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Assessment of Wild Edible Plant Species in East Hararghe Zone, Oromia, Ethiopia

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Abstract
Wild edible plant species are very important to improve food security and diversify household income sources. However, its identification and document of wild edible plant species limited. The study was conducted in four districts of East Hararghe Zone, to assess, identify and document of wild edible plant species in the study area. Wild edible plant species surveys, and data such as wilderness, edibility or parts used, growth form, threatening factors, conservation measures assessed at the field. People perceptions were captured from a total of 170 informants using an informal interview, focus group discussions, and questionnaires and observation in the field. Most species taxonomically known and for those unknown, were collected and identified with elder peoples. Descriptive methods of data analysis were employed to analyze data on wild edible plant species. The result showed that a total of 26 wild edible plant species were recorded in the study area. Four life forms: 65% species were found growing as trees, 15% as shrubs, 8% as herbs, and 8% as climbers. Parts of wild edible plant species used were fruits 83%, bark 5%, seed 4%, leaf 4%, stem 2.94 and root 2% were recorded. Most of wild edible plant species were consumed as raw fruit 80% and the majority consume wild edible plant species as supplementary food supply. Women and children are responsible in wild edible plants collection. Potential of existed wild edible plants in the study area were low and the current abundance of wild edible plant species was decreasing. The most threatening factors to hinder the development of wild edible plant species were agricultural expansion and deforestation. These findings confirm the assumption that wild edible plant species are important for the generation of household income. This study identified the most importance of wild edible plant species to local communities, particularly in the selected districts. Wild edible plant play an important role in rural livelihoods by ensuring food, medicine, and sustained income.Therefore, there is an urgent need for research on the more domestication of wild edible plants in home gardens, mixing with domesticated crop plants in the study area to enhancing the wild edible plan species production for food security and dietary diversity in East Hararghe Zone. Further research also need to collect and conserve, propagation and management activities of the wild edible plants species identified in the study area. Further study also carried out on nutritional contents of the wild edible plants species. Finally, further study must be on strengthening botanical information, germplasm collection and genetic improvement, increasing the supply of high-quality planting materials, and promoting on-farm cultivation in the form of agroforestry systems to recognize the identifying and selecting preferred species.
Keywords: Identification, wild edible plants, domestication, food supply, traditional knowledge
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"# ntrod!ction
Wild edible plant species refer to species that are neither cultivated nor domesticated, which are available from their wild natural habitat and used as sources of food (Beluhan and Ranogajec, 2010). These trees are generally grown in different habitats such as forests, cultivable fields, and even anthropogenic ally disturbed areas such as roadsides and wastelands (Ranogajec 2010). Wild edible plant species have played a significant role in the livelihoods of rural communities in developing countries (Mabaya et al. 2014; Khruomo & Deb 2018) due to their nutritional and medicinal value (Biswas et al. 2018). Wild edible plant species are important sources of traditional food recipes, medicines, fodder, firewood, and building materials for rural communities (Navia et al. 2020; Suwardi et al. 2020a). Even though the primary dependence of most agricultural societies on staple crop plants such as wheat, maize and rice, while the conventional eating of wild edible plant species products are used as food are more than 7,000 species in human history continues until the present day (Grivetti and Ogle, 2000). Wild edible plant species are closing food gaps and play an important role in maintaining livelihood food security for many people in developing countries during seasonal food shortages, as emergency food aid (Afolayan and Jimoh, 2009). Moreover, the indigenous edible plant species are adapted to the local culture and environment welfare through natural growing manner with a minimum requirement of external inputs and maintenance such as management, fertilizer and pesticides (Ruffoet al., 2002).

Despite the fact that can easily be integrated into sustainable farming systems by the majority of the rural population, they are still not treasured as of cultivated fruit trees, such as mango, avocado, Papaya and orange due to lack of scientific support. Therefore traditional knowledge of wild plants, generally in Africa and particularly in Ethiopia are in danger of being lost, as habits, value systems and the natural environment change

(Ruffoet al., 2002). There is a widespread failure with knowledge especially among young people and urban dwellers to preserve wild edible plant species in order to be valuable for future generations. So it needs to be recorded systematically (Demel et al., 2010).

