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Study of Vegetation Composition of Magada Forest, Borana Zone, Oromia, Ethiopia

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Abstract The Magada forest is one of the National Forest Priority Areas (NFPAs), which is located in the southern part of the country in the Borana Zone of Oromia National Regional State. It lies approximately between longitudes 38^0 15' E and 38^0 20' E and latitude 5^0 27 N and 5^0 32' N (EMA, 1987) in between Bule-Hora and Dugda Dawa districts. The objective of this work was to provide a list of plant species found in the forest and to recommend solutions for management and conservation problems. The vegetation compositions of the Magada forest were described based on the vegetation data collected between February 2013 and October 2013. Releves of 30 m x 30 m were taken for the woody species and 2 m x 2 m for field layers. A total of 66 releves were analyzed at altitude between 1750 and 2100 m a.s.l. Data on the species list was collected. A total of 197 species of vascular plants belonging to 64 families were identified. Out of these [100 (50.8 %)] are woody species and [97 (49.2 %)] are non-woody species (field layers). 84.3 % of the families are dicots while 12.5 % are monocots and gymnosperms and pteridophytes comprise 1.6 % each. Asteraceae is the largest family with [18 (9.1%)] followed by Acanthaceae [16 (8.1%)], Lamiaceae and Rubiaceae each with [14 (7.1%)] and Fabaceae [13 (6.6%)] species. The vegetation of the Magada forest is disturbed through grazing and browsing by domestic livestock, cultivation and other human uses. This further retard regeneration processes of the trees and shrubs. Pressure on the resources from human population could intensify and impose more rapid and more degenerative changes. Recognizing these issues as possible future scenario underlines the need for management intervention to increase quality of regeneration being recruited and accelerate the growth of the young plants already present.

Keywords Vegetation Composition, Magada Forest, Borana Zone

1. Introduction

The numerous isolated mature forest trees or patches of forest or woodland of approximately the same species composition as that of the remaining areas with closed forest indicates the extent to which Ethiopian highlands were once forested [17]. There is no accurate or reliable information about the extent and location of the past and present natural forests and woody vegetation cover in Ethiopia. However, historical sources indicate that, on the basis of potential climatic climax high forests might have once covered about 35 – 40 % of the total land area of the country. If the savannah woodlands are included, 66 % of the country has been believed to be covered with forests and woodlands [3].

The country's forest and woodland resources have been declining both in size (deforestation) and quality (degradation) and the current annual loss of high forests is estimated to about 150,000 – 200,000 ha. The main reasons of deforestation are agricultural expansion, uncontrolled exploitation for various purposes, notably for fuel wood charcoal, construction materials, etc, shifting cultivation and forest fire [3] which are closely linked with the vicious cycle of mutually reinforcing factors, i.e. poverty, population growth and the state of the environment. The other reason is inadequate standard of forest management.

The depletion of the natural vegetation in many parts of the country has led to the threat and decline in number and area of distribution of many plant species, and surprisingly, 120 threatened endemic plant species are known from Ethiopia [5]. Unless the present trend of exploiting the remaining spare forest resources, every piece of relict forest remaining will be gone in the very near future [15]. The trend can only be reversed if appropriate measures taken to halt them.

In order to maintain the ecological equilibrium and to meet the forest resources requirement of the population, scientific information is the basis. Several ecological studies have been made in Ethiopia with emphasis on plant community analysis, viz., [11,21,17,13,18,10,19,1,9,7,8,16] Despite these, studies on the ecology and flora of the Magada forest vegetation are lacking.

Therefore, ecological assessment of the existing forests is the basis for meaningful planning to rationally utilize the

remaining forest resources. Thus, the present study has the following objectives (a) to provide a list of plant species found in the forest and (b) to recommend solutions for management and conservation problems.

2. Materials and Methods

2.1. Description of the Study Area

The Magada forest is one of the National Forest Priority Areas (NFPAs), which is located in the southern part of the country in the Borana Zone of Oromia National Regional State. It lies approximately between longitudes 38^0 15' E and 38^0 20' E and latitude 5^0 27 N and 5^0 32' N (EMA 1987) in Bule-Hora district (Fig. 1). The forest covers about 25,012 ha of land [14] and comprises essentially a single compact block of forest, roughly four sided and divided into two unequal sized areas by the main road running north south from Addis Ababa to Nairobi and it is about 485 km away from Addis Ababa.

Magada forest is distinctive in that *Podocarpus* is dominant and mapped by Reference [2] as *Podocarpus* dominated coniferous forest. The altitude of the forest ranges between 1750 – 2100 m a.s.l. The southern and south-eastern parts of the country including the Magada forest area experience a bimodal rainfall pattern from September to November and from March to May. The most reliable rainy months are April and May. The nearest weather station to Magada forest is Bule-Hora town in about 10 km north of the forest edge. From metrological data for 2003 – 2012 the mean annual rainfall in Bule-Hora was 809 mm, and there are two peaks (April and October). The mean annual maximum temperature and the mean annual minimum temperature were 24.5℃ and 11.56℃ respectively. The mean maximum temperature for the hottest month was 28.3℃ in February and mean minimum temperature for coldest month was 8.8℃ in December. The mean annual temperature was 18.03℃. According to FAO (1990) mean annual rainfall and mean temperature were 18.6℃ and 973 mm respectively. The recent data indicated lower precipitation rather than before.

