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Tree species distribution in natural forest and the factors affecting its diversity and structure in Menit Goldia Woreda, Western Omo Zone, Southwestern Ethiopia

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ABSTRACT

This research evaluated tree species distribution and determinants influencing diversity and structural composition within natural forests of Menit-Goldia Woreda. Data collection occurred in three Kebelles using both primary and secondary sources. Primary data were acquired through field observations and systematically sampled forest plots. A total of 35 forest plots (300, 400, and 500 m²) were established along transect lines spaced 50-100 meters apart. Tree density, height, and Diameter at Breast Height measurements characterized vegetative structure. Regeneration status was assessed in five 1m × 1m subplots, categorizing trees as saplings or seedlings. Interviews with 39 participants identified factors contributing to forest degradation using structured questionnaires during key informant interviews and focus group discussions. Data analysis utilized SPSS and Microsoft Excel with descriptive statistics and Pearson correlation analysis. The survey identified 16 tree species across 11 families, with Fabaceae being the most predominant, followed by Moraceae and Combretaceae. The Shannon-Wiener diversity index (H') and evenness value (J) were 2.5 and 0.92, respectively. Millettia ferruginea and Comberut mole had the highest frequency (20.7% of total basal area). Comberut mole exhibited the highest Importance Value Index (IVI), followed by Ficus vasta and Cordia Africana, while Ficus sur had the lowest. Seedlings, saplings, and adult trees comprised 20.8%, 16.8%, and 62.4% of the population, respectively, indicating fair regeneration. Significant negative correlations existed between forest decline and population growth (-0.95), agricultural expansion (-0.91), resettlement (-0.79), and charcoal production (-0.64). Conservation efforts should include raising local awareness, exploring alternative livelihood options, and promoting afforestation initiatives.

INTRODUCTION

Forest cover globally represents approximately 31% of Earth's terrestrial surface (FAO, 2020). These ecosystems are critical for biodiversity conservation, climate regulation, carbon sequestration, soil preservation, and water management. Forest structure and composition vary considerably, from dense tropical rainforests with high biodiversity to temperate and boreal forests with different ecological characteristics (Tedersoo et al., 2017). Understanding specific drivers of change and ecological implications of forest cover shifts is essential for effective conservation (Keenan et al., 2015).

In Africa, forests occupy approximately 17% of the continent's land area, reflecting diverse climatic and ecological zones (FAO, 2020). These forests encompass tropical rainforests, dry forests, and montane forests, each with distinct floristic diversity and structural characteristics. Climatic variations, particularly temperature and precipitation, significantly influence tree species composition and diversity (Mason et al., 2015). Tropical forests typically exhibit greater species richness compared to savannah woodlands due to more favorable growing conditions (Malhi et al., 2014). However, African forests face severe threats from deforestation driven by agricultural expansion, overexploitation for energy and timber, logging, and infrastructure development (González et al., 2018). The continent loses more than 4 million hectares of forest annually, exacerbating biodiversity loss and increasing carbon emissions (Nasi et al., 2020).

Ethiopia's forest cover is approximately 15.2% (17.35 million hectares), including bamboo, dense woodlands, natural forests, and planted forests (MEFCC, 2015; EFDP, 2019). The country's forests exhibit diverse tree species with high endemism reflecting varied climatic and topographic conditions (Becker et al., 2016). Ethiopia ranks fifth in floral diversity in tropical Africa, supporting rich flora and fauna, including numerous endemic species (Motuma et al., 2010). Estimates suggest Ethiopia hosts 6,000-7,000 higher plant species, with approximately 780-840 species (12-13%) considered endemic (Girma et al., 2004; Nune et al., 2007). Ethiopia's montane forests are among Africa's richest biodiversity reservoirs, supporting numerous endemic species and providing significant ecosystem services (Friis et al., 2010).

Southwestern Ethiopia is renowned for its rich forest cover and exceptional tree species diversity, contributing significantly to the country's overall biodiversity. This region contains most of Ethiopia's remaining forests, including moist evergreen forests, montane forests, and transitional forests, each with distinct ecological features and species compositions (Birhanu et al., 2021).

Menit-Goldia Woreda, situated in the West Omo Zone of Southwestern Ethiopia, contains an extensive variety of flora and fauna, including numerous endemic species. This area represents one of the few remaining Afro-montane forests in southern and southwestern Ethiopia. These forests are integral to local livelihoods, providing timber, non-timber forest products, and supporting agricultural practices (Moges & Abiy, 2018). While several studies have examined tree species diversity in southwestern Ethiopia, research gaps remain regarding tree species distribution and factors affecting diversity and structure, specifically within Menit-Goldia Woreda's natural forests (Gidey et al., 2023).

