Understanding the ethnobotany of a native tree *_Dracaena ombet_* (Kotschy and Peyr.) and associated indigenous knowledge of the local people in the Afar drylands, Ethiopia

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Research

Abstract

Background: Dracaena ombet is part of the dragon tree group, native to Ethiopia, Eritrea, Djibouti, Somalia, Sudan, Egypt, Yemen, and Saudi Arabia, with several social, economic, and environmental uses. The study identified the ethnobotany of *D. ombet*; including the indigenous knowledge of local people related to its uses and associated factors in Afar, Ethiopia.

Methods: Data collection tools, including semi-structured interviews, observations, and focus group discussions, were used to collect ethnobotanical and socioeconomic data. Econometric models were employed to evaluate the relationship between indigenous knowledge of the local people and socioeconomic variables.

Results: Findings recognized indigenous knowledge of pastoral and agropastoral communities on the uses of *D. ombet*, and *D. ombet* was utilized to produce utensils, beehives, construction materials, medicine, gum, resin, food, and fodder. The stem part is used to make the majority of the products. The most preferred product by the communities was food plates. Findings indicated a relationship between the household heads' socioeconomic profiles and their level of ethnobotanical knowledge.

A significant ($p \leq 0.05$) association between ethnobotanical knowledge of the households to use *D. ombet* and the age of household heads, household size, size of livestock, wealth status, and access to extension services was recorded.
Conclusions: The findings revealed that the local people are endowed with an ethnobotanical knowledge of the uses *of D. ombet*. Therefore, this knowledge should be developed at the grassroots level for the sustainable conservation of multipurpose plants in particular and biodiversity in general.

Keywords: Ethnobotany; endangered species; socioeconomic factors; conservation, Erebti

Background

Ethnobotanical studies help uncover how plants are utilized and inform their management and conservation based on indigenous knowledge systems (Gaoue *et al.* 2017; Zenderland *et al.* 2019; Accogli *et al.* 2023). Communities have cultivated experiential indigenous knowledge to interact effectively with their local environment. This is a dynamic process and is exposed to continuous modification and change. For this reason, the contemporary social, cultural, and economic settings are mentioned. However, limited attention was given to understanding this issue (Paniagua-Zambrana *et al.* 2014). Few studies assessed the benefits of association between the socioeconomic factors and ethnobotanical knowledge (EK) for developing conservation interventions (Beltrán-Rodríguez *et al.* 2014; Mattalia *et al.* 2020; Hailemariam *et al.* 2021; Corroto *et al.* 2022; Perrino *et al.* 2024). Ethnobotanical knowledge and resource conservation practices are mutually supporting to each other. Sustainable utilization of forests is advocated by ethnobotanical knowledge (Hussain *et al.* 2023). Moreover, it can provide useful information about the benefits of native tree species, thereby contributing to the conservation, monitoring, and evaluation of restoration activities (Haq *et al.* 2023). The EK of local people is original knowledge that has developed over many generations helpful in the management of resources (O'Neill *et al.* 2017; Haq *et al.* 2023). Nowadays, ethnobotanical knowledge has been influenced by socioeconomic and cultural changes. The existing knowledge of indigenous people cannot familiarize them with the contemporary living style, and this has been aligned with the current deterioration of EK has been linked (Fitwi and Lemenih 2011). Thus, ethnobotanical studies are important to evaluate the socio-economic and cultural setups of a given society and provide appropriate prototypes for understanding the changing features across the people depending on the multipurpose plants (O'Neill *et al.* 2017; Corroto *et al.* 2022; Khan *et al.* 2023).

D. ombet is grouped in the dragon trees. Taxonomically, it is classified in the family Asparagaceae subfamily Nolinoideae, genus Dracaena L. It is native to Ethiopia, Djibouti, Eritrea, Somalia, Sudan, Saudi Arabia, Egypt, and Yemen. It is found in altitude ranges from 1,000-1,800 meters above sea level. *D. ombet* is a globally endangered species (Vahalík *et al.* 2020). Besides, it has social, cultural, and environmental uses (Al-Fatimi 2018). *D. ombet* is an icon species in the drylands of the northeast African region (Al-Okaishi 2020; Ding *et al.* 2020; Lengálová *et al.* 2020; Maděra *et al.* 2021). It is found in the dry Afro-montane and dryland forests in the eastern parts of Ethiopia (Edwards *et al.* 1997) and provides multiple ethnobotanical uses (Al-Okaishi 2020; Ding *et al.* 2020; Lengálová *et al.* 2020; Maděra *et al.* 2020; Maděra *et al.* 2021) such as economic and ecological services (Al-Okaishi 2020; Ding *et al.* 2020). In north-eastern Africa and Arabia *D. ombet* served as a source of food (Elnoby *et al.* 2017; Lestari *et al.* 2019; Al-Okaishi 2020; Al-Fatimi 2021), traditional medicine, fodder, and household materials, (Ghazali *et al.* 2008). However, it has been strongly threatened by unwise utilization, habitat destruction, and climate change (Hubálková 2011; Lengálová *et al.* 2020; Vahalík *et al.* 2020; Birhane *et al.* 2023; Gidey *et al.* 2023), road construction, mining activities (Hubálková 2011; Vahalík *et al.* 2020), intensive cutting, debarking and defoliation of the trees by local communities for the production of various goods (Gidey *et al.* 2024).