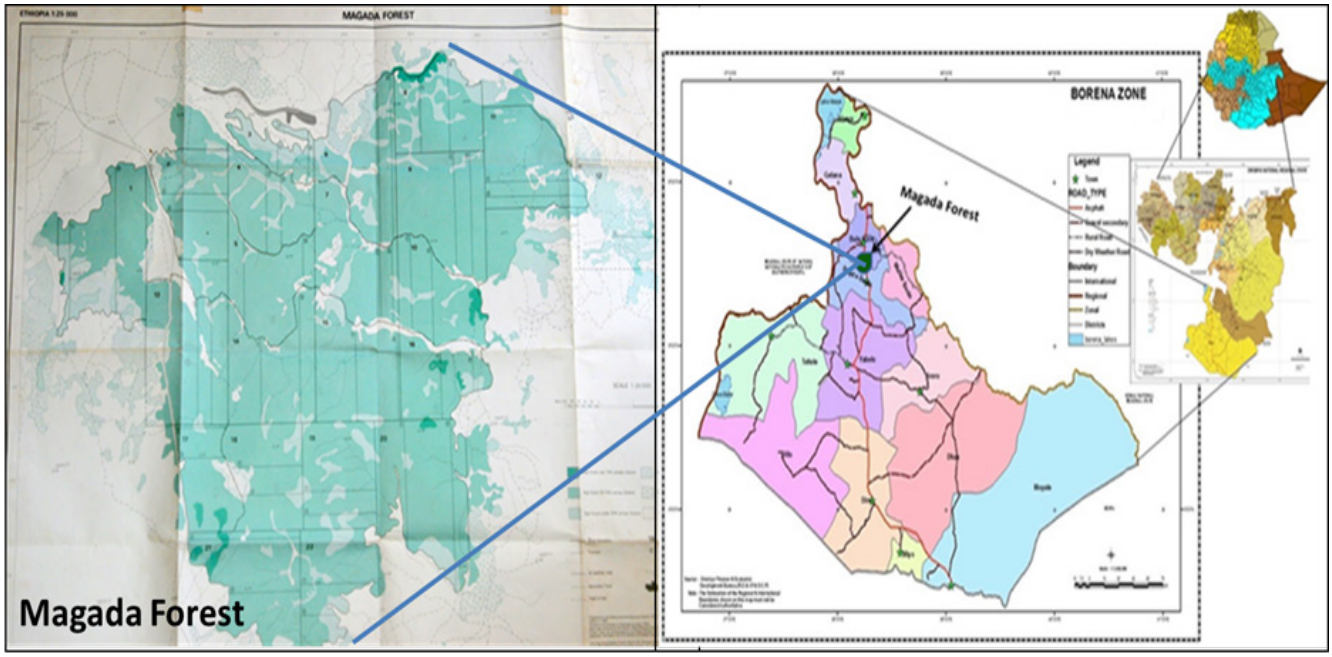

Figure 1. Location Map of Magada Forest in Borana Zone

2.2. Data Collection

A reconnaissance survey was made across the Magada forest on 10 -12 February 2013 in order to obtain an impression of the site conditions and variation in physiognomy of the vegetation. Field data were collected during February 2013 to October 2013. During sampling visually checked homogenous representative stands were subjectively selected (subjective sampling) in such a way that the various conditions encountered were represented by at least one sample.

Sixty six sampling sites 900 m^2 (30 m x 30 m)in size were considered to sample trees and shrubs. Floristic analysis of herbaceous and graminoid species was made on a 2 m x 2 m (4 m^2) sub plots laid within the larger plot where the vegetation was assumed to be representative. At each sampling site altitude was measured using Pretzel digital altimeter and aspect and / or position using Magellan GPS. From each plot a complete list of trees, shrubs and herbs was made.

Additional plant species out of the plot, but in the forest, including the edaphic grasslands were recorded. Regeneration status, dead standing trees, stumps and logs in the plots were noted. Identification of plant specimens was conducted in the National Herbarium (ETH), Addis Ababa University and nomenclature follows that of the published volumes of the Flora of Ethiopia and Eritrea.

3. Result and Discussion

3.1. Floristic Diversity of Magada Forest

A total of 197 species of vascular plants representing 64 families were recorded from the tree, shrubs, and field layers. Of these, 52 (26.4 %) species were trees, 38 (19.3 %) species shrubs, 16 (8.1 %) species climbers including one epiphyte and one semi-parasite, 91 (46.2 %) species were herbs including 3 graminoids and one fern species (Fig. 2). 83.61 per cent of the families were dicots, while 13.11 % monocots, 1.64 % pteridophytes and 1.64 % gymnosperms. The families with the highest number of species were Asteraceae [18 (9.1%)], Acanthaceae [16 (8.1%)], Rubiaceae [14 (7.1%)], Lamiaceae [14 (7.1%)] and Fabaceae [13 (6.6%)]. Fourteen species of climbers belonging to 11 families were recorded from the plots. Three species to Asclepiadaceae, and two Vitaceae, whereas the rest belong to Apocynaceae, Asparagaceae, Celastraceae, Cucurbotaceae, Fabaceae, Oleaceae, Ranunculaceae, Rhamnaceae and Rubiaceae.

