Indonesian Journal of Environmental Management and Sustainability
e-ISSN:2598-6279 p-ISSN:2598-6260

IJEMS

Research Paper

Assessment of Use Values and Propagation Methods of Native Fodder and Fruit Species in Merhabete District, Ethiopia

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Abstract
Native fodder and fruit species provide various products and services to local communities besides their fruit (food) and fodder supply in our country including in the study area. Although, there is rich traditional knowledge on propagation methods of native fodder and fruit species and their local use, but little recognition has been given by forestry research and extension efforts to enhance them. The general objective of the study was to investigate the use value and propagation methods of native fodder and fruit species in the Merhabete district, Ethiopia. A total of 127 households were randomly selected and interviewed about local use and propagation methods of native fodder and fruit species. The study indicated that the majority of native fodder and fruit species were used for firewood (23.9%) followed by charcoal (10.9%), timber, and construction wood (10.6%), fencing (9.3%), soil fertility improvement (9.1%), farm tool (7.1%), and medicine (3.3%). Native fodder and fruit species (42.7%) were propagated through wilding (natural regeneration) and the remainder were propagated through seedlings (7.2%), seed (6.06%), and stem cutting (4.8%). Overgrazing (46.5%) followed by overexploitation (22%), climate change/drought (20.5%), and disease and pest (11%) were the major regeneration constraints to native fodder and fruit trees/shrubs species in the study area. Therefore, proper involvement either through research or development works are essential to reduce the propagation constraint of studied species. *Ziziphus spina-christi (L.) Desf.* followed by *Faidherbia albida (Delile) A. Chev., Cordia africana Lam., Ximenia americana L.*, and *Acacia senegal (L.) Willd.* were the most preferred species for planting by farmers in the study area. Domestication should focus on the preferred top five species to promote species conservation and sustainable use.

Keywords
Use Value, Merhabete District, Native Species, Natural Regeneration, Species Preference

Received: 10 September 2023, Accepted: 23 November 2023
https://doi.org/10.26554/ijems.2023.7.4.137-146

1. INTRODUCTION

Native tree species in traditional agroforestry practices provide various products and services. They provide products such as timber, wood for construction, firewood, farm implements, fodder (leaves), and fruit as a source of income (Negash et al., 2012; Robi and Edris, 2017; Gemechu et al., 2021; Molla et al., 2023). Ecological services include soil fertility improvement, biodiversity conservation, and carbon sequestration (Negash et al., 2012; Gebrewahid et al., 2018; Gebre et al., 2019). Moreover, food security, declining grazing areas, and fodder availability are becoming a problem in dryland parts of Ethiopia (Tulu et al., 2023). Native species producing fruit and fodder can help people's livelihoods while ensuring fodder availability.

Despite their importance, many native tree species in Ethiopia are being lost due to various reasons such as deforestation, agricultural expansion, charcoal production, free grazing, fires, and uncontrolled forest product harvesting (Bahru et al., 2014; Tefera et al., 2015; Tamiru et al., 2021). For instance, *Cordia Africana* and *Teclea nobilis Del.* were the two endangered endemic species that local people used for food and fodder in Southern, Ethiopia (Robi and Edris, 2017). Hence, these species need conservation priority, management, and sustainable utilization.

In Ethiopia, native species are established through retention, planting, or both (Endale et al., 2017; Eyasu et al., 2020). Farmers manage trees, mainly native species, to regenerate naturally in the field, protecting saplings and saplings grown from seed stores in the ground (Liyama et al., 2017; Lelamo, 2021). Moreover, plants reproduce sexually or vegetatively; sexual reproduction through seeds is important because it conserves genetic variety and is less expensive than asexual approaches (Nyamukuru et al., 2014; Denham

et al., 2020). On the other hand, vegetative propagation methods may have less genetic variety, but produce progeny that mature very early and give farmers timely access to the product(Asaah et al., 2012; Nyamukuru et al., 2014). Some native plants reproduce vegetatively (without seeds) as a means of survival in Ethiopia. For example, *Erythrina abyssinica* and *Erythrina bruce* were the two native fodder species propagated vegetatively in southern Ethiopia (Abraham et al., 2022).

The Merhabete district has several traditional agroforestry practices that farmers have been using for many years, mixing local fodder and fruit species for various benefits. They have well-founded indigenous knowledge for the establishment and propagation methods of native species in the study area. For example, Nyamukuru et al. (2014), reported that there was limited empirical scientific research on how to establish and restore native species in Africa; and most research focused on exotic species.