The dryland forests in southern, southwestern (Agize *et al.* 2022), and eastern Ethiopia are endowed with endemic plants, and local communities are gifted with ethnobotanical knowledge (Hailemariam *et al.* 2021; Agize *et al.* 2022) related to sustainable use of resources (Ameneshewa *et al.* 2023). The pastoral and agropastoral communities of these areas have indigenous knowledge used for environmental management, and weather forecasting (Watson 2005; Alemu and Flintan 2007; Balehegn *et al.* 2019). *D. ombet* is a native plant to Ethiopia, and it is found in the dryland areas in between 800 - 1500 meter above sea level (Fig. 1). Two studies on the population and conservation status of the globally endangered *D. ombet* have been conducted (Gidey *et al.* 2023; Gidey *et al.* 2024), however, there is still limited evidence of ethnobotanical knowledge to use *D. ombet* (Al-Okaishi 2020; Lengálová *et al.* 2020).

Furthermore, this ethnobotanical knowledge has been associated with the socioeconomic characteristics of knowledge holders, and this can lead to a change in the plant use knowledge and management systems (Paniagua-Zambrana *et al.* 2014; Berhe *et al.* 2025). Despite the richness of indigenous knowledge, to tackle the current challenges of *D. ombet*, identification of ethnobotanical knowledge on uses of *D. ombet* (Al-Okaishi 2020) and understanding the socioeconomic changes that

interlinked with the transmission and preservation of this type of knowledge is still crucial for the conservation of *D. ombet* in particular and biodiversity in general.

Consequently, the objectives of this study were; to identify the ethnobotany of *D. ombet* and associated indigenous knowledge, and to evaluate the relationship between socioeconomic factors and the knowledge of pastoral and agropastoral communities on the uses of *D. ombet* in Erebti district, Afar region Ethiopia. To achieve these objectives the following assumptions were postulated: (i) ethnobotanical knowledge of the uses of *D. ombet* is not random: it is related to the socioeconomy of the area and (ii) the use value of *D. ombet* is dependent on the socioeconomic characteristics of the local people.

(a) (b)

Figure 1. Whole stands of *D. ombet* (a), and (b) its parts in Erebti district, Afar Ethiopia.

Material and Methods

Study area

The study site is found in the arid and semi-arid areas of the Northern Zone, Afar National Regional State, Ethiopia. Erebti district is one of the eight districts in this zone, and about 330 and 910 km from the Afar Regional State capital, Samara, and Addis Ababa city, respectively. The study site is located between 39° 58' 30'' and 40° 9' 0'' E, and 39° 58' 30'' and 40° 9' 0'' N (Fig. 2). It is predominantly a lowland region. It is mainly related to exposed, flat sand, and rock surfaces. The district has 76,141 total populations, of which 38,882 were men and 37,309 were women (CSA 2008). More than 95% of the population lives in rural regions. Less than 5% live in urban regions. Most of the people are engaged in pastoralism livelihood (dominated by livestock production), and few are agropastoral. The mean annual temperature of the Erebti district is 25.6°C with 37.8°C maximum and 15.6°C minimum temperature and receives 196 mm of rainfall annually (NMA 2022).

Sampling techniques

The study site (i.e. Erebti district) was selected using purposeful sampling techniques. Aadu and Erebti 01 Kebeles were then selected for this study. Aba'a and Gala'ato villages from Aadu Kebele and Botali and Saaso villages from Erebti 01 Kebele were selected based on the availability of *D. ombet*, ethnobotanical use practices, and proximity to the main road (Hailemariam *et al.* 2021).