The Magada forest is a home for 11 endemic species of plants (Tesfaye Hawas, unpublished database) and 13 indicator species of plants for forest disturbance were identified [12]. The endemic plant species of the Magada forest include *Ceropegia microgaster, Cynoglossum coeruleum, Justicia bizuneshiae, Echinops longisetus, Maytennus addat, Millettia ferruginea, Phylanthus mooney, Saturegia paradoxa, Senecio ochrocarpus, Solanecio gigas, Thunbergia ruspolii* and *Vernonia leopoldi.*

The indicator species for disturbance of the forest include *Achyranthus aspera, Asparagus Africana, Biden biternata, Croton macrostachyus, Cyathula polycephala, Dodonia angustifolia, Galinsoga parviflora, Girardinia bullosa, Pterolobium stellatum, Solanum inacum, Tagetus minuta.*

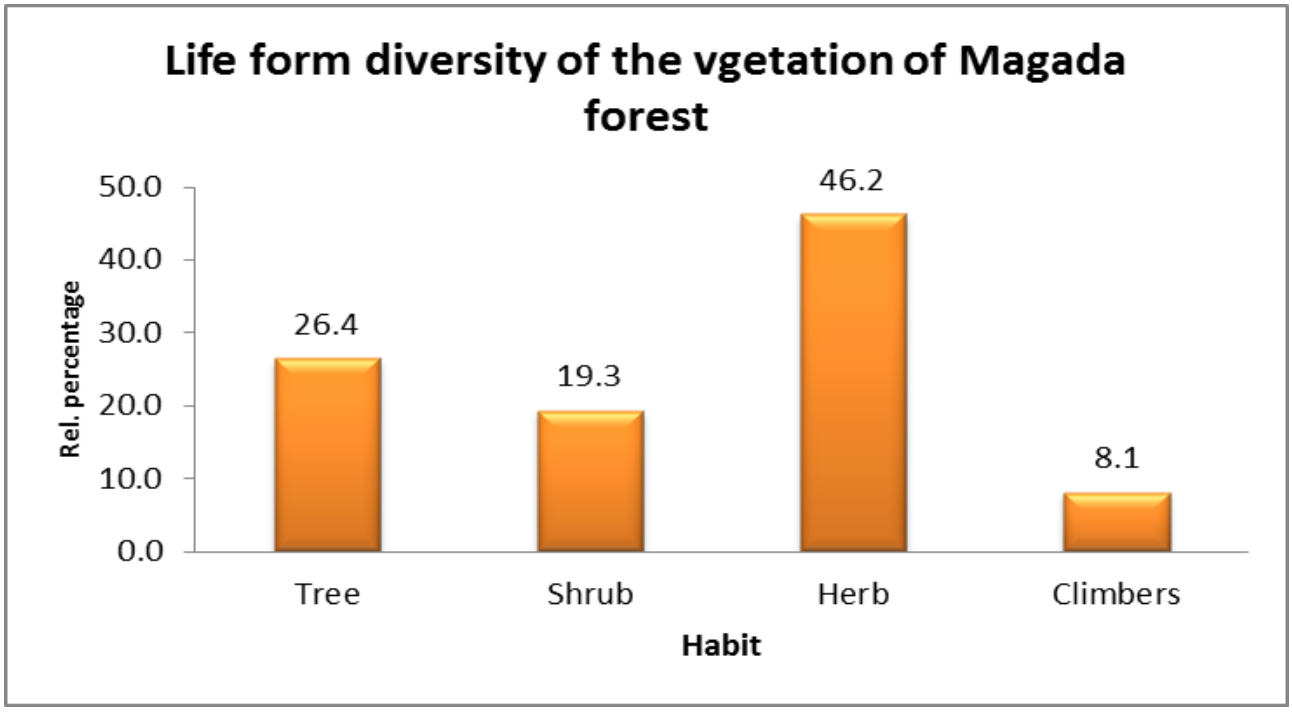

Figure 2. Percentage proportion of Habit diversity of Magada forest

3.2. Vegetation composition of Magada Forest

Table 1. List of tree species of the Magada Forest

R. No.	Species name	Family	Local name	Habit
1	*Abutilion longicuspe* Hochst. Ex A. Rich.	Malvaceae	Arxume Karaabaa	Herb
2	*Acacia abyssinica* Hochst. Ex Benth.	Fabaceae	Xadacha	Tree
3	*Acacia albida* Del.	Fabaceae	Xadacha	Tree
4	*Acanthus eminens* C. B. Clarke	Acanthaceae	Korisa	Shrub
5	*Achyranthes aspera* L.	Amaranthaceae	Dergu	Herb
6	*Achyrocline glumacea* (Dc.) Oliv. & Hiern	Asteraceae	Tombo Loonii	Herb
7	*Acmella caulirhiza* Del	Asteraceae	Jilo Qala	Herb
8	*Acokanthera schimperi* (Dc.) Benth	Apocynaceae	Qaraaru	Tree
9	*Aerva lantana* (L.)Juss. Ex Schutes	Amaranthaceae	Ruffo-qaalu	Herb
10	*Ageratum conyzoides* L.	Asteraceae		Herb
11	*Albizia schimperiana* Oliv.	Fabaceae	Garbii	Tree
12	*Allophylus abyssinica* (Hochst.) Radelk	Sapindaceae	Saarajjii	Tree
13	*Allophylus macrobotryus* Gilg.	Sapindaceae	Hiqa-qamu	Shrub
