected community based participatory using single visit transect walk, informal interviews of elder community and review other literature. The collected data was summarized by table, percent and figure. A total of 112 forest species were recorded. Out of them 34.8% plant species were highly threatened, 22.3% species near threatened and 42.9% were least threatened plant species. Hence, it is recommended to establish legal basis for the in situ and ex situ conservation sites for the conservation of the priority species. In addition, there is an urgent need to apply biotechnology to propagate some of the priority species and raise public awareness on the value of forest genetic resources.

Keywords: Ethiopia, Forest Genetic Resource, Hararge, Threatened, Indigenous Knowledge

1. Introduction

Ethiopia is one of the top 25 biodiversity-rich countries in the world [1], and hosts two of the world’s 34 biodiversity hotspots, namely the Eastern Afromontane and the Horn of Africa hotspots. It is also among the countries in the Horn of Africa regarded as major centre of diversity and endemism for several plant species. The Ethiopian flora is estimated to about 6000 species of higher plants of which 10% are considered to be endemic [2]. Woody plants constitute about 1000 species out of which 300 are trees.

Forests form the major constituents of vegetation resources and thus conservation of forest genetic resources (FGRs) is among the priority areas of biodiversity conservation in Ethiopia. Efforts have been made to conserve and sustainably utilize FGRs in the country. Notable examples of such efforts are floristic, structure and socio-economic studies of woody plant species in Afromotane forests of the country; FGR conservation strategies and establishment of in situ and ex situ conservation sites.

Studies have shown that tropical forests are being destroyed at an alarming rate [3, 4, 5, 6]. Deforestation has been contributing to a decline in forest cover, loss of biodiversity both at global and national levels [7, 8]. Expansion of agricultural land as a result of over-increasing population growth, increase demand for fuel wood and construction material, illegal settlements within forests, logging and illegal trade were considered as major contributing factors to the loss of forest resources. Moreover, poverty and lack of alternative livelihoods have been driving forces of forest destruction [9, 10]. The annual rate of deforestation in Ethiopia was found to be extremely high [11, 12].

Particularly, the forest resource of Harari region eastern and west Hararge zone has been dramatically degraded due to limited agricultural land, over grazing, limited awareness of
forest value, due to high population pressure, mismanagement and recurrent drought. Moreover, absence forest protected areas and weak law enforcement, limited floristic document on forest diversity and conservation status are tackle for future conservation and research in the region. These situations are urgently called for forest data collection and writing forest biodiversity resource document in this region. Therefore, the objective of this study was to collect and document tree and shrub species found in Harari, eastern and west Hararge; to identify threatened species for priority conservation.

2. Methodology

2.1. Description of the Study Area

The study was conducted in the eastern part of Ethiopia at West and East, Hararge zones of Oromyia region and Harari region. The study area is situated approximately 400 km east of the capital, Addis Ababa. It is bordered by east Showa zone in the west, Arsi zone in south west, Bale zone in the south, Somali National Regional State in the east and south-east, and Dire Dawa Administrative Council in the north. The study area has 541 kebeles from east Hararge, 449 from west Hararge and 36 from Harari which have totally 1026 kebele (the lowest administrative structure in Ethiopia). The study area has the total area of approximately 4 million square kilometer. The physiographic condition of the study area is characterized by plateaus, rugged dissected mountains, deep valleys, gorges and plains. There are various prominent mountains and peaks in the area; Kundudo and Gara Mullata mountain chain are the major ones.

![Figure 1. Map of the study area.](image)
2.2. Methods of Data Collection

The data were collected through community based participatory approach using reconnaissance survey of single field visit; transect walk and informal interviewing with farmers and elder of local community. The survey covered Harari region, Babile, Jarso, Gara Mullata, Meta, Qarsa, Fadis and KurfaChale woredas in East Haragehe zone of Oromiya regional state and also Habro, Asbot, Dindin and Ades Forest of West Hararge. During informal interview respondent was requested to categorize level threat for all of the forest species into three categories: High, Medium and low. Where ‘High’ represent highly threatened plant species, when the population of the plant is rare and declining in the study area. Where ‘medium' represent near threatened plant species, when the population of plant species some was present but, not much abundant generation. Where ‘low’ represent least threatened plant species, when the population of plant species has good regeneration. To help the respondents to categorize the species key questions like trends of plant species, the origin of plant species and importance of individual species were asked.