In general, the regardless of their importance, wild edible plant species are faced with serious threats of anthropogenic and environmental factors in the country due to agricultural expansion, overgrazing/overstocking, deforestation and urbanization (Teklehaymanot and Giday, 2010). In Ethiopia, where more than 80% of the population is rural, the people have depended on their traditional knowledge for utility of edible plant species without exhaustive documentation of their contribution, management and utilization in their surroundings. This is particularly true in rural population of East Hararghe Zone, where rural communities of the area depend on wild edible plant species for various purposes.

Wild edible plants species also faced with serious threats of anthropogenic and environmental factors (Teklehaymanot, 2010). However, there are no any researches so far done, on assessment of wild edible plant species in the study area to being as impetus for policy makers, NGOs, and end users in order to sustain utilization and management of wild edible plant species without jeopardizing for future generation. Hence, as natural resources of the area along with their identification, conservation and domestication for future food security. However, there are no any researches so far done, on assessment of wild edible plants species in the study area Therefore, it needs to identify and recorded systematically in scientific ways (Demel *et al.,* 2010). The study was filled the gap of indigenous knowledge related to utility and management as well as constraints and potentials of wild edible plant species. Therefore, the specific objectives of the study were initiated to,

- ✓ To identify wild edible plant species in different agro ecology,
- ✓ To identify traditional knowledge and skill of rural communities on management and utilization of commonly used wild edible plant species and
- ✓ To assess constraint and potential role of wild edible plant species in combating food insecurity in the study area.

$# %aterials and %ethods

$#"# Descriptions of the St!dy Area

Eastern Hararghe is one of the 20 administrative zones of the Oromia regional state. It is located in the Eastern part of the country about 600 km of the capital, Addis Ababa (Figure 1).