MATERIALS AND METHODS

Study Area

The study was conducted in Menit-Goldiya Woreda, West Omo Zone of the South West Ethiopia Peoples Regional State (SWEPRS), between 06°39′ 07′ North latitude and 35°14′ to 35°30″ East longitude (Figure 1). The Woreda is bordered by the south Menit Shasha, west Debub Bench, northwest Shay Bench, and northeast Kaffa Zone. Elevation ranges from 1000 to 2200 meters above sea level. The Woreda is 180 km from the regional capital, Bonga, and 626 km from Addis Ababa. According to the Central Statistics Agency (CSA, 2007), the Woreda has a total population of 88,863 (49% men, 51% women), with 2.9% urban dwellers. Bachuma serves as the administrative town, with 18 rural Kebelles and 5 town Kebelles. The total surface area is approximately 114,500 hectares.

Data Collection

Primary data on vegetation components, including species composition, density (seedling, sapling, and tree), frequency, plant height, and Diameter at Breast Height (DBH) were recorded (Neelo et al., 2015). Three Kebelles (Gas, Gimbab, and Deka) were purposively selected based on forest availability and coverage. A total of 35 sample forest plots (15 m × 20 m [300 m²], 20 m × 20 m [400 m²], and 20 m × 25 m [500 m²]) were established: 15 in Gas, 10 in Gimbab, and 10 in Deka Kebelle. Plot size differences reflected variations in forest cover among Kebelles. Transects were spaced 50 meters apart in Gas Kebelle and 100 meters apart in Gimbab and Deka Kebelle, considering tree abundance and forest cover size (Worku et al., 2022; Siraj et al., 2023).

A Systematic sampling design was used to collect vegetation data. Forests were divided into 15, 10, and 10 fragments in Gas, Gimbab, and Deka kebele, respectively. A total of 35 plots were established proportionally along transect lines at 10-meter intervals. All tree species were identified by local and/or scientific names using reference materials (Aezene et al., 2007; Bein et al., 1996) and assistance from local people and forest experts from the Woreda natural resource office.

Tree density, height, and Diameter at Breast Height (DBH) data were collected and utilized for characterizing the vegetative structure. The tree species were classified into distinct growth forms. Based on their dimensions. Seedlings and saplings were identified in five 1m × 1m subplots (four at the corners and one at the center). A seedling was defined as an individual stem with a DBH of less than 2 cm and a height below 1.5 m, while saplings were delineated as individuals with a DBH of less than 2 cm and a height ranging from 1.5 to 2 m. Mature trees were classified as individuals with a DBH of 2 cm or more and a height of 2 m or greater, according to the standards set forth by Temesgen & Werkineh (2020) and Negesse & Woldearegay (2022). A caliper was used to record DBH readings at a height of around 1.3 meters above the ground, which were subsequently translated into DBH units. Additionally, a clinometer was used to measure the trees' height.

Data Analysis

Microsoft Excel and SPSS (version 2.17) calculated vegetation structure based on density, frequency, DBH, basal area (BA), and Important Value Index (IVI) (Yinger et al., 2008; Kebede et al., 2016; Brhan et al., 2018). The following metrics were computed: dominance, IVI, relative density, relative frequency, and basal area (Mueller et al., 1974).

1. Relative density (RD%)=(No. of individual species A)/(total No. of individual in the area)*100
2. Density (D)=(Count of individual species A)/(sampled area)
3. Diameter at breast Height (DBH)=C/π Where, C is circumference, π is 3.14
4. Basal area of a tree (BA)= π $d^2/4$, where BA is the basal area in square meter per hectare, d is the diameter at breast height in meter and π = 3.14.
5. Dominance (Do)=(Basal area or total cover of species A)/(sampled area)
6. Relative Dominance (RDo%)=(dominance of species A)/(total dominance of all species)*100
7. Relative frequency (RF%)=(Frequency value for species A)/(Total of all frequency values for all species)*100
8. Important value index (IVI) = Relative density + relative frequency + relative dominance

Diversity was analyzed using the Shannon diversity Index (H') and evenness index (E) (Yinger et al., 2008; Gurmessa et al., 2012). The Shannon diversity index considers species richness and evenness (Teketay et al., 2018), typically ranging between 1.5 and 3.5, rarely exceeding 4.5 (Gebrehiwot et al., 2019). Scores > 3 indicate high diversity, 2-3 medium, 1-2 low, and ≤ 1.0 very low diversity (Atsbha et al., 2019). Abundance and diameter data were log-transformed. Diversity indices and true diversity were computed using SPSS (Cardelus et al., 2019; Tesfamariam et al., 2019). The Shannon diversity index was computed as:

$$H' = -\sum_{i=1}^{s} Pi \ln Pi$$

Where H′ Shannon-Wiener diversity index, S the number of species existed in the study site, Pi the proportion of individuals in the ith species and ln natural logarithm.