The total number of households in the two Kebeles is 999. The plant knowledge and practices of the households were used for the inclusion of sample households, and the sample size was determined based on the formula by (Yamane 1967) (Eq.1).

$$\frac{\mathrm{N}}{1+\mathrm{N}\,(e)^2} \ldots\ldots 1$$

$$217 = \frac{999}{1+999(0.006)^2}$$

Where n = sample size, N = total population, e^2 = limit of tolerable error, 1 = a constant value

A random lottery method was used to select 217 sample household heads from the group. An almost equal number of household heads were selected from each site to avoid sample selection bias (Hailemariam *et al.* 2021). Later, the 217 sampled households were categorized into low/poor, medium, and high-wealth status. It was assessed by the indigenous

wealth ranking practice in Afar areas, based on the type and number of livestock (i.e. Camel, Cattle, Goats, Sheep, and Donkeys) (MA 2014).

Key informants were selected by purposeful sampling (Martin 1995), based on the recommendations from the local administrations, and elders were confirmed to be most knowledgeable about *D. ombet* (Hailemariam *et al.* 2021). Due to the nomadic lifestyle of the sample households, and the knowledge of *D. ombet*, the researchers were obliged to use 16 key informants. An equivalent number of informants were selected from each village (4 from each village) to minimize sample selection bias.

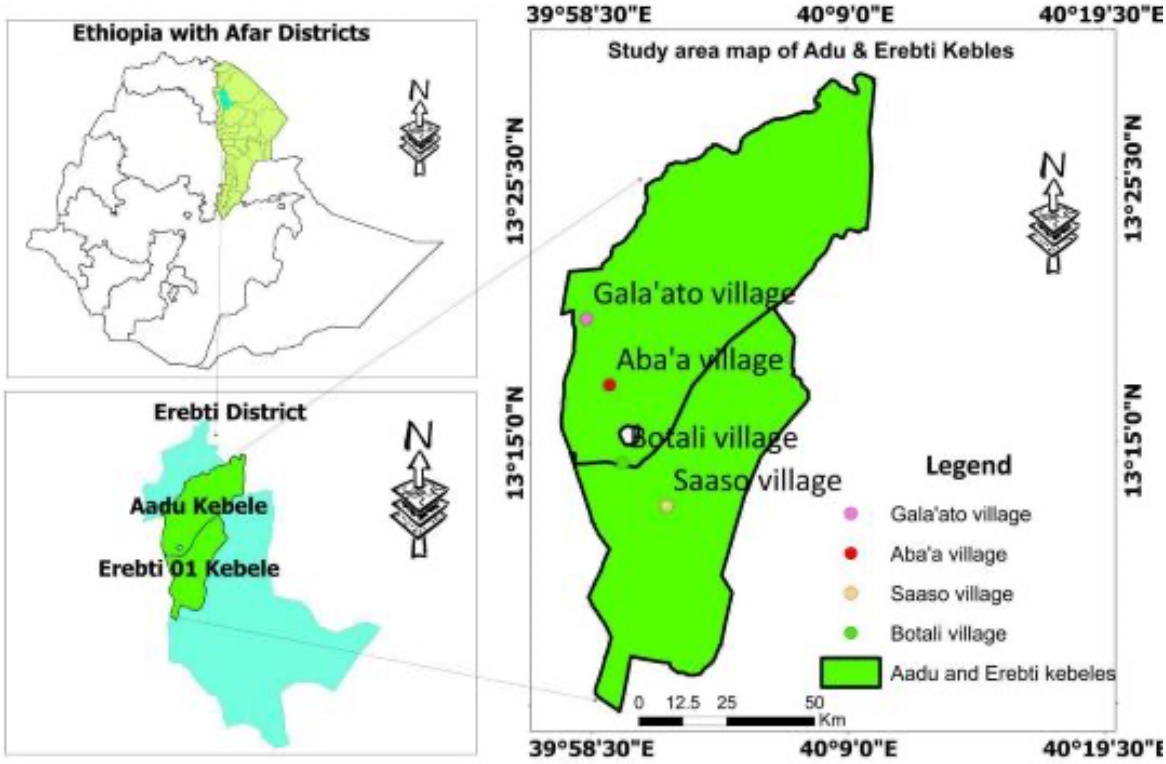

Figure 2. Study area map showing the Erebti district in the Afar region, Ethiopia.

Data collection

A preliminary survey was conducted in June 2022. A discussion was made with the Erebti district administrators, natural resource management officers, elders, and clan leaders to get an idea of the potential village to study the occurrence and ethnobotanical use practices of *D. ombet*. The baseline information was taken as a criterion for inclusion in the study site. Following this, field observation was made jointly with the field assistants to check the availability, and utilization practices of *D. ombet* (Al-Fatimi 2021). Before we reached out to the sample households for ethnobotanical data collection, we called a short meeting with the two Kebele administrators and field assistants in the centers of both Kebeles. During the meeting, a discussion was employed on the local culture of the households, the mode of communication, and the ideal time to reach out to the sampled households. Based on this, ethnobotanical data was collected between July 2022 and December 2023 using standard data collection tools as described in (Martin 1995).