Assessing and documenting indigenous knowledge before it is lost is crucial for sustainable utilization and conservation of the targeted species. Therefore, further research should be conducted on existing as well as new methods of cultivating local fodder and fruit species in the study area. Therefore, the objectives of this study were :(1) to determine the use value of native fodder and fruit species; (2) to assess the establishment method, propagation methods, and regeneration constraints of native fodder and fruit species; and (3) to identify native multipurpose fodder and fruit species for planting in the study area. The results of this study will provide useful information for scientific studies and researchers and will be useful for the conservation of native fodder and fruit tree species in the study area.

2. EXPERIMENTAL SECTION

2.1 Description of the Study Area

This study was conducted in the Merhabete district, North Shewa Zone, Amhara Regional State, Ethiopia. Geographically, the area is located approximately 185 km north of Addis Ababa at 9° 54' - 10° 12' N and 38° 42' - 39° 18' longitude (Figure 1). There were two study kebeles, namely, Kusay Chora and Goranda Mariam Serka for this study. The sampled locations are located between 1108 and 1381 m above sea level (Kefelegn, 2020).

The topographic features of the two kebeles are distinguished by the rugged terrain. Annual rainfall in the study area follows a unimodal system, characterized by a single rainfall peak (July–September) and the driest season between November and May. The average annual rainfall ranges from 299 to 940 mm for Kusay Chora and 200 to 921mm for Goranda Mariam Serka kebele. The average annual temperature ranges from 20°C to 29°C for Kusay Chora and 20°C to 31°C for Goranda Mariam kebele (National Meteorological Services Agency (NMSA), 2017). Nitosols, cambisols, and vertisols are the soil classification types found in the study areas. Natural forests, homegarden, parkland, cultivated, and grazing lands are the common land use types found in the study areas. *Acacia tortilis (Forssk.) Hayne, Ziziphus spina christi,* and *Balanites aegyptiaca (L.) Delilel* are native fodder and fruit tree species found in the study areas (MDARDO, 2019).

Rain-fed agriculture with a mixed farming system is the main source of livelihood source for people in the study areas. Teff (*Eragrostis Tef*), Sorghum (*Sorghum bicolor*), and Sesame (*Sesamum indicum*) are the most dominant crops in both kebeles (Belayneh et al., 2019). The total number of residents is 5773 for Kusay Chora and 6770 for Goranda Mariam Kebele.

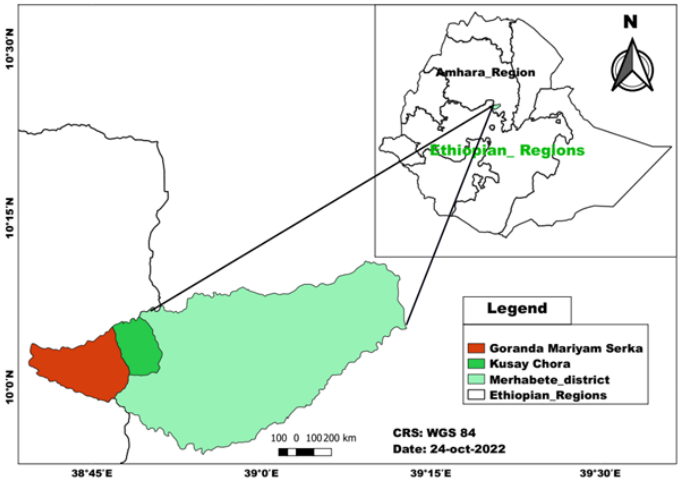

Figure 1. Map of the Study Area

2.2 Research Site Selection and Sampling Techniques

Multi-stage sampling procedure was used in the household survey. First, preliminary information was collected locally through discussions with agricultural experts and local elders who had knowledge of local fodder and fruit tree species. The discussions were attentive to the distribution of targeted species. Then, a reconnaissance survey was conducted to identify the study sites and verify kebeles having native fodder and fruit species. Secondly, two kebeles (Kusay Chora and Goranda Mariam Serka) with high density and wide distribution of targeted species were selected purposively (Figure 1). Thirdly, through key informant interviews, we identified all households having native fodder and fruit tree /shrub species in the study area (87 from Kusay Chora and 103 households from Goranda Mariam Serka). The proportional sample size formula was to determine the required number of household respondents in both kebeles with an accuracy of 5% (Equation (1)) (Kothari, 2004).

$$n = \frac{Z^2pgN}{e^2(N-1) + Z^2pq} \quad (1)$$

Where n = the required sample size; p = sample proportion which is 0.5 and q = 1-p (1-0.5) = 0.5; N = A total

Table 1. Socio-economic Characteristics of the Household Heads (N= 127) Interviewed at Two Kebele of Merhabete District, Ethiopia