Simpson's diversity index is a measure of diversity which takes into account the number of species present as well as the relative abundance of each species. Simpson's diversity index was calculated using the following formula: Simpson's diversity Index (D) was calculated as:

$$D = 1 - \sum_{n=1}^{s} (Pi)^2$$

Where D is a Simpson's diversity index, S is number of species; and Pi is proportion of total sample belonging to ith species. Evenness (Shannon equitability index) was calculated as:

$$J = \frac{H'}{H\,max} = \frac{H'}{\ln s}$$

Where J is Shannon equitability (evenness), H′ is Shannon-Wiener diversity index, H′max = lnS is the natural logarithm and S is the total number of species in the sample existed at the study site.

Regeneration status was categorized as: (1) optimal regeneration: seedling density > mature trees > sapling density; (2) moderate regeneration: seedling density ≥ sapling density ≤ mature tree density; (3) inadequate regeneration: species only in sapling phase without seedlings; (4) absence of regeneration: species only in mature form; (5) nascent regeneration: absence of mature trees with saplings and/or seedlings present (Tiwari et al., 2010; Dhaulkhandi et al., 2008).

RESULTS AND DISCUSSION

Species Composition and Diversity

The survey identified 16 distinct tree species across 11 families in Menit Goldia Woreda's natural forests. Fabaceae, Moraceae, Combretaceae, and Euphorbiaceae were most prominent, including species such as *Erythrina abyssinica*, *Albizia gummifera*, *Millettia ferruginea*; *Ficus vasta* and *Ficus sur*; *Combretum mole*; *Combretum collinum* Fres; *Hevea brasiliensis* and *Croton macrostachys*, respectively (Table 1). Boraginaceae, Rosaceae, Myrtaceae, Sapotaceae, Apocynaceae, Asteraceae, and Cupressaceae each contained only one tree species.

The most abundant tree species were *Comberut mole* (Gonut) at 18.6% (83), *Cordia africana* at 12.9% (58), and *Ficus vasta* at 14.3% (64). The least abundant were *Ficus sur* (Shola) at 2% (9), *Hevea brasiliensis* (Dobit) at 2.24% (10), and *Acokanthera schimperi* (Kerero) at 2.46% (11). This indicates a relatively uniform distribution of tree species across the study area.

The Shannon-Wiener diversity index (H'), Simpson diversity index (D), and evenness (J) values were 2.55, 0.90, and 0.92, respectively, indicating notable species diversity and balanced distribution of individual trees within the tree community of Menit Goldia Woreda (Table 2).

Table 1. Tree species composition and distribution in the natural forests of Menit Goldia

No.	Family	Specie Name	Local name	Number count	Percentage
1	*Combretaceae*	*Comberut mole*	Gonut	83	18.57
2	*Boraginaceae*	*Cordia Africana*	Wanza	58	12.98
3	*Moraceae*	*Ficus vasta*	Warka	64	14.32
4	*Rosaceae*	*Prunus Africana*	Omach	23	5.15
5	*Myrtaceae*	*Syzygium guineense*	Dokma	29	6.49
6	*Fabaceae*	*Erythrina Abyssinica*	Berach	22	4.92
7	*Sapotaceae*	*Manilkara butugi*	Goshut	25	5.59
8	*Moraceae*	*Ficus sur*	Shola	9	2.01
9	*Fabaceae*	*Alibiza gummifera*	Sesa	23	5.15
10	*Combretaceae*	*Combretum collinum Fres*	Gagut	13	2.91
11	*Euphorbiaceae*	*Hevea brasiliensis*	Dobit	10	2.24
12	*Apocynaceae*	*Acokanthera schimpero*	Kerero	11	2.46
13	*Fabaceae*	*Millettia ferruginea*	Zegut	17	3.80
14	*Asteraceae*	*Vernonica amygdalina Del*	Jampach	21	4.70
15	*Euphorbiaceae*	*Croton macrostachys*	Gombelit	21	4.70
16	*Cupressaceae*	*Juniperus procera*	Tsid	18	4.03
Total				447	100

Table 2. Tree species distribution, diversity, and evenness in Menit Goldia

Diversity	Study Kebelle			Menit Goldia
	Gimbab	Gas	Decka	
SDI (*H'*)	1.568	2.308	2.154	2.547
SDI (*D*)	0.791	0.897	0.886	0.905
Equitability (*J*)	0.974	0.963	0.981	0.919

Frequency

Millettia ferruginea (zegut) was the most frequent tree species, occurring in 99% of surveyed forest plots, followed by *Comberut mole* (Gonut) (96%), *Alibiza gummifera* (Sesa) and *Vernonica amygdalina* Del (Jampach) (95% each), and *Combretum collinum* Fres (Gagut) (90%). These five species contributed 37.21% of the total relative frequency. Conversely, *Croton macrostachys* (Gombelit), *Manilkara butugi* (Goshut), and *Ficus sur* (Shola) had lower occurrence, contributing 14.38% of total relative frequencies. This variation is attributed to habitat preferences, regeneration ability, and disturbance degree.