2.2. Species Identification

Most plant species were identified in the field by the help of the book called flora of Ethiopia and Eritrea. Few species which couldn’t be identified at the field were identified at the herbarium by table. The data on level of plant threat, local name, family plant species some was present but, not much abundant. The collected data were mostly analyzed and summarized by descriptive statics such as, tables and percentages. The study of the vegetation data revealed that a total of 116 plant species were registered from study area. This all were belong to 42 families and 86 genera. Fabaceae was the most dominant family which comprise 24 species. Euphorbiaceae was the second family comprising 7 species. Moraceae and Rosaceae are both the third most abundant families by holding 6 species each. Asteraceae is the fourth family with 5 species while Anacardiaceae, Lamiaceae, Rhamnaceae, Tiliaceae are together ranking fifth by holding 4 Species each. Boraginaceae, Rubiaceae, Spotaceae, and Flacourtiaceae are the sixth altogether by holding 3 species each. The families Acanthaceae, Apocynaceae, Burseraceae, Myrtaceae, Oleaceae, and Simaroubaceae were represented by 2 species while the rest of the families were represented by a single species. The genus Acacia was represented by 10 species, Ficus by 4 species, Grewia and Euphorbia were represented by 3 species each, Cordia, Combretum, Grewia, Prunus, Ziziphus, Acanthus, Rhocicissus, Commiphora, Boswelia and Albizia by 2 species each. The rest of the genera of the survey area contained a single species each (Table 1).

Out of the 116 plant species 53 (45.7%) were categorized as highly threatened, 26 (22.4%) as medially threatened, and 37 (31.9%) as least threatened by the local community. Out of the 53 plant species categorized as highly threatened 22 were tree, 24 were Shrub, 6 species were exhibiting tree or shrub life-forms, and 1 species was herbaceous.

Among the recorded woody plant species, there was a number of plant species that are already nationally red listed (following the IUCN threat categories) as threatened species. These include Acacia negrii, Acanthus senii, Cadaba divaricata, Euphorbia burger, Euphorbia dalettiensis, Hagenia abyssinica, Juniperous procera, Prunus fricana and Podocarpus falcatus [22]. On the other hand out of the plants collected from the study area, 16 (13.8 %) were endemic to Ethiopia, calling immediate conservation measures. The endemic plant species in the study area are listed in Table 3.

### 3. Data Analysis

The collected data were mostly analyzed and summarized by table. The data on level of plant threat, local name, family and scientific name was analysed by descriptive statics such as, tables and percentages.

### 4. Results and Discussions

The study of the vegetation data revealed that a total of 116 plant species were registered from study area. This all were belong to 42 families and 86 genera. Fabaceae was the most dominant family which comprise 24 species. Euphorbiaceae was the second family comprising 7 species. Moraceae and Rosaceae are both the third most abundant families by holding 6 species each. Asteraceae is the fourth family with 5 species while Anacardiaceae, Lamiaceae, Rhamnaceae, Tiliaceae are together ranking fifth by holding 4 Species each. Boraginaceae, Rubiaceae, Spotaceae, and Flacourtiaceae are the sixth altogether by holding 3 species each. The families Acanthaceae, Apocynaceae, Burseraceae, Myrtaceae, Oleaceae, and Simaroubaceae were represented by 2 species while the rest of the families were represented by a single species. The genus Acacia was represented by 10 species, Ficus by 4 species, Grewia and Euphorbia were represented by 3 species each, Cordia, Combretum, Grewia, Prunus, Ziziphus, Acanthus, Rhocicissus, Commiphora, Boswelia and Albizia by 2 species each. The rest of the genera of the survey area contained a single species each (Table 1).