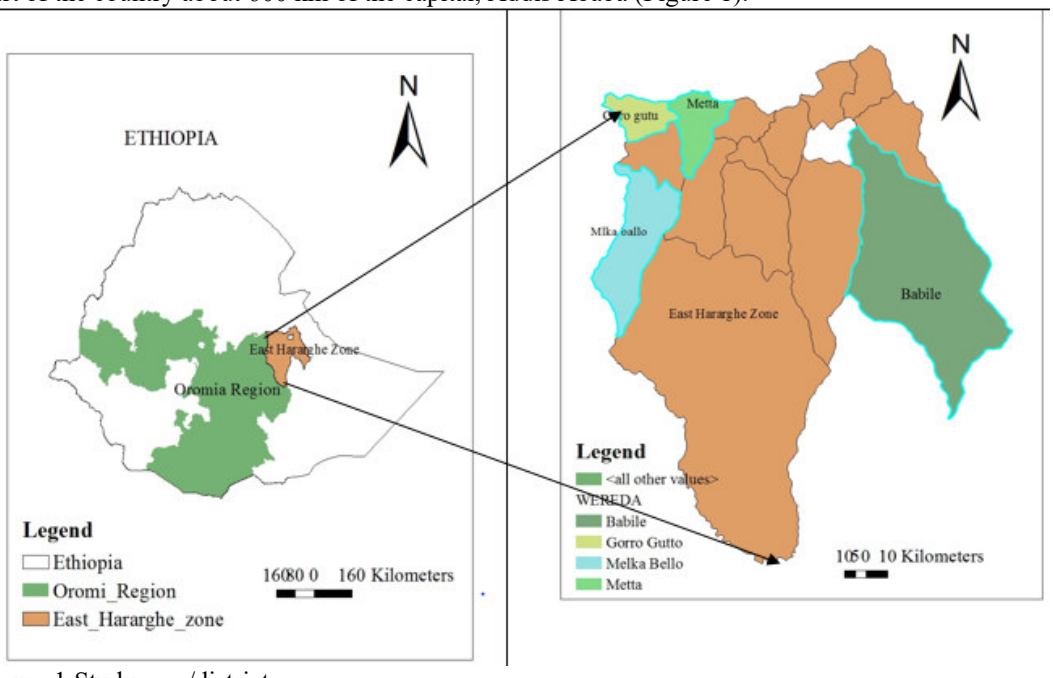

Figure 1:Study area/districts

East Harerghe Zone is geographically located 9° 42' 41" North latitude and 42° 0' 9" East longitudes. The zone is bordered on the southwest by Bale, on the west by West Hararghe Zone, on the north by Dire Dawa and on the north and east by the Somali Region. The Administrative center of this zone is Harar. The capital town of the Zone is Harar, which is located at a distance of 526 km East of Addis Ababa. The area coverage of the Zone is 2,260,000 ha (22,600 km2), comprising of 20 districts with a total population of 2,723,850, an increase of 48.79%. Hararge has a population density of 151.87. While 216,943 or 8.27% are urban inhabitants, a further 30,215 or 1.11% are pastoralists, 17% agro-pastoralists, and the rest are agriculturalists (74%).

Melka balo: The study area is found at 487kms of east of Addis Ababa, the capital city of the country. The average temperature in the area is 24^0c with the average rain fall is 1800 mm and the altitude ranges from 1300-3140m above sea level and the various topographic features of district include Dega (high land)(20%), Woyna Dega (Mid-high land) (39%) and kola (Lowland) (41%) (NAMSA, 2015). Mixed farming system is the mode of agriculture in the districts play an important role for the livelihood of the local population (CSA, 2009).

Babile: The study is located 31km away from the Harar town and about 557 km east from Addis Ababa. The altitude is 1000 -2000 a. s. l. and the various topographic features of district more kola (Lowland) (NAMSA, 2015).Rainfall pattern in the area is bi-modal rain fall .Average annual rainfall amount is 1145 mm. Mean annual temperature is 24°C (FARC, meteorological data). Mixed farming system is the mode of agriculture in the districts play an important role for the livelihood of the local population (CSA, 2013). The population of the woreda according to the 2007 census was 93,674. Rural residents account for 81.1 percent of the population. The agro-climatic condition of the area is semi-arid, arid. The annual maximum and minimum temperatures are 26 and 20^0C, respectively.

Goro-Gutu, is located 420 km east of Addis Ababa, on the main road to Harar. The woreda is located 140 km north-east of the zonal capital, Harar. According to the 2007 Population and Housing Census, the population of the woreda was 143,896, of which 93 percent live in rural areas. The total population of the woreda is 143,896 (73,512 male persons and 70,384 female persons and the total number of households (HHs) in the woreda is 24,284 (22,666 male headed HHs and 1,618 female headed (HHs). The majority of inhabitants work in agriculture. The agro-ecology is divided in to highland (dega) that covers 23 percent of the area, midland (weynadega) 29 percent and the remaining 48 percent is classified as lowland (kolla). Meta contains three agro-ecologies like the zone even though the proportion varies. The agro ecology of the woredas falls in highlands (Dega), midland (Woina Dega) and low land (Kolla). The proportion of highland (Dega), midlands (Woina Dega) and low lands (Kolla) vary. The Meta total population is 252,185 (127, 3 11 male persons and 124,874 female persons and the total number of households (HHs) and in is 51,398 (25,974 male headed HHs and 25,424 female headed HHs.

$#$# %ethodology and &esearch design

$#$#"# Selection of the St!dy Area

The location for the studies were identified in collaboration with a multidisciplinary research team and local administration. Reconnaissance surveys were undertaken. The study districts, Melka ballo, Goro gutu, Metta and Babile were selected purposively based on it's their altitude range that from low land, mid land and highland of agro ecology zones.

$#$#$# Sampling Proced!res and Sample Si'e determination

Sampling Proced!res

The location for the studies were identified in collaboration with a multidisciplinary research team and local administration. Reconnaissance surveys were undertaken. Multistage sampling technique was used for this particular study. In the first stage, Melka ballo, Goro gutu, Metta and Babile districts were selected purposively for this study. In the second stage, the study kebeles were stratified into three different strata to cover varying agro-climate due to time shortage and to have a representative sample. In the third stage, the six Kebeles were randomly selected from each agro-climate. In the fourth stage, sample households were selected from each Kebeles.