Density of Tree Species

The density of all tree species was 6544.66 stems ha^{-1} (Table 3). The five largest contributors were *Comberut mole* (1215.2 stems ha^{-1}), *Ficus vasta* (937.04 stems ha^{-1}), *Cordia Africana* (849.19 stems ha^{-1}), *Syzygium guineense* (424.6 stems ha^{-1}), and *Manilkara butugi* (366.03 stems ha^{-1}), accounting for 57.9% of total forest cover. In contrast, *Ficus sur*, *Hevea brasiliensis*, and *Acokanthera schimpero* were the rarest species, representing less than 7% of the forest.

The density of individuals with DBH ≤10 cm was 1478.77 stems ha^{-1}, while those with DBH between 10-20 cm and >20 cm were 263.54 stems ha^{-1} and 4802.34 stems ha^{-1}, respectively (Table 5). The ratio between DBH class (10-20 cm) and DBH >20 cm was 0.06:18.22, indicating that medium-sized trees (DBH ≤10 cm) were much less abundant than large-sized trees (DBH >20 cm).

Table 3. Tree species structures in the natural forests of Menit Goldia

Species	Local name	F	RF (%)	D (stems ha^{-1})	RD	BA
Comberut mole	Gonut	0.96	7.52	1215.23	271.86	3.89
Cordia Africana	Wanza	0.86	6.76	849.19	189.98	4.13
Ficus vasta	Warka	0.72	5.61	937.04	209.63	2.92
Prunus Africana	Omach	0.85	6.66	336.75	75.34	0.15
Syzygium guineense	Dokma	0.75	5.88	424.60	94.99	3.21
Erythrina Abyssinica	Berach	0.80	6.27	322.11	72.06	4.60
Manilkara butugi	Goshut	0.62	4.82	366.03	81.89	4.47
Ficus sur	Shola	0.62	4.86	131.77	29.48	0.74
Alibiza gummifera	Sesa	0.95	7.44	336.75	75.34	0.00
Combretum collinum Fres	Gagut	0.90	7.05	190.34	42.58	0.06
Hevea brasiliensis	Dobit	0.67	5.25	146.41	32.75	6.31
Acokanthera schimpero	Kerero	0.73	5.72	161.05	36.03	1.93
Millettia ferruginea	Zegut	0.99	7.76	248.90	55.68	3.68
Vernonica amygdalina Del	Jampach	0.95	7.44	307.47	68.78	0.01
Croton macrostachys	Gombelit	0.60	4.70	307.47	68.78	0.13
Juniperus procera	Tsid	0.80	6.27	263.54	58.96	0.27
Total	16	12.77	100	6544.66	1464.13	36.49

Basal Area

The basal area of all tree species was 36.49 m^2 ha^{-1} (Table 3). The five species with the largest basal area were *Hevea brasiliensis* (17.28%), *Erythrina Abyssinica* (12.61%), *Manilkara butugi* (12.24%), *Cordia africana* (11.31%), *Comberut mole* (10.66%), and *Millettia ferruginea* (10.08%). These species constituted 74.19% of the total basal area.

The three Kebelles differed in basal area composition. *Cordia africana*, *Syzygium guineense*, and *Comberut mole* comprised 98% of basal area in Gimbab Kebelle, while *Hevea brasiliensis*, *Comberut mole*, and *Millettia ferruginea* covered 64.8% and 64.27% in Gas Kebelle, and *Ficus vasta*, *Manilkara butugi*, and *Erythrina Abyssinica* dominated in Deka Kebelle. This demonstrates that the relative importance of tree species varied among Kebelles.

Important Value Index (IVI)

Comberut mole (17.43%), *Ficus vasta* (13.41%), *Cordia africana* (12.5%), and *Syzygium guineense* (6.59%) were the most significant tree species, accounting for 49.94% of the overall IVI value (Table 4). *Ficus sur* (2.18%), *Acokanthera schimpero* (2.83%), and *Combretum collinum* Fres (2.9%) had the lowest IVI values.