14	*Apodytes dimidiata* E.Mey. Ex Benth.	Icacinaceae	Me'ee	Tree
15	*Asparagus africanus* Lam. (Sarittii)	Asparagaceae	Sarittii	Climber
16	*Asparagus racemosus* Willd.	Asparagaceae	Hiddo	Shrub
17	*Aspilia mossambicensis* (Oliv.) Wild.	Asteraceae	Hirbo	Herb
18	*Baphia abyssinica* Brummit	Fabaceae	Jibaata	Shrub
19	*Barleria ventricosa* Hochst. Ex Nees	Acanthaceae	Uddoottu	Herb
20	*Bersama abyssinica* Fresen.	Meliantaceae	Xibiro	Tree
21	*Biden biternata* (Lour)	Asteraceae	Haadaa	Herb
22	*Brucea antidysenterica* J.F.Mill	Simaroubaceae	Qomanyoo	Tree
23	*Calpurnia aurea* (Ait.) Benth.	Fabaceae	Cekkataa	Shrub
24	*Canthium lactescens* Hiern.	Rubiaceae	Korbo	Shrub
25	*Carissa spinarum* L.	Apocynaceae	Agamsa	Shrub
26	*Cassipourea malosana* (Baker) Alston	Rhizophoraceae	Xillo	Tree
27	*Celtis africana* Burm. f.	Celtidaceae	Mataqomaa	Tree
28	*Ceropegia microgaster* M.G. Gilbert	Asclepiadaceae	Dhamsa Wocco	Climber
29	*Chenopodium murale* L.	Chenopodiaceae		Herb
30	*Chionanthus mildbraedii* (Gilg & Schellenb.) Stearn	Oleaceae	Walicho	Tree
31	*Cissus petiolata* Hook. f.	Vitaceae	Araayyee	Climber
32	*Clausena anisata* (Willd.) Benth	Rutaceae	Xir'dho	Shrub
33	*Clematis hirsuta* Perr. & Guill.	Ranunculaceae	Fittii	Climber
34	*Clerodendrum myricoides* L.	Lamiaceae		Shrub
35	*Clutia abyssinica* Jaub. & Spach.	Euphorbiaceae	Muka dhiigaa	Shrub
36	*Combretum collinum* Fresen.	Combretaceae	Hallo	Tree
37	*Combretum molle* R. Br. ex G.Don	Combretaceae	Rukkensa	Tree
38	*Commelina africana* L.	Commelinaceae		Herb
39	*Commelina benghalensis* L.	Commelinaceae	Littu	Herb
40	*Commelina diffusa* Burm.f.	Commelinaceae	Qaayyo	Herb
41	*Cordia africana* Lam	Boraginaceae	Wodessa	Tree
42	*Crinum abyssinicum* Hochst. Ex.A.Rich	Amarylidaceae	Bute-woraabessaa	Herb
43	*Crotolaria cylindrica* A. Rich.	Fabaceae	Saayisa	Herb