To select sample households, a systematic sampling method was applied by taking the n^{th} element of the sample frame. There are 6387 households in six selected Kebeles. The list of households were obtained from Woreda agricultural office in the study area. The total households were divided by sample size (170) and it gave 40. So that the 40^{th} value is 39. So that every 40^{th} number was selected to get sampled household. It also assures that the community will be evenly sampled (Johnson et al., 2007)

(able ": Study area characteristics

Distruct	Kebeles	Agro ecology	Altitude (m a.s.l)	Latitude (N)	Longitude (E)	Total HHs	Sample HHs
Babile	B. babile	Lowland	1664	9^0 35' 43"	42^0 18' 50"	1030	27
	Abdi buch	Lowland	1778	9°17'59''	42° 17'26'	1010	30
Goro gutu	Madisa	Midland	1889	9^0 22' 45"	41^0 25' 10"	1168	26
Melka ballo	Dire kufa	Midland	2000	9^0 4' 44"	41^0 21' 51"	918	30
Meta	Ch. lola	Highland	2185	9^0 41' 54"	41^0 37' 18"	1085	29
	B. oromia	Highland	2200	9^0 14' 60"	41^0 24' 59"	1176	28
Total						),*+,	",-

Sample Si'e determination

The household head were considered for household interview; other members of the family were included in focus group discussions and key informant interviews. Population size of the study area was determined. Sample

size was calculated with the simple random sampling method based on proportional to population size using (Yemane, 1967) formula, presented below

$$n = \frac{N}{1 + N(e)}2$$

n= No. of samples, N= No. of population in selected kebeles, σ^2 = Variance of Population, D= (d/t) ^{2}, D= A certain rate of deviation (5%) from the average and t= t table value (1.96) corresponding to the limit of the confidence interval 95%. Where n is the sample size, N is a total number of households in the selected kebeles [the sample size (n) in each Kebele was picked based on its proportion to N because the number of households in each Kebele is different], the maximum variability or margin of error 5 % (0.05), 5 = probability of the event occurring. Based on the above technique, 170 sample households were selected. Therefore, the total sample size was 170.

$#*# Data .ollection

Data collected tools are observations, interview questions and questionnaires. Data on types: local names, growth form, parts used, pattern of consumption, management and major threatening factors of wild edible plants species were gathered. In order to asses and identify the existing wild edible plants species, checklist were set to list the species by the guide and support informants for the study areas. The wild edible plant species in different agro ecology, traditional knowledge and skill on management and utilization commonly used wild edible plant and the constraint and potential role of edible plant species for combating food insecurity in the area were collected.

$#/# Data analysis

The data collected were analyzed by means of descriptive statistics, with Microsoft Excel and SPSS (Statistical Package for Social Sciences, Version 26). In addition data was analyzed using both qualitative and quantitative methods. Close ended questions were analyzed through tables and percentage to compare the results while open ended questions like interview and observations were analyzed using descriptive methods.

*# &es!lt 0 Disc!ssion

*#"# dentified Wild Edible Plants Species in the St!dy Area

Wild edible plant species in the study area were assessed and identified. A total of 26 wild edible plant species were identified and most frequently the habitat of wild edible plants were at the wild and forests in the study areas. A total of 170 respondents were interviewed through both household survey and key informant interviews. The study were considered by respondents to be commonly consumed by the community, and they were considered to be the most useful species among those listed for the studied areas. The number of wild edible plants reported in this study was relatively low compared with the number of species documented in previous studies carried out by (Assefa *et al.,* 2010) in other parties of Ethiopia. The lower number of wild edible plants found in the present study may be associated with differences in local traditions and customs relating to the use of wild plants in different parts of the country.