Table 4. Important value index (IVI) of tree species in the natural forests of Menit Goldia

Species	Local name	DBH (cm)	Do	RDo	IVI (%)
Comberut mole	Gonut	0.4979	7.78	10.66	29.00 (17.43)
Cordia Africana	Wanza	0.5127	8.26	11.31	20.81 (12.5)
Ficus vasta	Warka	0.4310	5.83	7.99	22.32 (13.41)
Prunus africana	Omach	0.0987	0.31	0.42	8.24 (4.95)
Syzygium guineense	Dokma	0.4522	6.42	8.80	10.97 (6.58)
Erythrina Abyssinica	Berach	0.5414	9.20	12.61	9.09 (5.46)
Manilkara butugi	Goshut	0.5334	8.94	12.24	9.89 (5.95)
Ficus sur	Shola	0.2166	1.47	2.02	3.64 (2.18)
Alibiza gummifera	Sesa	0.0127	0.01	0.01	8.28 (4.97)
Combretum collinum Fres	Gagut	0.0637	0.13	0.17	4.98 (2.99)
Hevea brasiliensis	Dobit	0.6338	12.61	17.28	5.53 (3.32)
Acokanthera schimpero	Kerero	0.3503	3.85	5.28	4.70 (2.83)
Millettia ferruginea	Zegut	0.4841	7.36	10.08	7.35 (4.42)
Vernonica amygdalina Del	Jampach	0.0223	0.02	0.02	7.62 (4.58)
Croton macrostachys	Gombelit	0.0924	0.27	0.37	7.39 (4.44)
Juniperus procera	Tsid	0.1306	0.54	0.73	6.60 (3.96)
Total	16	5.0738	72.99	100	166.41 (100)

Each species' IVI percentage was divided into five classifications (Table 6). Class 1 had the greatest IVI value, followed by classes 4 and 2, which together comprised 87.5% of overall IVI value.

Table 5. Diameter at breast height (DBH) class intervals tree species in the natural forests of Menit Goldia

Class	Range	DBH (cm)	Density (stems ha^{-1})	Counts	Percentage
1	<0.013	0.013	263.543	1	6.25
2	0.014-0.17	0.29	1478.770	5	31.25
3	0.18-0.32	0.22	131.772	1	6.25
4	0.33-0.48	1.23	1522.694	3	18.75
5	>0.49	3.20	3147.877	6	37.5
Total		5.07	6544.656	16	100

Table 6. Importance value index (IVI) proportion of species belonging to each class in the natural forests of Menit Goldia

IVI Class	Class interval (%)	No. of species	Sum of IVI	Percentage
1	<3.64	1	3.64	6.25
2	3.65-9.98	11	79.67	68.75
3	10.10-16.32	1	10.97	6.25
4	16.33-22.66	2	43.13	12.5
5	>22.66	1	29.00	6.25
Total		16	166.41	100

Regeneration Status

The population size of seedlings, saplings, and mature trees examined from the representative forest samples in Gimbab, Gas, and Deka Kebelles was used to determine the regeneration status of the natural forest in Menit Goldia Woreda. As a result, the study's findings indicated that, in Gas Kebelle, the forest's regeneration status was fair because the number of seedlings was higher than that of saplings and the population of saplings was lower than that of matured trees (seedlings > saplings < matured trees). In Gimbab and Deka Kebelles, on the other hand, the forest's regeneration status was poor because the numbers of seedlings and saplings were lower than those of mature trees (seedlings < saplings < matured trees) (Figure 2 (b) (c) &

(d)).Nonetheless, it was clear from the data gathered from these Kebelles, which were utilized to examine the general regeneration state of the Menit Goldia natural forest, that the distribution and overall population of seedlings were greater than those of saplings, and that the sapling population was smaller than that of mature trees (Figure 2 (a)). This suggests that Menit Goldia Woreda's forest is at a fair state of general recovery.