44	*Croton macrostachyus* Del.	Euphorbiaceae	Makkanisa	Tree
45	*Cucumis aculeatus* Cogn.	Cucurbotaceae		Climber
46	*Cyanoglossum coeruleum* Steud. Ex DC.	Boraginaceae	Maxannii	Herb
47	*Cyathula uncinulata* (Schrad.)Schinz	Amaranthaceae	Nenqqo	Herb
48	*Cycniopsis humifusa* (Forssk.)Engl.	Scrophulariaceae		Herb
49	*Cycnium tubulosum* (L.f.)Engl	Scrophulariaceae	Maa'saltu	Herb
50	*Cyperus fischerianus* A. Rich.	Cyperaceae	Shakkotaa	Herb
51	*Cyperus nigricans* Steud.	Cyperaceae	Qundhii	Herb
52	*Desmodium repandum* (Vahl) DC.	Fabaceae	Qoffe badaa	Herb
53	*Dicliptera maculata* Nees.	Acanthaceae	Degu	Herb
54	*Dicrocephala integrifolia* (L.f.)O. Kuntze	Asteraceae		Herb
55	*Dodonea angustifolia* L.	Sapindaceae	Dhitacha	Shrub
56	*Dombeya torrida* (J.F. Gmel.) P. Bambs	Sterculiaceae	Daanisa	Tree
57	*Dovyalis abyssinica* (A.Rich.) Warb.	Flacourtiaceae	Kurawa	Shrub
58	*Dregea schimperri* (Dec.) Bull.	Asclepiadaceae	Yabalu	Climber
59	*Drimia altissima* (L.f.) Ker-Gwal	Hyacintaceae	Mirtu	Herb
60	*Dyschoriste multicaulis* (A.Rich.).O.Ktze	Acanthaceae	Xuyyale	Herb
61	*Dyschoriste radicans* Nees	Acanthaceae		Herb
62	*Echinops longisetus* A. Rich	Asteraceae	Gogodhu	Shrub
63	*Ehretia cymosa* Thonn. var. Silvatica (Guerke) Brenen	Boraginaceae	Uraagaa	Tree
64	*Ekebergia capensis* Sparm	Meliaceae	Anonnu	Tree
65	*Erianthemum dregei* (Eckl. & Zeyh.) Tiegh	Loranthaceae	Baaldo	Semi-para
66	*Euclea divinorum* Hiern.	Ebenaceae	Mi'essaa	Tree
67	*Euphorbia adjurana* Bally & Carter	Euphorbiaceae	Adaammaa	Tree
68	*Faurea speciosa* Welw.	Proteaceae	Daanse	Tree
69	*Ficus thonningii* Blume	Moraceae	Dambii	Tree
70	*Ficus vasta* Forssk.	Moraceae	Qilxaa	Tree
71	*Flacourtia indica* (Burm. f.) Merr.	Flacourtiaceae	Akkoku	Tree
72	*Galinsoga parviflora* Cav.	Asteraceae	Ruffo Kadhe	Herb
73	*Galium spurium* L.	Rubiaceae	Qaqabatto	Herb
74	*Gardenia ternifolia* Schumach. & Thonn.	Rubiaceae	Gambello	Tree
75	*Girardinia diversifolia* (Link)Friis	Urticaceae	Dobbii	Herb
76	*Gnidia stenophylla* Gilg.	Thymelaeaceae	Arsaa	Herb
77	*Grewia bicolor* Juss.	Tiliaceae	Dhoqonnu	Shrub
78	*Grewia ferruginea* Hochst. ex A. Rich.	Tiliaceae	Dhoqonnu	Shrub
79	*Grewia kakothamnos* K. Schum.	Tiliaceae	Dhoqonnu	Shrub
80	*Guizotia scabra* (Vis.)Chiov	Asteraceae	Hirbo	Herb
81	*Helinus mystacinus* (Ait.) E. Mey. ex Steud	Rhamnaceae	Homachisaa	Climber
82	*Hippocratea goetzei* Loes.	Celastraceae	Xixxixaa	Climber
83	*Hypoestes aristata* (Vahl)Roem. & Schult	Acanthaceae	Dergu	Herb
84	*Hypoestes forsskaolii* (Vahl)R. Br	Acanthaceae	Dergu	Herb
85	*Hypoestes triflora* (Forssk)Roem. & Schult	Acanthaceae	Dergu	Herb
86	*Indigofera atriceps* Hook.F.	Fabaceae	Silinqaa	Herb
87	*Isoglosa somalensis* Lind	Lamiaceae		Herb
88	*Jasminum abyssinicum* Hochst. ex DC	Oleaceae	Dikkii	Climber
89	*Justicia bizuneshiae* Ensermu	Acanthaceae	Dergu	Herb