(able $# Listed of identified, their part used, growth form, and habitat of wild edible plants species in the study areas

1o	2ocal names	Scientific names	Edible part	3rowth form	Habitat
1	Gora	Rosa abyssinica	Fruit	climber	W
2	Tinii	Balanites aegyptiaca	Fruit	Shrubs	W/F
3	Xaxessaa	Grewia ferruginea	Fruit	Shrubs	W/F
4	Agamsa	Cassia siamese	Fruit	climbers	W
5	Shimirkolii	Dovyalis abyssinica	Fruit	Shrubs	W/F
6	Zeyituna	Psidium guajava	Fruit	Trees	Wild/FL
7	Buruurii	Vanqueiria ariseppala	Fruit	Trees	W/F
8	Bissii/sukee	Ocimum urticifolium	Leaf	Herbs	wild
9	Walensuu	Erythiria brucei	bark	Trees	W/F
10	Ulaagaa	Ehretia cymosa.	Leaf	Trees	W/F
11	Jilboo	Oncobaspinosaforss	Fruit	Shrubs	W/F
12	Dabobessa	Rhus natalensis	Leaf	Trees	W
13	Biqaa/Gambelo	Gardenia ternifolia	fruit	Shrubs	W
14	Rummana	Runicagranetum	Fruit	Trees	W/FL
15	Qancaraa	NA	leaf	Shrubs	W/F

1o	2ocal names	Scientific names	Edible part	3rowth form	Habitat
16	Birreessa	Terminalia brownii	Leaf	climber	W/F
17	Qurquraa	Ziziphus mucronata	Fruit	Trees	W/F/FL
18	Waddeessa	Cordia africana	Fruit	Trees	W/F/FL
19	Harbuu	Ficus sur	Fruit	Trees	Forest
20	Baddeesaa	Syzygium guineesa	Fruit	Trees	Forest
21	Roqaa	Tamarindus indica	Fruit	Trees	W/F
22	Hudhaa	Ximenia americana	Fruit	Trees	Forests
23	Xossinnoo	Ruta chalepensis	leaf	Herbs	W/F
24	Darguu	Achayrentesaspera	Leaf	Shrubs	W/F
25	Buruurii	Discorea sp	Fruit	Shrubs	W/F
26	Dhangaggoo	Rumex nervosus	Leaves	Herbs	W/F

Note: W-wild, F-forest, FL-farm land, W/F –wild & forest

Thus, this may reflect social variations in attitudes and preferences towards wild food sources. Hence, it also explains differences in agro ecology in different parts of the country. The number of interviewed households were visited mainly for of the species on their local name, edibility, growth form, and habitats forms of wild edible plants. 26 wild edible plants species represents 4 life forms: Trees, Shrubs, Herbs, and Climbers. The study carried out in the sampled study area founded 26 wild edible plant species comprising life forms in percent across in different agro ecology

The majority of the wild edible plants were recorded in the wild, but the integration of some plants in farm lands and home gardens indicate their potential to be used in different land use systems. Based on the identified wild edible plants by respondents were categorized into different parts (wild and domestic). Wild edible plants were mainly used for directly edible purpose and unripe fruits trees were used in pickle making. The farmers opined that, wild edible plants were also used in many herbal medicines. Preferred wild edible plants for domestication based on farmer's perception. Farmers in the study area were interviewed and their perception on domestication of some species was documented. The farmers preferred *Psidium guajava, Oncobaspinosaforss*, *Annona senegalenis, Tamarindus indica*, and *Cordia africana* species for domestication.