| NO. | Scientific name          | Local name | Family      | Level of threat | Habit |
|-----|-------------------------|------------|-------------|----------------|-------|
| 1   | Acacia albida           | Garbi      | Fabaceae    | Medium         | T     |
| 2   | Acacia brevissipce      | Hamareessa | Fabaceae    | High           | T     |
| 3   | Acacia busset           | Harlo      | Fabaceae    | High           | T     |
| 4   | Acacia etabaica         | Doddoti    | Fabaceae    | High           | T     |
| 5   | Acacia lahai            | Laftoo     | Fabaceae    | Medium         | T     |
| 6   | Acacia negrii           | Dhedacha   | Fabaceae    | High           | T     |
| 7   | Acacia nilotica         | Serkama    | Fabaceae    | Medium         | T     |
| 8   | Acacia senegal          | Sobehensiama | Fabaceae | Low            | T     |
| 9   | Acacia seyal            | Wacaudima  | Fabaceae    | Medium         | T     |
| 10  | Acacia tortils          | Dhadacha   | Fabaceae    | High           | T     |
| 11  | Acanthus senii          | Kosorruu   | Acanthaceae | High           | S     |
| 12  | Acoelanthera schimperi  | Qaraaru    | Apocynaceae | Medium         | T     |
| 13  | Albizia lebbeck         | Lebbek     | Fabaceae    | Low            | T     |
| 14  | Albizia lophantha       | Shifire    | Fabaceae    | Low            | T     |
| 15  | Allphylus abyssinicus   | Duruba     | Sapindaceae | Low            | T/S   |
| 16  | Aloe trichosanthe       | Hargiisa   | Aloaceae    | High           | S     |
| 17  | Aningera altissima      | Kuraro/quduba | Spotaceae | High           | T     |
| 18  | Arundinaria alpinia     | Karkaa     | Poeaceae    | Medium         | S     |
| NO. | Scientific name     | Local name     | Family            | Level of threat | Habit |
|-----|-------------------|----------------|-------------------|-----------------|-------|
| 19  | Balanites aegyptiaca | Baddanoo       | Balanitaceae      | High            | T     |
| 20  | Berchemia discolor  | Jajebaa        | Rhamnaceae        | Low             | T     |
| 21  | Calaba divaricata   | Qulqacha        | Capparidaceae     | High            | S     |
| 22  | Caesalpinia decapetala | Qijimaaraaba   | Fabaceae          | Low             | S     |
| 23  | Calpurnea aurea     | Ceekaa         | Fabaceae          | Medium          | S     |
| 24  | Capparis tomentosa  | Ganoora        | Capparidaceae     | Low             | C     |
| 25  | Carissa edulis      | Agarssaa       | Apocynaceae       | Medium          | S     |
| 26  | Celtis africana     | Mataqooma      | Ulmaceae          | Low             | T     |
| 27  | Combretum aculeatum | Totaf          | Combretaceae      | Low             | T     |
| 28  | Combretum molle     | Bikaaka/Rukeesa| Combretaceae      | Medium          | T     |
| 29  | Commiphora africana | Anqa           | Burseraceae       | High            | T/S   |
| 30  | Commiphora erythraea| Hagar          | Burseraceae       | High            | T     |
| 31  | Cordia africana     | Wodeesaa       | Boraginaceae      | High            | T     |
| 32  | Cordia monoica      | Medhero        | Boraginaceae      | Medium          | T/S   |
| 33  | Croton macrostachyus| Mekenisaa      | Euphorbiaceae     | High            | T/S   |
| 34  | Cussonia holstii    | Harfattu        | Araliaceae        | Low             | T     |
| 35  | Dichrostachys cherea| Jirima/adesesa | Fabaceae          | Low             | T/S   |
| 36  | Dodonaea angustifolia| Kikita/dhadacha| Sapindaceae       | Low             | S     |
| 37  | Doyvulis abyssinica | Koshamoo       | Flacourtiaceae    | Low             | S     |