Socio-economic Characteristics	Categories	Number (%) of Respondents	Mean
Sex	Male	116 (91.3)	-
	Female	11 (8.7)	
Age (Years)	≤30	15 (11.8)	42.5
	31-45	54 (42.5)	
	46-60	37 (29.1)	
	≥60	21 (16.5)	
Educational status	Illiterate	80 (63)	-
	Literate	47 (37)	
Marital status	Married	116 (91.3)	-
	Windowed	11 (8.7)	
Family size	≤3	19 (15)	5.8
	4-7	92 (72.4)	
	≥7	16 (12.6)	
Total livestock in TLU	≤5	48 (37.8)	5.7
	≥6	79 (62.2)	

households having study species in the selected kebeles; Z = Confidence linterval at 95% which is 1.96 and; e = the margin of error which is 0.05.

$$n = \frac{1.96^2(0.5)(0.5)(190)}{0.09^2(189) + 1.96^2(0.5)(0.5)}$$

The sample size for each kebele was calculated as follow Equation (2):

$$n = \frac{n \times N1}{N} \quad (2)$$

Where n is the sample size in the individual kebeles, $N1$ is the whole number of households contained in the study (127), and N is the whole number of households having study species in two kebeles (190).

$$n(\text{Kusay Chora}) = \frac{87 \times 127}{190} = 58$$

$$(\text{Goranda Marima Serka}) = \frac{103 \times 127}{190} = 69$$

Accordingly, 127 households 58 from Kusay Chora kebele and 69 from Goranda Mariam Serka kebele were randomly selected for interviews from the list of identified households.

2.3 Methods of Data Collection

The study included both primary and secondary data sources of data. The secondary data were gathered from published and unpublished documents for review of the study sites whereas the primary data were gathered through household surveys, key informant interviews, and focus group discussions.

Both closed and open-ended questionnaires were used for this study. The household questionnaire was written in English and translated into Amharic, the language of the study area. Experts with knowledge in the field of the study participated in data collection. The objectives of the research were explained to the enumerators and they were trained in data collection and interview techniques. Household interviews were conducted with 127 randomly selected households in two kebeles. Information was collected on indigenous knowledge on methods of establishing and propagating native species, local uses, and their preference.

Both key informant interviews and focus group discussions were conducted for qualitative data. In the present study, key informants are those whose social positions in a research setting and respective kebeles give them specialist knowledge about tree use value, propagation methods, and farmer's tree species preferences. The choice of key informants was made by using the snowball sampling method (Bernard, 2017). For this study, 12 key informants were interviewed (6 key informants per kebele). Through key informant interviews, information was collected on tree species establishment and propagation methods, local uses, and

species preferences.

Focus group discussions were held with representative farmers, youth, and women from each kebele. Individual focus group discussions were conducted with development agents from each kebele. The purpose of this discussion was to confirm the results of a household survey on methods of establishment and propagation of indigenous tree species in the study area, as well as the use and preference of tree species For each specimen, the local name, code, GPS location and provenance name of the species were recorded. Some scientific names of tree species have been confirmed and verified based on Bekele-Tesemma and Tengnäs (2007) and Ermias (2011). Species not identified in the field were taken to the Addis Ababa University National Herbarium.

2.4 Data Analysis

This study used quantitative and qualitative methods to analyze the data. Then, the quantitative data were analyzed descriptively using the SPSS version 25 Package Software program. On the other hand, the interpretation of the qualitative data was done through verbal description and narrative.

3. RESULTS AND DISCUSSION

3.1 Households and Socio-economic Characteristics

In this study, the socio-economic features of the sampled households were assessed and presented (Table 1). About 91.3% of the respondents were male. The average age of the selected sampled households was 42.5 years old. The majority (42.5%) were between 30 and 45 years old. In terms of educational status, the majority of sample respondents (63%) were illiterate (Table 1). The majority of the households (72.4%) had a family size ranging from 4 to 7 persons and about 12.6% of the households had a family size greater than 7 members. Farmers in the area engaged in agriculture, including animal husbandry. Cattle, goats, donkeys, and poultry were important livestock species raised by farmers in the study area. The average total number of animals of the selected respondents was 5.8 tropical livestock units. Agriculture was the main occupation of all households accounting for about 92.9% and 7.1% of households were engaged in other income such as selling props, selling charcoal, and labour.

3.2 Use Values of Native Fodder and Fruit Trees/ shrub Species

Farmers have retained native species on their farmlands for different products and services. In this study, forty-one useful fodder and fruit species were identified. According to respondents, the major benefits of native fodder and fruit species for households were fuel wood (23.9%), charcoals (10.9%), timber and construction woods (10.6%), soil fertility improvement (9.1%), fencings (9.3%), farm tools (7.1%), and medicines (3.3%) (Table 2).