*#$# dentify (raditional Knowledge, %anagement and 4tili'ation of .ommonly !sed Wild Edible Plants Species in the st!dy area

Parts !sed of wild edible plant species

The wild edible plants species had different plant parts are consumed. Six edible parts of wild edible plants recorded in the districts. These are fruits, barks, seeds, leaves, stem, and root (Table. 5). Fruits comprise 82% of edible parts whereas bark 5%, seed 4%, leaf 4%, stem 3% and root were 2% provided. This means fruits are the major parts consumed followed by barks, seeds and leaf. Stem and root are the least. Most fruits consumed in raw. Regarding wild edible parts consumed, five edible parts were documented namely fruits, bark, stem, leaves, seeds, and root. This indicates the edible parts of reported wild edible plants in study area is also highly diverse. The most widely consumed parts are fruits (82%) that eaten raw. The preference of fruits to other parts might be low energy investment. Fruits are harvested and consumed in the field or outdoor when they ripe by children while collecting fuel wood or herding cattle. The result of this research is in agreement with current study results (Tebkew *et al.*, 2014; Regassa *et al.*, 2015; Betti *et al.*, 2020; Mutie *et al.*, 2020). In other studies, leaves are the main consumable part of wild edible plants in a different part of the world (Ali-Shtayeh *et al.*, 2008). This implies the types of wild edible parts and culture of the communities vary from location to location. This indicates that the different cultural groups in Ethiopia make use of diverse wild edible fruit trees and shrubs species parts as food sources.

(able *: Wild edible plants parts used for consumption in the study area

Parts used	Parts !sed of wild edible plants along different agro5ecologies							
	6abile district		%# ballo 0 3# g!t! districts		%etta district		(otal	
	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)
Fruit	51	80.95%	50	81.97%	40	86.96%	141	82.94%
Bark	3	4.76%	4	6.56%	1	2.17%	8	4.71%
Seed	1	1.59%	4	6.56%	2	4.35%	7	4.12%
Leaf	4	6.49%	0	0.00%	2	4.35%	6	3.53%
Stem	2	3.17%	2	3.28%	1	2.17%	5	2.94%
Root	2	3.17%	1	1.64%	0	0.00%	3	1.76%
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The wild edible plants species parts that commonly used were the fruit, bark, seed, leaf, stem and root.

Habits of Wild Edible Plants in the Area:

In the study area, generally the identified species were mostly different life forms/growth forms and existed, occurred, distributed of these species their production and utilization. The wild edible plant species belong to four life forms namely trees, shrubs, herbs and climbers. Trees contributed 69%, shrubs 15%, and herbs 8%, while climbers contributed only 8% of all identified wild edible plant species (Table. 4). The life forms of wild edible plants in this study were diverse and accordingly the largest number of wild edible plant species found to be trees followed by shrubs, herbs and climbers. The least diverse wild edible plants in terms of life forms were climbers. This result is also seen in a study conducted nearby area by Tebkew *et al.* (2018) in the Northern part of Ethiopia where trees are dominant life forms of wild edible plants followed by shrubs. However, this result is different from a result reported by Alemayehu *et al.* (2015) and by Amente (2017) in the western part of Ethiopia. This shows the variation of the life forms of edible wild plants from place to place that might be due to variations in type edible wild plant species and culture of the communities. In the study area, products from edible plants species are generally identified for subsistence used mainly because the production of edible parts, such as fruit, as seasonal and, therefore, can only be gathered for a short period of time.