90	*Justicia exigua* S. Moore	Acanthaceae	Dergu	Herb
91	*Justicia ladanoides*Lam.	Acanthaceae	Dergu	Herb
92	*Kalanchoe schimperiana* A.Rich	Crassulaceae	Bosoqqe	Herb
93	*Kleinia grantii* (Oliv. & Hiern) Hook.f.	Asteraceae	Tombo Loonii	Herb
94	*Kohautia platyphylla* (K. Schum.)Bremek.	Rubiaceae	Danse diqqo	Herb
95	*Landolfia buchananii* (Hall. f.)Stapf	Apocynaceae	Hophii	Climber
96	*Lantana trifolia* L.	Verbanaceae	Uddo	Herb
97	*Lantana viburnoides* (Forssk.)Vahl	Verbanaceae	Dubaro	Shrub
98	*Leonotis ocymifolia* (Burm. f.) Iwarsson	Lamiaceae	Qimamii gaalaa	Herb
99	*Lepidotrichilia volkensii* (Gurke) Leroy	Meliaceae	Saakarro	Tree
100	*Leucas argentea* Gurke var. argentea	Lamiaceae		Herb
101	*Leucas martinicensis* (Jacq.)R. Br.	Lamiaceae		Herb
102	*Lippia adoensis* Hochst. Ex Walp	Lamiaceae	Dama kasse	Herb
103	*Lippia vibrunoides* (Forssk.) Vahl.	Lamiaceae	Qaya dubraa	Herb
104	*Margaritaria discoidea* (Baill.) Webster	Euphorbiaceae	Bobiyyaa	Tree
105	*Maytenus addat* (Loes.) Sebsebe	Celastraceae	Hagalaa	Tree
106	*Maytenus arbutifolia* (A. Rich) Wilczek	Celastraceae	Kombolicha	Shrub
107	*Maytenus grassilipes* (Welw.)Ex Oliv.)Exell	Celastraceae	Kombolicha hido	Shrub
108	*Maytenus senegalensis* (Lam.) Exell	Celastraceae	Kombolicha bofe	Shrub
109	*Maytenus undata* (Thunb.)Blacklock	Celastraceae	Okoluu	Tree
110	*Millettia ferruginea* (Hochst.) Bak.	Fabaceae	Dhadhattu	Tree
111	*Mimusops kummel* A. DC	Sapotaceae	Olaatii	Tree
112	*Monothecium glandulosum* Hochst.	Acanthaceae	Qaxine	Herb
113	*Mussaenda arcuata* Poir.	Rubiaceae	Idime	Climber
114	*Nuxia congesta* R. Br. ex Fresen	Loganiaceae	Udessa	Tree
115	*Ochna holstii* Engl.	Ochnacaea	Koraayyu	Tree
116	*Ocimum suave* Willd (Hancabbii)	Lamiaceae	Hancabbii	Herb
117	*Oldenlandia corymbosa* L.	Rubiaceae		Herb
118	*Olea capensis ssp macrocarpa* (C.H. Wright) Verdo	Oleaceae	Gagamaa	Tree
119	*Olea europaea ssp cuspidata* (Wall.ex. Dc.) Cifferri	Oleaceae	Ejarsa	Tree
120	*Olea welwitschii* (Knobl.) Gilg & Schellenb	Oleaceae	sawwaa	Tree
121	*Olinia rochetiana* A. Juss	Oliniaceae	Qadiida daalacha	Tree
122	*Oplismenus hirtellus* (L.) P. Beauv.	Poaceae	Buushe	Herb
123	*Otostegia tomentosa* A. Rich	Lamiaceae		Herb
124	*Oxalis corniculata* L.	Oxalidaceae	Butiyye	Herb
125	*Oxalis radicosa* A. Rich	Oxalidaceae	Sodara'o	Herb
126	*Oxyanthus speciosus* DC.	Rubiaceae		Shrub
127	*Panicum hochstetteri* Steud.	Poaceae	Mara	Herb
128	*Pavetta abyssinica Fresen.*	Rubiaceae	Dhggo	Shrub
129	*Pavonia glechomifolia* (A. rich.) Garcke	Malvaceae	Iccinnii	Herb
130	*Pentanisia ouranogyne* S. Moore	Rubiaceae		Herb
131	*Pentas Lanceolata* (Forssk.)Deflers	Rubiaceae	Cunfaa	Herb
132	*Periploca linearifolia* Quart. Dill & A. Rich.	Asclepiadaceae	Gaalee	Climber
133	*Persicaria setosula* (A. Rich.) K.L.Wilson	Polygonaceae		Herb
134	*Phaulopsis imbricata* (Forssk.) Sweet	Acanthaceae	Qaxine	Herb
135	*Phoenix reclinata* Jacq.	Arecaceae	Meexxii	Shrub