The major type of household energy in rural Ethiopia is fuel wood, so there is a need to encourage native fodder and fruit species in fields where there is the ability to integrate native fodder and fruit with cereal crops in the land use system. A total of 37 native fodder and fruit species with fuelwood uses were recorded, representing 23.9% of the total native fodder and fruit species identified (Table 2).In the study areas, except *Dodonaea viscosa subsp. angustifolia (L.f.) J.G.West, Euphorbia tirucalli L., Opuntia ficus-indica*, and *Sesbania sesban*, all species were used for fuel wood (Table 2). The results of this study are consistent with those of Eyasu et al. (2020), who reported that most native species were used as fuelwood in Southern Tigray, Ethiopia. Tree species like *Acacia Senegal, Acacia tortilis*, and *Acacia nilotica (L.) Delile* were the best-preferred species for fuelwood in the study area (Table 2). This study was in line with the findings of Bahru et al. (2021), who reported that *Acacia senegal* and *Acacia tortilis* were the two popular native species used for fuelwood in Central Ethiopia. Moreover, fuel wood is a significant source of income for rural farmers in the study area. For instance, according to key informants, fuelwood from a single-standing matured *Acacia senegal* tree could generate an income ranging from 450 to 700 Ethiopian Birr (EB). This demonstrates the economic contribution of native fodder and fruit species to farming households and livelihood strategies in the study area, in addition to their ecological services.

Native fodder and fruit species can increase soil fertility through litter fall. Species like *Faidherbia albida, Acacia senegal, Cordia Africana*, and *Croton macrostachyus Hochst. ex Delile* were the most suitable species to increase soil fertility in the study area. For example, in Ethiopia, integration of *Cordia africana, Millettia ferruginea*, and *Croton macrostachyus* have been recognized as a practice to increase soil fertility (Teketay and Tegineh, 1991; Mamo and Asfaw, 2017; Lameso and Bekele, 2020). Furthermore, in Rift Valley, Southern and Eastern Ethiopia, *Faidherbia albida, Cordia Africana*, and *Croton macrostachyus* play a great role in soil fertility improvement (Negash et al., 2012; Mamo and Asfaw, 2017; Sida et al., 2018).

A total of 14 (34.1%) native fodder and fruit species were recorded for charcoal production(Table 2). *Acacia nilotica* had the highest use value for charcoal production uses, followed by *Mimusops kummel Bruce ex A.DC., Acacia seyal Delile*, and *Bridelia micrantha (Hochst.) Baill.* (Table 2).

Farmers retained native fodder and fruit species in the farmland for timber and construction purposes. According to key informants, fast-growing native fodder and fruit species were integrated into their farmlands, primarily for timber construction wood. Likewise, farmers also maintained fast-growing tree species in their fields, primarily for timber, wood products, and to increase soil fertility (Mamo and Asfaw, 2017). Species such as *Cordia africana, Croton macrostachyus, Mimusops kummel, Acacia senegal*,

Table 2. Percentage of Respondents on Various Use of Indigenous Fodder and Fruit Trees/shrubs Species in Merhabete District, Ethiopia (N=127)