The occurrence of *D. ombet* and the use practices of the local people in the study sites were checked by field observation. Field assistants were selected based on their readiness to participate in the study, their familiarity with the study area, and their knowledge of *D. ombet*. Field observation was useful in cross-checking the connection between *D. ombet* and the local communities. Additionally, field observation was employed to collect the voucher specimen.

A semi-structured interview was conducted to collect ethnobotanical and socioeconomic data. Both open and closed-ended questions were prepared in English. However, to facilitate the interview all question items were translated into the local Afar language during the interview. Similar questions were asked to 217 sample household heads independently. Besides, each

interviewee was allowed to mention any idea during the interview, not necessarily as responses to questions (Hailemariam *et al.* 2021).

Furthermore, the ethnobotanical data collected by interviews was validated by focus group discussions (FGDs). A list of questions was prepared for the discussions. Based on this, eight FGDs were conducted in groups of six in each Kebele. Most of the participants in the group discussion were men individuals. Due to cultural protocols, women were prohibited to participate and provide information (Tsegaye *et al.* 2013). The knowledge of the ethnobotanical uses of *D. ombet* use was considered for inclusion of the representatives. The key informants, clan leaders, local administrators, and natural resource officers participated in the group discussion, and it was facilitated by the researcher (Hailemariam *et al.* 2021; Gebrehiwot and Zeynu 2022).

Data analysis

The use value (UV) of the *D. ombet* was calculated by counting the number of uses mentioned by each household head and dividing by the total number of uses mentioned by all household heads (Hailemariam *et al.* 2021; Corroto *et al.* 2022; Sheko *et al.* 2023). All *D. ombet* uses reported by the respondents were grouped into 7 use categories following Hoffman and Gallaher (Hoffman and Gallaher 2007), with some modifications proposed by (Al-Okaishi 2020; Maděra *et al.* 2020; Gidey *et al.* 2023; Gidey *et al.* 2024), as utensils (i.e., food plates, milking taps, cheese containers), beehives, construction material, gum and resin, medicine, food, and fodder. The ethnobotanical ranking was employed to analyze the most preferred use of *D. ombet* by local people (Martin 1995). Direct matrix ranking was conducted to rank the most preferred use of *D. ombet*. Key informants ranked the uses of *D. ombet* based on the community level and their personal preferences. Scales ranging from 1 to 5; where 1 reveals the lowest and 5 is the highest value, were used and summed (Hailemariam *et al.* 2021; Melkamu 2021). Finally, the given numbers were summed up for all key informants and given an overall rank (Martin 1995). The use category with the highest score is represented as the most preferred use of *D. ombet* (Beltrán-Rodríguez *et al.* 2014; Hailemariam *et al.* 2021; Melkamu 2021).

Statistical analysis was employed in STATA version 17.0. Multiple linear regression and linear mixed model were used to assess the association between the ethnobotanical knowledge of the uses of *D. ombet* and the socioeconomy of the local people in the studied sites of the Erebti district. One ethnobotanical indicator was analyzed, i.e., use values of *D. ombet* mentioned by the households (Paniagua-Zambrana *et al.* 2014). It was taken as the dependent variable based on previous studies and the current theory on ethnobotanical knowledge dynamics. The variables were measured in the local context, and the interactive effect of the independent variables of indigenous knowledge was considered (Gaoue *et al.* 2017). The independent variables were the age of the household heads, gender, educational status, household size, variables such as proximity to markets and forests, duration of settlement, involvement in community forest programs (PFM), and access to forestry extension support, size of livestock, livelihood activities for household income, wealth status, and ethnobotanical knowledge sources, and location of the households.

Multiple linear regressions were performed to determine the linear association between the Indigenous knowledge of the uses of *D. ombet* and socioeconomic variables. The following formula (Eq. 2) was used to construct the model for multiple linear regressions.

$$Yi = \beta o + \beta 1\chi\iota 1 + \beta 2\chi\iota 2 + \beta\rho\chi\iota\rho + \varepsilon\iota \cdots\cdots\cdots\cdots 2$$

Where, for i = n observation, Yi = dependent variable, Xi = independent variable, β_0 = y-constant, β_p = slope coefficient for each independent variable, ει = the model error term.