| 38  | Draecena ofromontana| Algehe         | Dracaenaceae      | Low             | S     |
| 39  | Ebrectina cymosa    | Huulaga        | Boraginaceae      | High            | T/S   |
| 40  | Ekebergia capensis  | Somboo         | Meliaeaceae       | Low             | T     |
| 41  | Entada abyssinica   | Kentafa        | Fabaceae          | Low             | T     |
| 42  | Eriobotrya japonica | Woshmella      | Rosaceae          | High            | T/S   |
| 43  | Erythrina brucei    | Walensuu       | Fabaceae          | High            | T     |
| 44  | Eulea schimperi     | Mi, eesa       | Ebenaceae         | Low             | T/S   |
| 45  | Euphorbia burgeri   | Qancaree       | Euphorbiaceae     | High            | S     |
| 46  | Euphorbia dalattensis| Adamii        | Euphorbiaceae     | High            | S     |
| 47  | Euphorbia tirucalli | Qincibba       | Euphorbiaceae     | Low             | T     |
| 48  | Ficus carica        | Beles          | Moraceae          | Low             | T     |
| 49  | Ficus sur           | Qixxu          | Moraceae          | Medium          | T     |
| 50  | Ficus sycomorus     | Lugoo          | Moraceae          | Low             | T     |
| 51  | Ficus vasta         | Odaa           | Moraceae          | High            | T     |
| 52  | Ficus thonningii    | Dambii         | Moraceae          | Medium          | T     |
| 53  | Flacourtia indica   | Hudhaa         | Flacourtiaceae    | High            | T     |
| 54  | Flueggea viroso     | Qacacilee      | Euphorbiaceae     | Medium          | T/S   |
| 55  | Gardenia terminifolia| Gambeloo       | Rubiaceae         | High            | T/S   |
| 56  | Grewia bicolor      | Horeresaa      | Tiliaceae         | Medium          | T     |
| 57  | Grewia tembensis    | Dheekkaa       | Tiliaceae         | Medium          | T     |
| 58  | Grewia villosa      | Ogomooodi      | Tiliaceae         | Low             | S     |
| 59  | Hagenia abyssinica  | Kosso          | Rosaceae          | High            | S     |
| 60  | Hildebrandtia diredawaensis| Dhacdhale | Convolvulaceae | High | S |
| 61  | Indigofera rothii   | Khoshi         | Fabaceae          | High            | S     |
| 62  | Indigofera ellenbeckii| Khoshi       | Fabaceae          | High            | S     |
| 63  | Indigofera stokesii | Jusminum abyssinicum | Oleaceae | Low | C |
| 64  | Juniperus procera   | Gatira         | Cupressaceae      | High            | T     |
| 65  | Justicia schimperiana| Dhumugaa      | Acanthaceae       | High            | S     |
| 66  | Kalanchee lanceolata| Kontorna       | Crussulaceae      | Low             | H     |
| 67  | Kirkia burgeri      | Hudhaasawwa    | Simaroubaceae     | High            | T     |
| 68  | Kirkia tenafolia    | Hudhaasawwa    | Simaroubaceae     | High            | S     |
| 69  | Kotschya recurvifolia| Henna         | Leguminosae       | High            | S     |
| 70  | Lamnea schimperi    | Handarakkhu    | Anacardiaceae     | Low             | T/S   |
| 71  | Maesa lanceolata    | Abbayyi       | Myrsinaceae       | Medium          | S     |
| 72  | Maytenus undata     | Kombolchea     | Celastraceae      | High            | T/S   |
| 73  | Milletea ferruginea | Dedatu, Sotellu| Fabaceae          | High            | T     |
| 74  | Mimusops kummel     | Buriri         | Sapotaceae        | Low             | T     |
| 75  | Moringa oleifera    | Shefera        | Moringaceae       | High            | T     |
| 76  | Myrcisca licifolia  | Abay, kataba   | Myricaceae        | Low             | T     |
| 77  | Myrtus communis     | Ades           | Myrtaceae         | Low             | S     |
| 78  | Ocimum lamifolium   | Darnacasee     | Lamiaceae         | Medium          | S     |