Scientific Name	Local Name	FR	FO	M	FUW	CH	SFI	TCW	F	FT
Acacia nilotica (L.) Delile.	Lemba	-	51	-	66.9	83	-	23.6	-	-
Acacia polyacantha Willd.	Kentafa	-	16	-	33.1	17	-	-	-	-
Acacia senegal (L.) Willd.	Dera	-	60	-	87.4	27	87.3	52	26	40.2
Acacia seyal Delile	Nech girar	-	43	-	59.8	51	16	-	43.3	-
Acacia tortilis (Forssk.) Hayne	Wacha	-	44	-	66.9	35	22	35.4	75.6	51.2
Acokanthera schimperi (A.DC.) Schweinf	Merenz	4.72	-	-	12.6	-	-	-	-	-
Balanites aegyptiaca (L.) Delilel	Bedeno	88.2	79	-	76.4	12	-	39.4	20.5	49.6
Bridelia micrantha (Hochst.) Baill.	Yezinjero Geba	31.5	53	-	31.5	43	-	-	-	-
Carissa spinarum L.	Agam	10.2	5.5	-	9.45	-	-	-	-	-
Capparis tomentosa Lam.	Gumero	14.2	8.7	-	7.87	-	-	-	-	-
Celtis africana Burm. f.	Tikur inchit	-	8.7	-	22	-	-	-	-	-
Combretum aculeatum Vent.	Zenfok	-	17	-	11	-	-	-	-	-
Combretum molle R.Br. ex G Don	Avalo	-	10	-	2.36	-	-	-	-	-
Commiphora africana (A. Rich.) Engl.	Anqa	-	3.1	-	5.51	-	-	-	-	-
Cordia africana Lam.	Wanza	43.3	33	3.15	45.7	4.7	66.9	62.2	-	-
Cordia monoica Roxb.	Chewanza	26	13	-	9.45	-	-	-	-	-
Croton macrostachyus Hochst. ex Delile	Bisana	-	17	51.2	37	-	66.9	54.3	-	-
Dichrostachys cinerea (L.) Wight & Arn.	Ader	-	85	15	22	26	-	-	36.2	-
Dodonaea viscosa subsp. angustifolia (L.f.) J.G.West	Tahses	-	9.4	-	-	-	-	-	-	-
Ehretia cymosa Thonn.	Wilaga	15	-	-	25.2	-	-	21.3	-	-
Euphorbia tirucalli L.	Kinchib	-	3.9	-	-	-	-	-	79.5	-
Faidherbia albida (Delile) A. Chev.	Girara	-	44	-	54.3	41	97.6	-	12.6	-
Ficus sur Forssk.	Shola	52.8	-	-	6.3	-	-	-	-	-
Ficus sycomorus L.	Banba	45.7	-	-	12.6	-	-	-	-	-
Ficus vasta Forssk.	Warka	33.9	-	-	10.2	-	-	-	-	-
Grewia damine Gaertn.	Sefa	59.1	27	-	7.09	-	-	-	-	-
Grewia ferruginea Hochst ex A. Rich.	Lenkuata	17.3	31	-	8.66	-	-	-	-	-
Grewia villosa Willd.	Chirnchir	52	15	-	9.45	-	-	-	-	-
Maytenus arbutifolia (Hochst. ex A.Rich.) R.Wilczek	Atata	-	7.1	-	15	-	-	-	-	-
Mimusops kummel Bruce ex A.DC.	Shuye	87.4	-	-	61.4	75	-	53.5	-	-
Moringa stenopetala (Baker f.) Cufod.	Shiferaw	-	25	51.2	9.45	-	-	-	-	-
Opuntia ficus-indica (L.) Mill	Beles	26	-	-	-	-	-	-	-	-
Rhus natalensis Krauss	Takma	-	40	-	33.1	-	-	-	-	26
Rhus retinorrhoea Oliv.	Tilem	-	3.9	-	15	-	-	6.3	-	-
Salvadora persica L.	Dedho	-	4.7	-	7.09	-	-	-	-	-
Sesbania sesban (L.) Merr.	Girangire	-	16	-	-	-	-	-	-	-
Stereospermum kunthianum cham.	Washint	-	68	-	5.51	-	-	-	-	83.5
Ximenia americana L.	Enkoy	85.8	7.1	10.2	25.2	15	-	42.5	-	-
Ziziphus mauritiana Lam.	Qurqurah	16.5	11	-	14.2	8.7	-	-	-	-
Ziziphus mucronata Willd	Foch	37.8	35	7.09	31.5	-	-	-	-	-
Ziziphus spina-christi (L.) Desf.	Geba	85.8	51	-	25.2	9.4	25.2	44.9	88.2	41.7
Average %		20.3	23.04	3.3	23.9	10.9	9.1	10.6	9.3	7.1

Key for uses; FR= Fruit, FO= Fodder, M= Medicine, FUW= Fuel wood, CH= Charcoal, SFI= Soil fertility improvement TCW= Timber, and construction wood, F= Fencing, FT= Farm tool

Table 3. Percentage of Respondents on Establishment and Propagation Methods of Native Fodder and Fruit Trees/shrubs Species in Merhabete District, Ethiopia (N=127)