The linear mixed model analysis was used to assess the effects of socioeconomic factors on the ethnobotanical knowledge of the households in each village. We selected this model due to its flexibility and incorporation of both random and fixed effects. It was applied in four villages in the study to understand the impact of socioeconomic variables on the D. ombet using the knowledge of the local people. The formula stated in equation 3 was used to construct the model for linear mixed analysis.

$$Y\iota j\kappa = \gamma oo\ (\beta o X\iota) + (\tau\iota X'\iota) + roj + \sigma L + \mathcal{E}\iota j\kappa \cdots\cdots 3$$

Where *Yij* is the independent variable; *γ00* is the common intercept; β and τ are the respective coefficients of continuous variables X*i* and categorical variable *X'; r0j* has a normal distribution with median 0 standard deviation *σL* represents the variability of the 4 villages, and Ɛιjκ is residual error.

Results

Sociodemographic characteristics of sample households

The results indicated that about 85.3% of the sample households were men, while 14.7% were women household heads. The results showed that 81.1% of households are illiterate and the remaining 18.9% attained informal education and can read. The age group of the households was categorized into 31-40, 41-50, and 51-65 years and constituted 30%, 49.5%, and 20.5% of the households respectively. Most of the households are pastoralists (43.8%), and others are agropastoral engaged in various livelihood activities such as harvesting forest productions (31.3%), and off-farm activities (24.9%).

Ethnobotanical uses of *D. ombet* in Afar

Results revealed that *Aserayto* is the common name of *D. ombet* in the local Afar language. It is a tree with multiple uses for the local people in the study site. The local people use *D. ombet* for material production, gum and resin production, traditional medicine, construction inputs, food, and fodder. All information from the respondents was included, and the detail of the discussion was presented in the following four sub-sections.

Source of materials

D. ombet is used for the production of utensils, beehives, and construction materials. The food plate is a commonly used utensil produced from the stem part of the species and is mentioned by 95% of the households. It is called *Koora* in the Afar language in Ethiopia and is used during marriages and in newborn mothers' homes to supply porridge. *Koora* is the most harvested material compared to other products. Sometimes, *Koora* is also used to collect milk and meat.

A milking tub (*Horde*) is another product made from the stem of *D. ombet* for milking and storing the milk from livestock such as cows, goats, sheep, and camels. The other product is used to store cheese and butter, called *Arari*. The function of *Horde* is very close to *Arari* but they are different in their color and shape. The opening of *Arari* is wider than *Horde*. The majority (95%) of the households produced *Horde* from the stem of *D. ombet*. *Arari* is also harvested from the stem part of *D. ombet*. According to the respondents (93%), *Horde* and *Arari* are used by Afar pastoral mothers in their day-to-day activities to milk and store dairy products.

Beehive is called *Goodu* locally, an indigenous product produced from the stem part of *D. ombet*. The beehive produced from *D. ombet* is lightweight and easily portable. This was important for the beekeepers to hang the beehive on the tree. The interior part of the beehive undergoes a fumigation process and is sometimes heated with fire to protect it from different insects such as termites. These fumigation processes are important to boost the strength and durability of the beehive.

Furthermore, the local communities have collected various construction inputs from this species, and this was reported by 20% of the households. The pastoral people use the stem and leaf part of *D. ombet* for construction purposes. Stems and leaves are used to build gates of houses and shelters for livestock, particularly goats and sheep. The leaf is used to produce fiber and rope. The wood from *D. ombet* is portable and suitable for a pastoral life.

Source of gum and resin, and medicine

The local people collected gum and resin from *D. ombet*. However, the products are not widely used by the local people. The children collect the milky latex and use it as gum, called *Asera-miira* in the Afar language. Gum is used to heal wounds and toothache. Patients chew the gum for 1-3 days. The dose is the same for all patient categories. The gum is useful for the strength of the teeth. The *D. ombet* secretion from the stem treats different diseases. The healing function of the latex was reported by 9% of the households, and the use of the root of *D. ombet* for abdominal diseases was also reported (4.15%).

Provision of nutritional resources for both humans and livestock

The fruits of *D. ombet* are consumed by the local people in drought season. According to the households, the fruits are used by poor individuals, otherwise consuming the fruits as a food is not common. Seeds of the species are also consumed by livestock. Camel and goats can consume the seed and leaf of *D. ombet*. Camels frequently used the seed and leaves of the species more than goats. The consumption of livestock depends on the availability of feeds. In the dry season, camel, goat, and sheep eat the species' plant parts. Moreover, 70% of the households acknowledged the use of *D. ombet* in income generation.

Source of income

D. ombet products such as utensils and beehives are sold in local markets for cash income. The products served as additional household income sources for the local communities. The local people harvested different parts of *D. ombet* harvested to produce various products.

Frequently used part of *D. ombet*

The results indicated that the stem is most frequently used (Fig. 3). More than 85% of the products are produced from the stem part. The leaf is used as a source of fibre and rope, mainly used as construction input (e.g., ceiling) and in traditional medicine. The leaf of D. ombet was used to collect 42.8% of products. Based on the findings, the stem and leaf parts are the most frequently used parts of the species by the local people to collect various products.