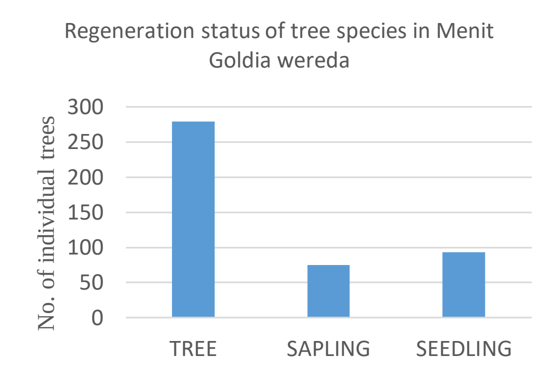

Figure 2 (a). Growth status of tree species

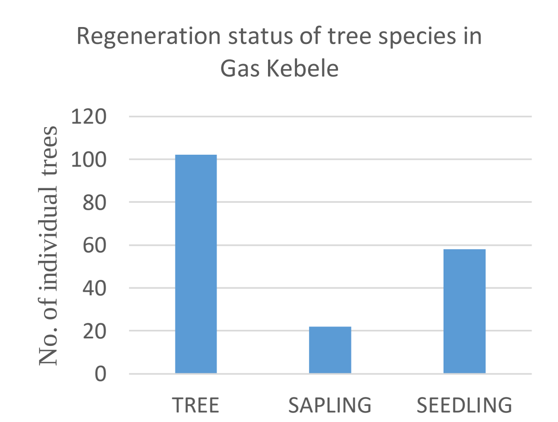

Figure 2 (c). Growth status of tree species

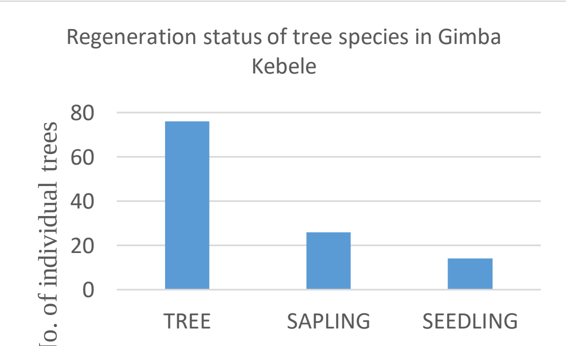

Figure 2 (b). Growth status of tree species

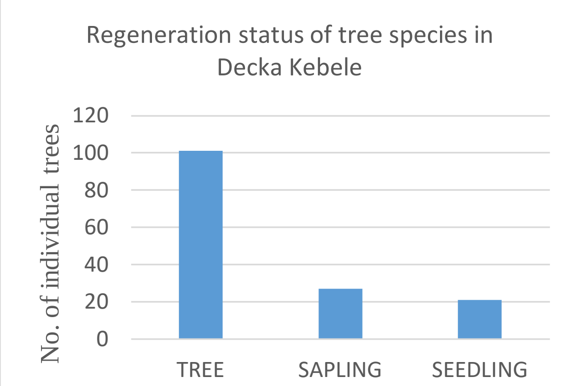

Figure 2 (d). Growth status of tree species

Figure 1. Regeneration status of natural forests in Menit Goldia

The study found that 43.75% of tree species, including *Millettia ferruginea*, *Hevea brasiliensis*, *Syzygium guineense*, *Erythrina Abyssinica*, *Comberut mole*, and *Manilkara butugi*, were only observed in mature stage with no regeneration signs. This may result from low natural regeneration capacity or lack of restoration efforts. In contrast, 25% of species showed strong regeneration (*Croton macrostachys*, *Alibiza gummifera*, *Prunus africana*, *Vernonica amygdalina* Del), 25% showed poor regeneration (*Ficus vasta*, *Ficus sur*, *Combretum collinum* Fres, *Juniperus procera*), and 6.25% (*Cordia Africana*) showed moderate regeneration.

The 16 woody species diversity in Menit Goldia Woreda is lower than in other Ethiopian forests like Wurg Forest (76 species) (Girma and Melese, 2020), Guraferda Forest (66 species) (Hundera and Deboch, 2008), Lammo Natural Forest (54 species) (Bekele and Abebe, 2016), and Wotagisho Forest (51 species) (Unbushe and Tekle, 2016). *Comberut mole*, *Erythrina abyssinica*, *Manilkara butugi*, and *Alibiza gummifera* were identified as endemic to Ethiopia, highlighting the need for conservation initiatives.

The Shannon-Wiener diversity index (H') of 2.55 and evenness index (J) of 0.92 indicate relatively high species diversity and evenness, consistent with findings from other Ethiopian forests (Girma and Melese, 2020; Senbeta, 2006). These indices are fundamental for ecosystem stability and resilience (Magurran, 2004).

The most frequent tree species (*Millettia ferruginea*, *Comberut mole*, *Alibiza gummifera*, *Vernonica amygdalina*) accounted for 37.21% of total relative frequency. The overall tree density (6,544.66 stems ha^{-1}) was higher than in other Ethiopian forests (3,328.47 stems ha^{-1} in Girma and Melese, 2020; 1,745.27 stems ha^{-1} in Siraj and Zhang, 2018).

The lack of regeneration in 43.75% of species (*Comberut mole*, *Millettia ferruginea*) is consistent with other studies showing mature tropical forest species often lack juvenile cohorts due to habitat degradation or anthropogenic pressures (Lutz et al., 2018). This absence may precipitate long-term forest degradation (Abiyu et al., 2020). In contrast, the robust regeneration in 25% of species (*Prunus africana*, *Alibiza gummifera*) suggests resilience and capacity to establish despite competitive pressures (Negash and Olsson, 2014).

CONCLUSION

Forests in Menit Goldia Woreda represent a subset of Ethiopia's southwestern natural forests, containing economically and ecologically significant flora. Despite their critical value, these forests face threats from natural phenomena and anthropogenic influences, resulting in a substantial reduction in area and biodiversity. The study identified 16 tree species across 11 families, with moderate diversity (H' = 2.55) and good evenness (J = 0.92). The regeneration status was fair overall, though varied among Kebelles. Significant negative correlations existed between forest decline and population growth, agricultural expansion, resettlement, and charcoal production.