Scientific Name	Local Name	Establishment Method		Propagation Methods			
		Planted	Retained	Seed	Seedling	Stem Cutting	Wilding
Acacia nilotica (L.) Delile	Lemba	-	70.1	-	-	-	68.5
Acacia polyacantha Willd.	Kentafa	-	80.3	-	-	-	67.7
Acacia senegal (L.) Willd.	Dera	-	90.6	-	-	-	52
Acacia seyal Delile	Nech girar	-	44.1	-	-	-	35.4
Acacia tortilis (Forssk.) Hayne	Wacha	-	12.6	-	-	-	70.9
Acokanthera schimperi (A.DC.) Schweinf	Merenz	-	7.09	-	-	-	26.8
Balanites aegyptiaca (L.) Delilel	Bedeno	-	61.4	-	-	-	80.3
Bridelia micrantha (Hochst.) Baill.	Yezinjero Geba	-	43.3	-	-	-	59.8
Carissa spinarum L.	Agam	87.4	15.7	-	-	-	10.2
Capparis tomentosa Lam.	Gumero	96.9	9.45	-	-	-	18.9
Celtis africana Burm.f.	Tikur inchit	-	70.9	-	-	-	42.5
Combretum aculeatum Vent.	Zenfok	-	51.2	-	-	-	25.2
Combretum molle R.Br. ex G Don	Avalo	-	40.2	-	-	-	25.2
Commiphora africana (A. Rich.) Engl.	Anqa	-	17.3	-	-	-	19.7
Cordia africana Lam.	Wanza	67.7	48	35.4	44.9	-	55.1
Cordia monoica Roxb	Chewanza	-	43.3	-	-	-	62.2
Croton macrostachyus Hochst. ex Delile	Bisana	61.4	78.7	27.6	35.4	-	39.4
Dichrostachys cinerea (L.) Wight & Arn.	Ader	-	87.4	-	-	-	53.5
Dodonaea viscosa subsp. angustifolia (L.f.) J.G.West	Tahses	35.4	-	-	-	-	-
Ehretia cymosa Thonn.	Wilaga	-	15.7	-	-	-	35.4
Euphorbia tirucalli L.	Kinchib	-	35.4	-	-	99.2	7.87
Faidherbia albida (Delile) A. Chev	Girara	31.5	85	43.3	51.2	-	59.1
Ficus sur Forssk	Shola	-	30.7	-	-	-	19.7
Ficus sycomorus L.	Banba	-	19.7	-	-	-	27.6
Ficus vasta Forssk.	Warka	-	59.1	-	-	-	29.1
Grewia damine Gaertn.	Sefa	-	52.8	-	-	-	19.7
Grewia ferruginea Hochst ex A. Rich.	Lenkuata	-	25.2	-	-	-	34.6
Grewia villosa Willd.	Chirnchir	-	51.2	-	-	-	23.6
Maytenus arbutifolia (Hochst. ex A.Rich.) R.Wilczek	Atata	-	3.94	-	-	-	6.3
Mimusops kummel Bruce ex A.DC.	Shuye	-	88.2	-	-	-	69.3
Moringa stenopetala (Baker f.) Cufod.	Shiferaw	85		62.2	61.4	-	-
Opuntia ficus-indica (L.) Mill	Beles	-	89	-	-	97.6	23.6
Rhus natalensis Krauss	Takma	-	51.2	-	-	-	94.5
Rhus retinorrhoea Oliv.	Tilem	-	59.1	-	-	-	59.8
Salvadora persica L.	Dedho	-	60.6	-	-	-	44.1
Sesbania sesban (L.) Merr.	Girangire	-	94.5	52.8	75.6	-	8.66
Stereospermum kunthianum cham.	Washint	-	97.6	-	-	-	59.8
Ximenia americana L.	Enkoy	-	89.8	-	-	-	62.2
Ziziphus mauritiana Lam.	Qurqurah	-	81.1	-	-	-	66.9
Ziziphus mucronata Willd.	Foch	-	84.3	-	-	-	89.8
Ziziphus spina-christi (L.) Desf.	Geba	11.8	89.8	27.6	27.6	0	78.7
Average %		11.9	51.2	6.06	7.2	4.8	42.7

and *Ziziphus spina-christi* were the most important timber and construction wood species in the study area. *Cordia africana, Croton macrostachyus,* and *Ficus vasta Forssk.* were among the best-known native species used for timber, construction, and furniture in Ethiopia (Agize et al., 2013; Mamo and Asfaw, 2017).

Fencing species constituted 8 native fodder and fruit species, accounting for 19.5% of all native fodder and fruit species documented. *Ziziphus spina-christi, Acacia tortilis, Euphorbia tirucalli*, and *Acacia seyal* were the common used for fencing. *Ziziphus spina-christi* was the most known species as reported by 88.2% of the respondents. Farmers make materials for everyday use from native tree species found in their farmlands.

Native fodder and fruit species were also valuable sources of wood for household farm implements in the study area. For instance, ploughs materials are made from *Stereospermum kunthianum, Ziziphus spina-christi, Acacia tortilis, Euphorbia tirucalli,* and *Acacia senegale* in the study area. This study is in line with the finding of Negash (2007) who reported that native species were preferred for constructing farm tool implement.

3.3 Establishment and Propagation Methods of Native Fodder and Fruit Species

Native fodder and fruit species are an important part of land use that requires careful management to ensure sustainable use and conservation. In this study, the majority of species (52.1%) were established through retaining (seed fall and seed bank) and the remainder were established through planting seedlings from government nurseries.