136	*Phyllanthus boehmii* Pax.	Euphorbiaceae	Guurii	Herb
137	*Phyllanthus mooneyi* M. Gilbert	Euphorbiaceae	Hadha Wayo	Herb
138	*Phyllanthus sepialis* Arg. Muell	Euphorbiaceae	Dhirrii baddaa	Herb
139	*Physalis peruviana* L.	Solanaceae	Hawixxi	Herb
140	*Pittosporum viridiflorum* Sims.	Pittosporaceae	Irbaa	Tree
141	*Plantago lanceolata* (Tourn.)L.	Plantaginaceae	Qunnii	Herb
142	*Plantago palmate* Hook. F.	Plantaginaceae		Herb
143	*Plectocephalus varians* (A. Rich.) C. Jeffery ex. Cuf.	Asteraceae		Herb
144	*Plectranthus punctatus* (L.) L' Herit	Lamiaceae	Obbaa	Herb
145	*Plectranthus sylvestris* Gurkee	Lamiaceae	Bullee	Herb
146	*Podocarpus falcatus* (Thurn) Mirb.	Podocaraceae	Birbirsa	Tree
147	*Polyschias fulva* (Hiern.) Harms	Araliaceae	Talaa	Tree
148	*Polystachya rivae* Schweinf.	Orchidaceae	Liiqaaqqaa	Epiphyte
149	*Premna schimperi* Engl.	Verbanaceae	Xulangee	Shrub
150	*Prunus africanus* (Hook. f.) Kalkman	Rosaceae	Sukke	Tree
151	*Psychotria orophila* Petit.	Rubiaceae	Buna durii	Tree
152	*Psydrax schimperiana* (A. Richs.) Bridson	Rubiaceae	Gaalloo	Tree
153	*Pteridium aquilinum* (L.) Kuhn	Dennstaedtiaceae	Tariccaa	Fern/Herb
154	*Pterolobium stellatum* (Forssk.)Brenan.	Fabaceae	Qajimaa	Climber
155	*Ranunculus multifidus* Forssk.	Ranunculaceae		Herb
156	*Rhamnus prinoides* L'Herit	Rhamnaceae	Gesho	Shrub
157	*Rhoicissus tridentata* (L. f.) Wild & Drummond	Vitaceae	Laallu	Climber
158	*Rhus natalensis* Krauss	Anacardiaceae	Dabobesa	Tree
159	*Rhus vulgaris* Meikle	Anacardiaceae	Xaaxesaa	Shrub
160	*Ritchiea albersii* Gilg.	Capparidaceae	Qalqalicha	Tree
161	*Rubus steudnerii* Schweinf.	Rosaceae	Goraa	Shrub
162	*Ruellia prostrata* Poir.	Acanthaceae		Herb
163	*Rumex nepalensis* Spreng.	Polygonaceae	Dhangaggo	Herb
164	*Rytigynia neglecta* (Hiern) Robyns	Rubiaceae	Miqqe	Shrub
165	*Salvia nilotica* Juss. Ex Jacq.	Lamiaceae		Herb
166	*Satureja paradoxa* (Vatke) Engl.	Lamiaceae		Herb
167	*Schrebera alata* (Hochst.) Welw.	Oleaceae	Dhamme	Tree
168	*Senecio ochrocarpus* Oliv. & Hiern	Asteraceae		Herb
169	*Setaria verticillata* (L.) Beauv.	Poaceae	Suutaa	Herb
170	*Sida ovata* Forssk.	Malvaceae	Arxume Karaabaa	Shrub
171	*Sida ternata* L.f.	Malvaceae	Dekkala	Herb
172	*Solanecio gigas* (Vatke) C.Jeffery	Asteraceae	Ginbodhaa	Shrub
173	*Solanum anguivi* Lam.	Solanaceae	Hidii Woraabessa	Shrub
174	*Solanum capsicoides* Guatteri	Solanaceae	Hiddii	Shrub
175	*Solanum incanum* L.	Solanaceae	Hiddi gamojjii	Shrub
176	*Staganotaenia eraliaceae* Hochst. ex A. Rich.	Apiaceae	Luqaan luqqe	Tree
177	*Stephania abyssinica* (Dill. & A. Rich) Walp	Menispermaceae	Kalaaltu	Herb
178	*Syzygium guineense* ssp *guineense* (Willd.) Dc.	Myrtaceae	Badesa	Tree
179	*Syzygium guineense* ssp *macrocarpum* (Engl.) F. White	Myrtaceae	Awwaajjo	Tree
180	*Tagetes minuta* L.	Asteraceae	Sunkii	Herb
181	*Teclea nobilis* Del.	Rutaceae	Hadhesa arabee	Shrub

182	*Teclea simplicifolia* (Engl.) Verdoorn	Rutaceae	Hadhessa	Shrub
183	*Terminalia schimperiana* Hochst.	Combretaceae	Dabaqqaa	Tree
184	*Thalictrum rhynchocarpum* Dillon and A. Rich	Ranunculaceae	Ali hanqaa	Herb
185	*Thunbergia alata* Boj. Ex Sims.	Acanthaceae	Surupha worabesaa	Herb
186	*Thunbergia ruspolli* Lindu	Acanthaceae	Nitii buqataa	Herb
187	*Tragia cinerea* (Pax)Gilbert & Radel. -Smith	Euphorbiaceae	Laaleesaa	Herb
188	*Trichilia dregeana* Sond	Meliaceae	(Sisaa	Tree
189	*Trifolium multinerve* A. Rich.	Fabaceae	Saayisa	Herb
190	*Triumfetta tomentosa* Boj.	Tiliaceae	Daanigola	Herb
191	*Vangueria apiculata* K. Schum.	Rubiaceae	Na dhala	Tree
192	*Vernonia amygdalina* Del.	Asteraceae	Ebicha	Shrub
193	*Vernonia auriculifera* Hiern.	Asteraceae	Reejjii	Shrub
194	*Vernonia bipontinii* Vatke	Asteraceae	Soyyamme	Shrub
195	*Vernonia leopoldi* (Sch. Bip. Ex Walp) Vatke	Asteraceae	Soyyamme	Shrub
196	*Vigna membranacea* A. Rich	Fabaceae	Dirro	Herb
197	*Zornia pratensis* Milne-Redh.	Fabaceae		Herb

Picture 1: Edaphic grassland in the middle of the forest

Picture 2: Illegal logging in the Magada forest

Picture 3: Livestock grazing inside the Magada forest

3.3. Disturbances of the Magada Forest

The forest areas which are located in the flat terrain and valley bottoms are highly disturbed by human interference with their cattle since they are found in the flat terrain and valley bottoms. This disturbance might lead to the establishment of large herbs such as *Girardina diversifolia, Triumfetta tomentosa, Rumex abyssinicus* and *Persicaria setosula.* Large numbers of *Cassipouria malosana* were found topped by humans to make fodder for their livestock.