| 79  | Ocimum jamessii     | Qayyadurbaa    | Lamiaceae         | Medium          | S     |
| 80  | Olea europaea       | Ijersa         | Oleaceae          | High            | T     |
| 81  | Oncoba spinosa      | Jilboo         | Flacourtiaceae    | High            | S     |
| 82  | Pappea capensis     | Biiqqua        | Sapindaceae       | Medium          | T     |
| 83  | Phytolacca dodecandra| Handode       | Phytolacaceae     | High            | S     |
| 84  | Plectranthus barbatu | Barbarusha     | Lamiaceae         | Low             | H     |
| 85  | Podocarpus falcatiis| Birbira        | Podocarpaceae     | High            | T     |
| NO. | Scientific name            | Local name | Family         | Level of threat | Habit |
|-----|----------------------------|------------|----------------|----------------|-------|
| 86  | Polygala obtusissima       | Harmal     | Polygalaceae   | High           | S     |
| 87  | Pouteria oliviformis       | Mandhisaa  | Sapotaceae     | Medium         | T     |
| 88  | Premna schimperi           | Urgeessa   | Lamiaceae      | Medium         | S     |
| 89  | Prunus africana            | Hadheessa  | Rosaceae       | High           | T     |
| 90  | Prunus persica             | Kuki       | Rosaceae       | High           | T     |
| 91  | Pyradax schimperiana       | Galo       | Rubiaceae      | Low            | T     |
| 92  | Pterolobium stellatum      | Qajimaa    | Fabaceae       | Low            | S     |
| 93  | Rhamnus prinoides          | Geshoo     | Rhamnaceae     | High           | S     |
| 94  | Rhoicissus revolii         | Dagachebsa | Vitaceae       | Low            | C     |
| 95  | Rhus glutinosa             | Tatessa    | Anacardiaceae  | High           | S     |
| 96  | Rhus retinorrhoea          | Debeluca   | Anacardiaceae  | Low            | S     |
| 97  | Rhus vulgaris              | Rigaawaraabo | Anacardiaceae | Medium         | T/S   |
| 98  | Rhynchosia erlangeri       | Soor-mudu  | Fabaceae       | High           | S     |
| 99  | Ricinus communis           | Qoboo      | Euphorbiaceae  | Medium         | S     |
| 100 | Rosa abyssinica            | Enqoto, Goro | Rosaceae    | High           | S     |
| 101 | Rothmannia urcelliformis   | Buruuri    | Rosaceae       | Low            | S     |
| 102 | Rubus apetalus             | Goraa/Altufa | Rosaceae  | High           | S     |
| 103 | Senecio myrioccephalus     | Ingeshu    | Asteraceae     | High           | S     |
| 104 | Sterculia africana         | Gere       | Sterculiaceae  | Low            | T     |
| 105 | Solanecio angulatus        | Jinraas    | Asteraceae     | High           | H     |
| 106 | Sparmannia macrocarpa      | Wulkifa    | Tiliaceae      | High           | S     |
| 107 | Suregada procera           | Xillo     | Euphorbiaceae  | Medium         | S     |
| 108 | Syzygium guineense         | Baddeessaa | Myrtaceae     | High           | T     |
| 109 | Tamarindus indica          | Roka       | Fabaceae       | High           | T     |
| 110 | Termina liabrownii         | Birensaa   | Combretaceae   | Low            | T     |
| 111 | Vernonia amygdalina        | Grawa/Ebicha | Asteraceae | Medium         | S     |
| 112 | Vernonia leopoldi          | Qaxxee korma | Asteraceae  | High           | S     |
| 113 | Vernonia ruepellii         | Reejji     | Asteraceae     | High           | S     |
| 114 | Woodfordia uniflora        | Marmarte   | Lythraceae     | Low            | S     |
| 115 | Ziziphus mauritiana        | Kurkura    | Rhamnaceae     | Medium         | T/S   |
| 116 | Ziziphus mucronata         | Kurkuragabroo | Rhamnaceae  | Low            | T/S   |