Conservation efforts should focus on raising local awareness, exploring alternative livelihood options, and promoting private and community-led afforestation initiatives. Special attention should be given to endemic species showing poor regeneration. Further research is needed to understand the specific ecological requirements of threatened species and develop targeted conservation strategies.

REFERENCES

Abiyu, A., et al. (2020). Regeneration status of woody species in dry Afromontane forests of Ethiopia. *Forest Ecology and Management*, 456, 117732.

Ahrens, C.W., et al. (2020). Plant functional traits differ in adaptability and are predicted to be differentially affected by climate change. *Ecology and Evolution*, 10, 232–244.

Allen, C. D., et al. (2015). On underestimation of global vulnerability to tree mortality and forest die-off from hotter drought in the Anthropocene. *Ecosphere*, 6(8), art129.

Atsbha, T., et al. (2019). Woody species diversity, population structure, and regeneration status in the Grat-Kahsu natural vegetation southern Tigray of Ethiopia. *Heliyon*, 5, e01120.

Becker, M., et al. (2016). The forests of Ethiopia: Diversity, distribution and conservation. *Biodiversity and Conservation*, 25(14), 2647-2669.

Bekele, T., & Abebe, M. (2016). Diversity and regeneration status of woody species in Lammo Natural Forest, Ethiopia. *Journal of Forestry Research*, 27(3), 653-663.

Birhanu, T., et al. (2021). Floristic composition, structure and regeneration status of woody plants in church forests of Dangila, Northwestern Ethiopia. *Cogent Food & Agriculture*, 7(1), 1932.

Cardelus, C.L., et al. (2019). Human disturbance impacts the integrity of sacred church forests, Ethiopia. *PLoS ONE*, 14(1), e0210151.

Chave, J. (2004). Neutral theory and community ecology. *Ecology Letters*, 7(7), 241-253.

Crowther, T.W., et al. (2015). Mapping tree density at a global scale. Nature, 525, 201–205.

Daniel, H., et al. (2024). Ecological study and forest degradation of the Waldiba Monastery woodland in Tigrai, Ethiopia. *Discover Sustainability*, 5, 57.

De Cárcer, P. S., et al. (2017). Responses of antinomic foliar traits to experimental climate forcing in beech and spruce saplings. *Environmental and Experimental Botany*, 140, 128-140.

EFDP (Ethiopian Forestry Development Program). (2019). National Forest Inventory Report. Addis Ababa, Ethiopia.

FAO (Food and Agriculture Organization). (2020). The State of the World's Forest 2020: Forests, Biodiversity and People. Rome, Italy.

Forrester, D. I., et al. (2016). Drought responses by individual tree species are not often correlated with tree species diversity in

European forests. *Journal of Applied Ecology*, 53(6), 1725–1734.

Gebre, A.B., Birhane, E., Gebresamuel, G., Hadgu, K.M., Norgrove, L. (2019). Woody species diversity and carbon stock under different land use types at Gergera watershed in eastern Tigray, Ethiopia. *Agroforestry Systems*, (93), 1191-1203

Gebrehiwot, K., et al. (2019). Classification and ordination of plant communities in Abune Yosef mountain range, Ethiopia. *Acta Ecologica Sinica*, 40 (5), 398-411.

Gidey, T., et al. (2020). Population status of Boswellia papyrifera woodland and prioritizing its conservation interventions using multi-criteria decision model in northern Ethiopia. *Heliyon*, 6, e05139.

Gidey, T., et al. (2023). Prioritizing forest conservation strategies using a multi-attribute decision model to address concerns with the survival of the endangered dragon tree (Dracaena Ombet Kotschy and Peyr.). *Journal of Nature Conservation*, 73, 126404.

Girma, B., & Melese, M. (2020). Woody Species Diversity and Vegetation Structure of Wurg Forest, Southwest Ethiopia. International Journal of Forestry Research, 2020, 8823990.

Grossiord, C. (2019). Having the right neighbors: How tree species diversity modulates drought impacts on forests. *New Phytologist*, 228: 42-49.

Gurmessa, F., et al. (2012). Structure and regeneration status of komto Afromontane moist forest, East Wollega Zone, west Ethiopia. *Journal of Forestry Research*, 23, 205–216.

Hansen, M. C., et al. (2013). High-resolution global maps of 21st-century forest cover change. *Science*, 342(6160), 850-853.

Hooper, D. U. (1998). The role of complementarity and competition in ecosystem responses to variation in plant diversity. *Ecology*, 79(2), 704-719.

Hundera, K., & Deboch, B. (2008). Woody species composition and structure of gurra farda forest, SNNPR, south west Ethiopia. *Ethiopian Journal of Education and Science*, 2, 44–54.