The major propagation methods for native fodder and fruit species were wilding (natural regeneration) for thirty-nine species, seedlings for six species, a seed for six species, and stem cutting for two species (Table 3). This was supported by Meaza and Demssie (2015) who found that soil seed banks and native seedlings in government nurseries were the main sources of fodder and fruit tree seedlings for farmers and communities in Northern Ethiopia. Moreover, farmers get planting material for native tree species from naturally regenerated seedlings. These can be obtained at low cost from both gardens and wild forests (Yakob et al., 2014) and matured in prepared areas/seedbeds. On the other hand, the regenerated seedlings can be preserved, marked, and replanted directly in the farmer's field (Negash, 2007; Nigussie et al., 2014). Seedlings capable of natural regeneration are often used to replace old trees in agricultural areas (Nigussie et al., 2014; Mamo and Asfaw, 2017). According to key informants, maintaining existing natural regeneration has many advantages, including reduced labor costs and cost savings, rather than producing seedlings at a nursery and transplanting them later. Seedlings from government nurseries are the second method for the establishment of native fodder and fruit species in the study area. This is in line with the finding of Nigussie et al. (2014) who reported that seedlings from government nurseries are the source of planting material for native species.

A total of 39 species were reproduced through wilding and six species by seed and seedling, namely *Cordia africana, Croton macrostachyus, Faidherbia albida, Moringa stenopetala (Baker f.) Cufod., Sesbania sesban* and *Ziziphus spina-christi.* Furthermore, *Euphorbia tirucalli* and *Opuntia ficus-indica* have been widely propagated through stem cutting and used to fence their homesteads. Hence, the majority of respondents, stated that natural regeneration was the dominant propagation method over seedlings, seed, and stem cutting in the study area (Table 3). This suggests that farmers usually preferred naturally growing native fodder and fruit tree seedlings to planting them from seed and seedling. This is consistent with the findings of Endale et al. (2017), who reported that farmers in the semi-arid East Shewa region of Ethiopia use farmer-led natural regeneration to establish indigenous tree species. Moreover, Eyasu et al. (2020) argue that farmers can only promote the regeneration of indigenous trees if the return on investment is reliable and commensurate with the economic value that such trees can provide to households.

3.4 Regeneration Constraint of Native Fodder and Fruit Species

The common regeneration constraints that affected the survival and development of native fodder and fruit species were overgrazing, overexploitation, climate change/drought, and disease and pests (Table 4). Each of these factors contributed in different ways to the reduction in the density and variety of native fodder and fruit species in the study area (Table 4).

Table 4. Percentages of Respondents Mentioning Types of Regeneration Constraints in the Study Area (N=127)

Constraints	Percentage of Respondents
Climate change/drought	20.5
Overgrazing	46.5
Disease and pest/termite	11
Overexploitation	22

Overgrazing is one of the greatest serious issues influencing seedling survival and plantation success in the study area. Due to the open grazing system, especially during the dry season of the year, all the seedlings in the communal farms face grazing, browsing, and trampling problems, directly and indirectly, detrimental to the survival of the planted seedlings. Previous studies indicated that a large number of cattle and grazing affect the growth of saplings and seedlings (Amsalu and Addisu, 2014; Nigusse and Welearegay, 2020; Alemneh and Biazen Molla, 2022). As a result, biological soil and water conservation efforts such as turf, hedgerows, and tree planting are also damaged or trampled, reducing

Table 5. Respondent's Native Fodder and Fruit Species Preference for Planting in the Study Area

Name of Species	Respondents Rate					Respondent Relative Score					Respondent Total Score	Ranks
	1st	2nd	3rd	4th	5th	1st	2nd	3rd	4th	5th		
Acacia nilotica (L.) Delile	6	10	8	2	-	0.29	0.9	0.6	0.04	-	1.83	8th
Acacia senegal (L.) Willd.	10	19	14	-	21	0.82	3.1	2	-	4.01	9.92	5th
Acacia tortilis (Forssk.) Hayne	13	-	-	18	-	1.39	-	-	3.09	-	4.47	6th
Balanites aegyptiaca (L.) Delilel	3	6	7	3	-	0.07	0.3	0.5	0.09	-	0.96	10th
Cordia Africana Lam.	12	20	24	23	-	1.18	3.4	5.8	5.04	-	15.5	3rd
Faidherbia albida (Delile) A. Chev.	18	-	13	37	22	2.66	-	1.7	13	4.4	21.8	2nd
Mimusops kummel Bruce ex A.DC.	10	13	9	3	-	0.82	1.5	0.8	0.09	-	3.18	7th
Ximenia americana L.	17	21	-	19	19	2.37	3.8	-	3.44	3.28	12.9	4th
Ziziphus mauritiana Lam	3	5	10	-	-	0.07	0.2	1	-	-	1.3	9th
Ziziphus spina-christi (L.) Desf	33	27	24	-	48	8.93	6.3	5.8	-	20.9	42	1st
Total	125	111	119	105	110							

Note: Relative scores for this survey were determined by multiplying the number of respondents in each category by its proportion (For example, 6×6/125 = 0.29)

the potential for establishment and recovery.