Key: *: Local name is unknown, T: tree, S: shrub, T/S: tree/shrub, H: herbs, C: climber

**Table 2.** Plant Families and number of highly threatened species they contained.

| Families          | Number of highly Threatened Species | Percentage |
|-------------------|------------------------------------|------------|
| Fabaceae          | 11                                 | 20.7       |
| Rosaceae          | 6                                  | 11.3       |
| Asteraceae        | 4                                  | 7.5        |
| Euphorbiaceae     | 3                                  | 5.6        |
| Acanthaceae       | 2                                  | 3.8        |
| Boraginaceae      | 2                                  | 3.8        |
| Burseraceae       | 2                                  | 3.8        |
| Flacourtiaceae    | 2                                  | 3.8        |
| Simaroubaceae     | 2                                  | 3.8        |
| Others in lump sum | 1                                  | 35.9       |

**Table 3.** Endemic plant species collected from the study area.

| NO. | Scientific name            | Local name | Family         |
|-----|----------------------------|------------|----------------|
| 1   | Acacia negrii              | Dhedeca    | Fabaceae       |
| 2   | Acanthus semii             | Kosorruu   | Acanthaceae    |
| 3   | Aloe trichosanthe          | Hargissa   | Aloaceae       |
| 4   | Berchemia discolor         | Jajeba     | Rhamnaceae     |
| 5   | Cadaba divaricata          | Qulqalcha  | Capparidaceae  |
| 6   | Euphorbia burgeri          | Qancaree   | Euphorbiaceae  |
| 7   | Erythrina brucei           | Fabaceae   | Tree           |
| 8   | Euphorbia dalettensis      | hadaamii   | Euphorbiaceae  |
| 9   | Hagenia abyssinica         | Koso       | Rosaceae       |
| 10  | Hildebrandtia diredawaensis | Dhacdhale  | Convolvulaceae |
| 11  | Indigofera ellenbeckii     | Khoshi     | Fabaceae       |
| 12  | Indigofera rothii          | Khoshi     | Fabaceae       |
| 13  | Kirkia burgeri             | Hudhaa Sawwa | Simaroubaceae |
| 14  | Maytenes undata            | Kombolcha  | Celastraceae   |
| 15  | Millettia ferruginea       | Dedatu, Sotellu | Fabaceae       |
| 16  | Moringa oleifera           | Shefera    | Moringaceae    |
| 17  | Vernonia ruepellii         | Reejji     | Asteraceae     |
Table 4. List of the top 22 highly threatened shrub and tree species as their population is highly decreasing.

| No. | Top Threatened species         | Habitat   |
|-----|--------------------------------|-----------|
| 1   | *Acacia brevispice*            | Tree      |
| 2   | *Acacia bussei*                | Tree      |
| 3   | *Acacia etabaica*              | Tree      |
| 4   | *Acacia tortilis*              | Tree      |
| 5   | *Aloe trichosantha*            | Shrub     |
| 6   | *Commiphora africana*          | Tree      |
| 7   | *Commiphora erythraea*         | Tree      |
| 8   | *Croton macrostachyus*         | Tree      |
| 9   | *Delonix rega*                 | Tree      |
| 10  | *Ehretia cymosa*               | Shrub /tree |
| 11  | *Eriobotrya japonica*          | Shrub     |
| 12  | *Flacourtia indica*            | Shrub     |
| 13  | *Justicia schimperiana*        | Shrub     |
| 14  | *Rosa abyssinica*              | Shrub     |
| 15  | *Maytenus undata*              | Shrub     |
| 16  | *Moringa oleifera*             | Shrub     |
| 17  | *Oncoba spinosa*               | Shrub     |
| 18  | *Prunus persica*               | Tree      |
| 19  | *Polygala obtusissima*         | Shrub     |
| 20  | *Rhamnus prinoides*            | Shrub     |
| 21  | *Solanecio angulatus*          | Herbs     |
| 22  | *Tamarindus indica*            | Tree      |

5. Conclusion and Recommendation

The objective of this community-based participatory survey was to identify the threatened forest genetic resource in Hararge area, eastern Ethiopia and to recommend appropriate genetic conservation approaches in the area. The study has revealed 44% of the forest plant species in the study area were categorized as highly threatened by the local community. Among those species some like *Cordia africana*, *Erythrina burci*, *Hagenia abyssinica*, *Juniperous procera*, *Prunus africana* and *Podocarpus falcatus* were already incorporated in the IUCN red data list as vulnerable species [22]. Moreover, the record of population structure showed that 100% tree species listed in IUCN red data list have abnormal population structures with no or few individual's distribution in study area. Therefore, these species need urgent conservation measures that will facilitate healthy regeneration and guarantee sustainable use of the species. In addition, the vegetation survey conducted in the same area in 1996 reported 361 vascular plants species [23] while only 116 species were recorded by the present study which indicates there is marked amount of biodiversity loss. Hence, the following recommendations were suggested:

1. Raise public awareness on the value of forest genetic resources and the problems related to loss of genetic information and devise a mechanism by which human impacts can be minimized through discussion and consultation with the local people.
2. Carry out further studies on the patterns of ecosystem functioning, biology and ecology of the key stone species to be able to restore the composition and structure of the forest.
3. Establish legal basis for the in-situ and ex-situ conservation sites for the conservation of the priority species.
4. Conduct research on storage behaviour (seed physiology) and reproduction biology of woody species that focus on threatened and economically important species.
5. There is an urgent need of application of tissue culture for the rapid and mass propagation of the threatened plant species to conserve the available genetic resource.
6. Increase traditional forest management like, home garden and on-farm conservation.
7. Implement participatory management of protected areas by insuring the benefit shared to the local people.

Conflict of Interests

The authors declare that they have no conflict of interests.

Authors’ Contribution

Tahir Abdela collected the field data by consulting the local people in the study area and prepared the first draft of the manuscript, Girma Eshetu initiated the idea of the research and designed the methodology, and Abebe Worku identified the plant species both in the field and in the herbarium.

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