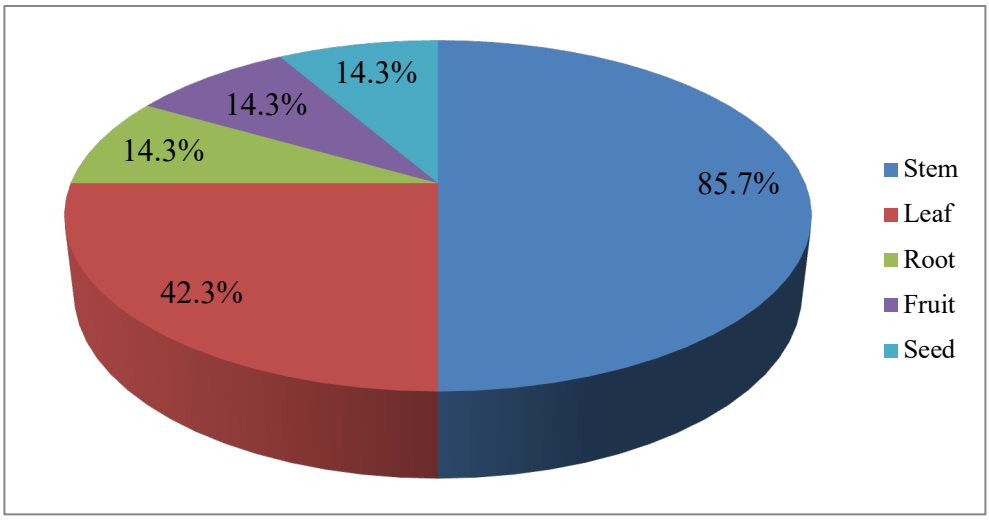

Figure 3. Percentage of *D. ombet's* parts used for various purposes.

Use preferences of *D. ombet*

The direct matrix ranking for the 7 use categories of the *D. ombet* was employed in the 4 study villages. The key informants were grouped in their particular villages and requested to give values for each use category. All households confirmed that the production of utensils such as food plates, milking material, and cheese plates were the most preferred products. The food plate was ranked first, the milking material was ranked second and the third was the cheese plate.

Table 1. Results showing direct matrix ranking of use preferences of *D. ombet*.

Villages	Use categories of *D. ombet*						
	FP	**MM**	**CP**	**BH**	**CM**	**MFFr**	**GR**
Aba'a	5	3.87	3.62	2.12	1.87	1.87	1.62
Botali	4.62	4.12	3.5	2.12	2	1.5	1.25
Gala'to	5	4.12	3.12	2.12	1.75	1.37	1.37
Saaso	4.75	4.25	3.5	2.12	2.12	1.87	1.37
Total	16.36	13.74	8.48	7.74	5.61	6.36	6.61
Rank	1	2	3	4	7	6	5

NB: food plate (FP), milking material (MM), cheese plate (CP), beehive (BH), construction material (CM), gum and resin (GM), medicine, food, and fodder MFFr), 1 most used, 2 best, 3 very good, 4 good, 5 less used and 6 least used

Results revealed beehive was preferred in the fourth part. Gum and resin were ranked fifth, the sixth rank was given to medicine, food, and fodder, and the last ranked use category was construction materials (Table 1). This implies that house materials and beehive products are the most preferred products by the local communities. Utensils were preferred by local communities for their strength and durability. However, construction materials were the least preferred products.

Sources of Ethnobotanical knowledge to use *D. ombet* by local communities

The results showed that the local people produced different products from *D. ombet* using ethnobotanical knowledge. Plant use knowledge was acquired from various sources through indigenous systems. The first source of EK was the parents. Parents are the highest indigenous knowledge holders in a given family. Parents allow their older son to observe and grasp EK and practices. This source of EK is the most common, and it was reported by 50.7% of the households. The EK related to the utilization of the *D. ombet* were acquired from their parents, while 20.7% of the households acquired the knowledge through informal learning. They have learned and developed indigenous from traditional healers, ethnobotanists, and local elders. About 14.7% of the households acquired the EK through observation. They observe EK practices from their parents, local elders, and ethnobotanists. The last source of EK was trial and error and 13.8% of the households acquired EK via this method.

Association of socioeconomic factors with ethnobotanical knowledge of the people

The findings of regression analysis showed that the indigenous knowledge of the households related to the uses of *D. ombet* was associated with the age of household heads, household size, extension service, size of livestock, and wealth status, and this was statistically significant ($p \leq 0.05$) (Table 2).