The southern edge of the forest has been subjected to high human interference. People from the surrounding villages took their domestic animals to the forest every day for grazing and returned home back holding bundles of firewood for their daily use as energy source and for selling as an income source. The local informants told that people from coffee growing areas located adjacent to the forest (Kilensso Makonisa, Burqa Ebala, Kilensso Rassaa are few examples) were supplied firewood from this forest. Large bunches of firewood for selling along the main asphalt road near Walga'ii village is very common, which confirms the information. As a result of severe exploitation, this vegetation community has an open canopy. The trees are scarce and short due to frequent disturbance made by the local people and their livestock. Moreover, disturbance might have led to the establishment different climbers such as *Pterolobium stellatum*, and large herbs. Although many of them were re-sprouting, large numbers of *Trichilia drageana, Rytigynia neglecta, Celtis africana* and *Cassipourea malosana* stumps were noted.

The peak of the forest area is situated at an altitude of 2050 m. a.s.l. and severely disturbed by human interference. There were cattle pens and pastoralists' dry season huts and around more than three hectares of land of this area was devoid of trees, which are indication of pastoralists' settlement during the dry season finding fodder for their cattle.

In addition the forest of Magada includes large areas of edaphic grasslands within the forest (Picture 1). The vegetation of these areas include *Leucas martinicensis*, *L. argentea,Thunbergia ruspolli, Thunbergia alata, Lantana viburnoides, L. trifolia, Bidens biternata, Cycnium tubulosum, Cycniopsis humifusa, Cynoglossum coerleum, Plectocephalus varians, Guizotia scabra, Commelina africana, Commelina benghalensis, Commelina diffusa Cyperus nigricans, C. fischerianus,* and *Panicum hochstetteri.* Although these areas have natural beauty, its presence inside the forest exerts high pressure on the forest vegetation. It invites human interferences. The local communities use these areas as communal grazing fields, so that large numbers of livestock move long distance crossing the forest in all directions to arrive at the fields. The trampling effects not only damage the standing vegetation but also severely affect the regeneration capacity the forest vegetation.

To the northern part of the forest, hundreds of hectares of forested land were heavily deforested and replaced by annual and perennial food and cash crops including maize, enset, coffee, and chat. Expansion of coffee and chat cultivation in the area, which is driven by economic need of the local people, has brought new dimension of forest destruction.

Over the years, large tracts of the vegetation of Magada forest have been subjected to illegal logging (Picture 2), forest grazing (Picture 3), permanent and temporary expansion of human settlements and plantation agriculture. Selective illegal logging in this forest involves the removal of best individuals from the forest without regard for replacement or regeneration of the exploited stand. This may lead to a shift in species composition increasing the proportion of more light demanding and fast growing trees.

In general, the vegetation of Magada forest is disturbed through grazing and browsing by domestic livestock, cultivation and other human uses. Trampling, which is one of the main source of disturbances in the forest is not uncommon. Timber harvest, spread of human settlement and the intensification of agriculture are some principal forces behind changes in land use. All disturbed forests are considered as secondary forests, irrespective of the intensity of disturbance [20].

Regular and frequent disturbance by goat and cattle may lead to abnormally small tree sizes. This further retards regeneration of the tree and shrubs. Human disturbances in the forest are manifested by the presence of abundant *Achyranthes aspera* population in the herb layer. This species is known to be indicator of previous human disturbance [12]). Most parts of the forest revealed more evidence of past exploitation (stumps and pit sawing). Pressure on the resources from human population could intensify and impose more rapid and more degenerative changes. Recognizing these issues as a possible future scenario underlines the need for management intervention to increase the quality of regeneration being recruited and to accelerate the growth of the young plants already present.

4. Conclusions and Recommendation

The floristic description indicated the presence of high species diversity (64 families represented by 197 species) in the forest. Out of these 14 endemic species, which are already in the red list of IUCN, and indicator species for forest disturbance have been recorded. The indicator species showed that the forest was under degradation and had not got emphasis by the scientific community and concerned department that should manage the forest. In most part of the forest evidence of past exploitation (stumps and pit sawing) have been observed. The vegetation of the Magada forest is disturbed through grazing and browsing by domestic livestock, agricultural expansion and other human uses. These further retard regeneration processes of the trees and shrubs. Pressure on the resource from human population could intensify and impose more rapid and more degenerative changes. Recognizing these issues as possible future scenario underlines the need for effective management intervention to increase quality of regeneration

being recruited and to accelerate the growth of the young plants already present so that effective utilization of the forest on sustainable bases will be assured. To ease the present human influence on the natural forest, and for a future management of the forest on a sustainable basis, the following recommendations are made:

- Participatory forest management programs should be introduced so that local communities assume responsibility for the management and conservation of the forest, and end up as the beneficiaries of economic benefits ensuing from these activities,
- Raising awareness, through extension programs, on the multiple use of forest resources and forest ecosystems,
- Agro forestry practices should be introduced and encouraged so that local communities can obtain multiple uses out of it,
- Natural regeneration of species in the forest can be facilitated through reduced grazing/browsing pressure,
- Cattle rearing, a basic livelihood in the area, should be carried out commensurate with the carrying capacity of the environment,
- The planning and management of forests can be assisted with research findings, and therefore, more basic and applied research should be encouraged.

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