Over-exploitation is the second limitation to regeneration and cutting trees for charcoal, firewood, house construction, and timber can severely destroy the understory/seedlings of mature tree species in the study area. Moreover, previous studies elsewhere found that overexploitation, climate change, drought, expansion of exotic species, and biotic factors had an impact on the regeneration of native species in Ethiopia (Tefera et al., 2014; Robi and Edris, 2017).

3.5 Farmer's Preference of Native Fodder and Fruit Species for Planting

The study indicated that farmers in the study area showed interest in planting 10 native fodder and fruit species as they are important for multiple functions and their contribution to livelihood (Table 5). However, the high-priority native fodder and fruit species for planting were *Ziziphus spina-christi,Faidherbia albida, Cordia Africana, Ximenia Americana*, and *Acacia senegal*. These native species were preferred for medicinal, firewood, charcoal, house construction, fodder, food(fruit), income, soil fertility improvement, fencing, and timber/pole.

Respondents in the study area listed tree-shrub species, their uses as fodder and fruit fodder, and their multiple uses to livelihood. *Ziziphus spina-christi, Faidherbia albida, Cordia Africana, Ximenia Americana*, and *Acacia senegal* were found to be the five preferred native fodder and fruit species. This study showed that farmers have a wealth of knowledge on trees and shrubs, and their multipurpose uses of native fodder and fruit species in the study area.

Ziziphus spina-christ is the furthermost preferred multipurpose native species in the study area, and it is preferred for its contribution to food (fruit), fodder (leaves), firewood, shade, house construction, and fencing material (dry branches). It is also used for fuel wood, timber, and medicine. This result was supported by the finding of Eyasu et al. (2020) farmers in northern Ethiopia used *Ziziphus spina-chris* for food, firewood, charcoal, fodder, live fence, and fencing material. And also, it is the most recommended drought-tolerant agroforestry species for arid and semi–arid areas. *Faidherbia albida* is the second preferred species and farmers view *Faidherbia albida* as a keystone species because it provides animal feed, fuel wood, soil fertility improvement, shade, and money from the sale of wood products. This is consistent with reports by Haskett et al. (2019) and Sida et al. (2018), who reported that Ethiopian farmers had *Faidherbia albida* in different seasons for improved soil fertility, improved crops, fodder, firewood, and shade. *Cordia Africana* is highly preferred for timber, and firewood, improving soil fertility and shade. Research has also shown that *Cordia Africana* is the most suitable multifunctional species for different regions of Ethiopia (Negash, 2007; Nigussie et al., 2014; Mamo and Asfaw, 2017). Thus, the survival of the top three species is under question, as the daily demand of the local communities continues with a lower rate of re-plantation. These results demonstrate the need for an immediate coordinated conservation effort to conserve the rapidly disappearing native multipurpose fodder and fruit species in the area.

4. CONCLUSION

Native fodder and fruit tree species provide firewood, charcoal, soil fertility improvement, medicinal value, construction and timber wood, farm tools, and fences. Therefore, the government should foster agroforestry with native fod-

der and fruit species by increasing research and extension services. Farmers have well-founded indigenous knowledge for the uses and propagation of native fodder and fruit species. Overgrazing followed by overexploitation, climate change/drought, and disease and pests were the major regeneration constraints to native fodder and fruit tree/shrub species in the study area. Therefore, appropriate interventions through research or extension are essential to reduce limitations on the reproduction of target species. The domestication should focus on five selected species including *Ziziphus spina-christi, Faidherbia albida, Cordia Africana, Ximenia Americana,* and *Acacia senegal*. However, it should be also integrated with other important species such as *Mangifer indica L.*, and *Moringa oliefera Lam.*, which were expressed additional interest by key informants during an interview. This research is essential for policymakers, scientists, and research institutions to focus on the development of technology and information for the sustainable use and conservation of target species.

5. ACKNOWLEDGEMENT

The author would like to thank the Ethiopian Environment and Forest Research Institute for financial support. We thank the entire staff of the Agricultural and Rural Development offices of the Merhabete Region for their technical support and guidance in data collection.

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