Table 2. Relationship between socioeconomic factors and ethnobotanical knowledge of the household heads using linear regression, ***p ≤ 0.01, **p ≤ 0.05, and *p ≤ 0.10.

Variables	Coef.	Std. Err.	t	P>t
Age	.0395532	.0059724	6.62	0.000***
Gender	.0529526	.1135408	0.47	0.641
Education	.1459158	.1045296	1.40	0.164
Household size	.0754817	.023398	3.23	0.001***
Market distance	.0268635	.0219229	1.23	0.222
Forest distance	-.0398678	.0244669	-1.63	0.105
Time of residence	.0115787	.009051	1.28	0.202
Participatory forest management	-.226358	.1726887	-1.31	0.191
Extension service	.4394096	.1832722	2.40	0.017**
Size of livestock	.2411155	.0187832	12.84	0.000***
Sources of ethnobotanical knowledge	.0282689	.0543313	0.52	0.603
Sources of income	.0589591	.0531318	1.11	0.268
Wealth status	.2495101	.0645735	3.86	0.000***
Location	-.1164726	.0621674	-1.87	0.062*
_cons	-.4675414	.5409297	-0.86	0.388

Furthermore, the mixed effect analysis employed at the village level also showed that, the age of household heads, participatory forest management activities, forest-related extension supports, and size of livestock in Saaso, Botali, and Aba'a villages; time of residence only in Saaso village; educational level and household size in Botali village; sources of income, and wealth status in Botali and Gala'ato villages were significantly associated with ethnobotanical knowledge to use *D. ombet* ($p \leq 0.05$) (Table 3).

Discussion

The study indicates *D. ombet* is a multipurpose species. The pastoral and agropastoral communities of Afar used this species to produce home utensils, beehives, construction materials, and traditional medicines (Al-Okaishi 2020; Birhane *et al.* 2023; Gidey *et al.* 2024). The local people interact with this plant through ethnobotanical knowledge and practices (Hailemariam *et al.* 2021; Agize *et al.* 2022). The communities have special values and connections with indigenous knowledge of *D. ombet* (Almeida *et al.* 2010; Garekae *et al.* 2017) and were commonly acquired and transferred through family routes, education, trial-and-error, and observation. The family route is a common source of Ethnobotanical knowledge where knowledge is transmitted from parents to children (Giday and Teklehaymanot 2013; Garekae *et al.* 2017; Mattalia *et al.* 2020; Hailemariam *et al.* 2021; Agize *et al.* 2022) and this was useful not only to documenting and preserving Ethnobotanical knowledge but also used for sustainable utilization and management of *D. ombet*. It implies that indigenous knowledge is a foundation for biodiversity conservation (Beltrán-Rodríguez *et al.* 2014; Albuquerque *et al.* 2019) at the local, regional, and global levels. Local communities use *D. ombet* for traditional medicine, gum, and resin production (Al-Fatimi 2018; Al-Okaishi 2020; Al-Awthan and Bahattab 2021), utensils and construction, and beehive production. The fruit of the species is consumed by local

communities and livestock (Hassan-Abdallah *et al.* 2013; Mukul *et al.* 2015; Lestari, Premono, and Kunarso 2019; Elnoby, Raouf, and Moustafa 2017), and the leaf is used to make mats in other parts of Ethiopia (Maděra *et al.* 2020). The utensils are unique and peculiar products of *D. ombet* where pastoral and agropastoral people use them daily. The stem is a dominantly used plant part to produce highly preferred products by the local people. However, the unwise production of *D. ombet* was linked to the highest preference for the products which was similar to the studies in Egypt (Kamel *et al.* 2015) and Yemen (Al-Okaishi 2020).

Table 3. Mixed effects of the socioeconomic factors on ethnobotanical knowledge that evaluated in 4 villages of the Erebti district, ***p ≤ 0.01, **p ≤ 0.05, and *p ≤ 0.05.

	Sites/ locations			
	Saaso	**Botali**	**Aba'a**	**Gala'ato**
Variables	**Coef.**	**Coef.**	**Coef.**	**Coef.**
Age	.023***	.035*	.015**	.070***
Gender	-.079	.011	-.024	.026
Education	-.035	.175*	.083	.382
Household size	.019	.054*	.028	.123
Market distance	-.012	.025	-.008	.002
Forest distance	-.005	-.046	-.010	-.090
Time of residence	-.034**	-.001	-.014	.015
Participatory forest management	-.345**	-.352**	-.377***	-.417
Extension service	.304*	.530***	.437***	.676**
Size of livestock	.278***	.247***	.627***	.131
Source of ethnobotanical knowledge	-.104	.008	-.047	*****
Sources of income	.026	.137**	.044	.026**
Wealth status	.114	.257***	.086	.382**
_cons	1.31	-.376	.193	.123