Ibrahim, T., et al. (2020). Diversity of woody species and biomass carbon stock in response to exclosure age in central dry lowlands of Ethiopia. *Open Environmental Research Journal*, 14, 1–12.

Jucker, T., et al. (2015). Crown plasticity enables trees to optimize canopy packing in mixed-species forests. *Functional Ecology*, 29(8), 1078-1086.

Kebede, B., et al. (2016). Floristic composition and community types of Gedo dry evergreen montane forest, west Shewa, Ethiopia. *Acta Ecologica Sinica*, 36, 392–400.

Keenan, R. J., et al. (2015). Dynamics of global forest area: Results from the FAO Global Forest Resources Assessment 2015. *Forest Ecology and Management*, 352, 9-20.

Lutz, J. A., et al. (2018). Global importance of large-diameter trees. *Global Ecology and Biogeography*, 27(7), 849-864.

Magurran, A. E. (2004). *Measuring Biological Diversity*. Blackwell Publishing.

Malhi, Y., et al. (2014). The productivity, metabolism and carbon cycle of tropical forest vegetation. *Journal of Ecology*, 102(1), 45-51.

Mason, N. W., et al. (2015). Patterns of functional diversity in New Zealand forest communities. Journal of Vegetation Science, 26(2), 311-322.

MEFCC (Ministry of Environment, Forest and Climate Change). (2015). Ethiopia's Second National Communication to the United Nations Framework Convention on Climate Change. Addis Ababa, Ethiopia.

Moges, Y., & Abiy, M. (2018). Forest resources and challenges of sustainable management in Ethiopia. *Journal of Sustainable Forestry*, 37(3), 271-291.

Motuma, T., et al. (2010). Floristic composition and structure of the Yayu forest in southwestern Ethiopia. *Journal of the Drylands*, 3(2), 254-267.

Mueller, L. D., et al. (1974). *A Handbook of Vegetation Analysis*. Pitman Publishing.

Nasi, R., et al. (2020). The State of the Forests in the Congo Basin: 2020. Center for International Forestry Research.

Neelo, J., et al. (2013). Factors affecting the distribution of woody species in a semi-arid savanna. *African Journal of Ecology*, 51(3), 423-430.

Neelo, J., et al. (2015). Patterns of woody species distribution along a topographic gradient in a semi-arid savanna. *Journal of Arid Environments*, 119, 49-56.

Negash, M., & Olsson, M. (2014). Tree regeneration in church forests: implications for conservation of biodiversity in fragmented landscapes. *Biodiversity and Conservation*, 23(10), 2549-2561.

Negesse, G., & Woldearegay, M. (2022). Floristic diversity, structure and regeneration status of Menfeskidus Monastery forest in berehet district, north shoa, central Ethiopia. *Trees, Forests and People*, 7, 100191–100210.

Nune, S., et al. (2007). Biodiversity conservation in Ethiopia: Challenges and opportunities. *Journal of Natural History*, 41(5-8), 539-553.

Senbeta, F. (2006). Diversity and regeneration status of woody species in the Harenna Forest, Ethiopia. *Journal of the Drylands*, 1(2), 163-174.

Siraj, A., & Zhang, J. (2018). Woody species diversity, structure, and regeneration status of a dry Afromontane forest in Ethiopia. *Journal of Forestry Research*, 29(4), 1083-1093.

Siraj, A., et al. (2023). Patterns of tree species distribution and diversity in Ethiopian forests: A review of recent studies. *Ecological Processes*, 12(1), 1-15.

Tedersoo, L., et al. (2017). Global diversity and geography of soil fungi. *Science*, 356(6330), 534-538.

Teketay, D., et al. (2018). Diversity and regeneration of woody species in a dry Afromontane forest in Ethiopia. *Journal of Forestry Research*, 29(3), 815-826.

Temesgen, B., & Werkineh, M. (2020). Woody species structure and regeneration status in Kafta Sheraro national park dry forest, Tigray region, Ethiopia. *International Journal of Forestry Research*, 2020, 4597456.

Tesfamariam, B., et al. (2019). Tree species diversity and carbon stock in a dry Afromontane forest in Ethiopia. *Journal of Forestry Research*, 30(2), 609-618.

Tiwari, J. K., et al. (2010). Regeneration status of tree species in a tropical forest of India. *Journal of Forestry Research*, 21(1), 103-108.

Unbushe, G., & Tekle, K. (2016). Diversity and regeneration status of woody species in Wotagisho Forest, Ethiopia. *Journal of Forestry Research*, 27(4), 905-915.

Worku, A., et al. (2022). Patterns of tree species distribution in Ethiopian forests: Implications for conservation. *Ecological Indicators*, 136, 108594.

Yinger, J., et al. (2008). Forest structure and diversity in the Ethiopian highlands. *Journal of Vegetation Science*, 19(5), 637-648.