Source: own survey 2022/23

Socioeconomic factors are essential in understanding the ethnobotanical knowledge of local people, and we found 14 socioeconomic variables. Age of household heads had a significant relationship with EK of *D. ombet*, and this agreed with several studies indicating individuals with older age showed high plant use knowledge (Weckmüller *et al.* 2019; Mattalia *et al.* 2020; Hailemariam *et al.* 2021; Kutal *et al.* 2021; Corroto *et al.* 2022). There might be various reasons for higher EK with increasing age. People can get a better opportunity to acquire EK with increasing age, and therefore, show more knowledge than young individuals (Weckmüller *et al.* 2019; Corroto *et al.* 2022). The ethnobotanical knowledge was not associated with gender difference. However, studies on medicinal plants conducted in different studies showed men had more medicinal plant knowledge than women (Mattalia *et al.* 2020; Hailemariam *et al.* 2021; Corroto *et al.* 2022). This can be due to variations between men and women household heads in the level of engagement in forest-related activities. Although, the studies by (Weckmüller *et al.* 2019), didn't show a significant association between gender and knowledge of medicinal plants. This can be linked to the equal opportunity of both genders to access and interact with the forests. However, several reports also showed that ethnobotanical knowledge variation between genders results from the sociocultural activities of the local people (Gaoue *et al.* 2017; Kimpouni *et al.* 2021). At the village level, education showed a significant association with the knowledge of the household heads in two villages (Corroto *et al.* 2022). At the same time, a significant variation in ethnobotanical knowledge was recorded between households with varied family sizes and size of livestock (Corroto *et al.* 2022). The EK to use *D. ombet* was increasing with the livestock number. This is related to the pastoral way of life in that local people travel to various areas to find fodder and water for their livestock and get the opportunity to interact with the forest. The ethnobotanical knowledge of *D. ombet* was also associated with households' residence time in one location. The level of EK increases as the residence time duration in a given area increases. The households living for a long time can get an opportunity to interact and familiarize themselves with the natural environment and this will increase their EK to use the resources within the environment (Mattalia *et al.* 2020; Hailemariam *et al.* 2021; Corroto *et al.* 2022). The *D. ombet* use knowledge between PFM members and non-member households were varied, and the PFM members showed more knowledge of using *D. ombet*. As the household's participation in PFM increases, they get an opportunity for forest exposure. Access to forest-related support has shown a significant relationship with ethnobotanical knowledge in Botali and Aba'a villages (Corroto *et al.* 2022). Sources of income and wealth or economic status of the households have a substantial association with ethnobotanical knowledge. Poor households frequently engage in forest production (Sheko *et al.* 2023), this can be due to ethnobotanical

knowledge variation. This variation can change the use and conservation pattern of *D. ombet* (Paniagua-Zambrana *et al.* 2014).

Conclusions

Based on the findings the pastoral and agropastoral people of Afar have gathered indigenous knowledge of *D. ombet*. *D. ombet* is used for utensils and beehive production, construction inputs, traditional medicine, food and fodder. This may expose the species to degradation. Therefore, continuous *D. ombet* population inventory is crucial. Regarding our hypothesis, ethnobotanical knowledge to use *D. ombet* was linked to age, family size, extension services, wealth status and size of livestock. On the other hand, market and forest distance don't show an association with the indigenous knowledge of this species. Moreover, age and extension services have shown a significant effect on the indigenous knowledge of *D. ombet* in all villages. Therefore, everyone should consider the importance of the socioeconomic conditions of the local people in developing conservation strategies of ethnobotanical knowledge. Further studies on other factors that can determine the *D. ombet* use knowledge are recommended.

Declarations

List of Abbreviations: EK= Ethnobotanical knowledge**,** FGDs = Focus group discussions, PFM = Participatory forest management, UV = Use value

Ethics approval and consent to participate: Ethics approval for our study was provided by Mekelle University, College of Dryland Agriculture and Natural Resources, Climate Change and Rural Development Program research ethics approval committee. Thus, the study was carried out following the guidelines of the ethics committee. The plant used in the study is a wild plant species. The procedure for plant material collection was employed based on the herbarium technique of the National Herbarium of Ethiopia, Addis Ababa University which complies with our local and national guidelines with no need for further affirmation. Verbal consent was obtained from all participants.

Consent for publication: Informed consent was obtained to publish.

Availability of data and materials: The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Author contributions: MS, EB, GG, GT, and HA, conceived and designed the study. MS worked in data collection and data analysis. MS and EB write the initial draft. TG contributed to editing the initial draft. All authors reviewed the manuscript. All authors read and approved of the final manuscript.

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