(able /: Growth forms of wild edible plants species identified in the study area

8ariables	2ife form of wild edible plants along different agro5ecologies							
	6abile district		%# ballo 0 3# g!t! districts		%etta district		(otal	
2ife form	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)
Trees	37	58.73%	50	81.97%	30	65.22%	117	68.82%
Shrubs	11	17.46%	7	11.48%	8	17.39%	26	15.29%
Herbs	8	12.69%	2	3.33%	4	8.69%	14	8.24%
Climbers	7	11.11%	2	3.33%	4	8.69%	13	7.65%
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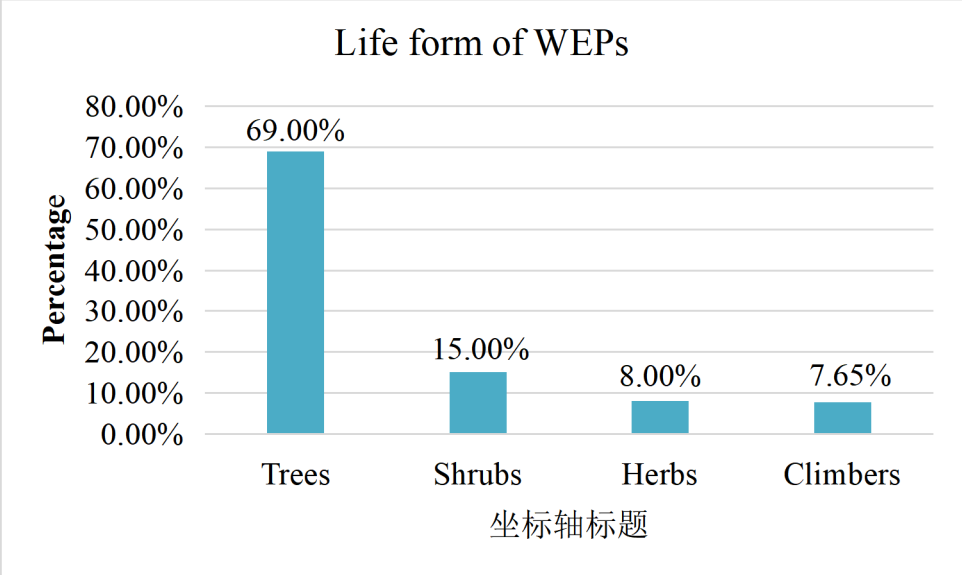
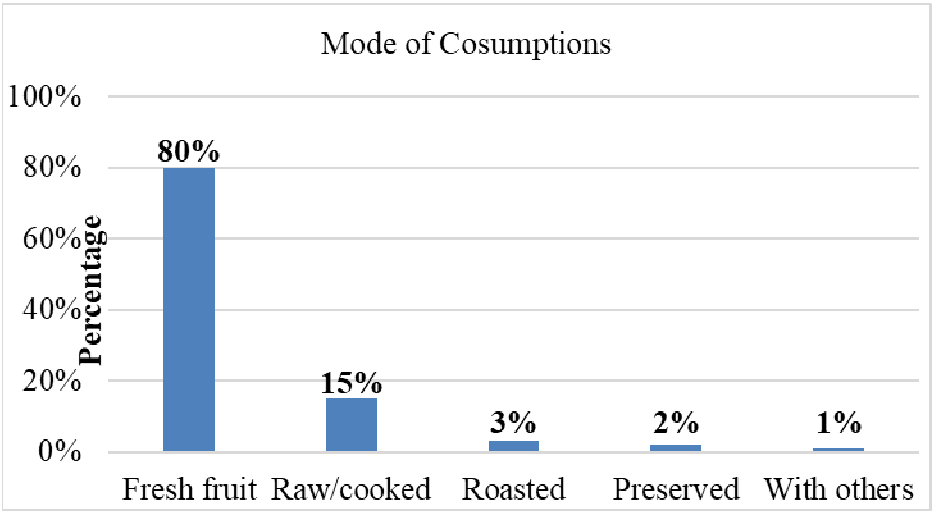


9ig# "# Growth form of wild edible plants of the study area

.ons!mption method of wild edible fr!it trees and shr!b species

Most wild edible plants parts were eaten directly in fresh forms as consumption method. The mode of consumption of wild edible plants in study area, showed that were consumed raw fruit and followed by raw/cooked were consumed cooked/roasted were consumed and Preserved and consumed with any ingredients were consumed in three agro ecologies. In the study area, the local people reported that about 80% of wild edible plants consumed raw fruit outdoor. However, about 15% can be consumed raw or cooked, about 3% can be consumed roasted and the rest 2% of wild edible plants in the area are found to be eaten preserved or cooked (Figure 2).



9ig# $# Consumption method of wild edible plants of the study area

According to the report of this finding, majority of the wild edible plants in the area consumed raw except *Ocimum urticifolium, Erythiria brucei, Ehretia cymosa, Rhus natalensis, Terminalia brownie, Ruta chalepensis, Achayrentesaspera, Rumex nervosus*. In the study area, the respondents reported that majority of the wild edible plants in the area were consumed as raw fruit. The study of Beche *et al.,* (2016) also indicated that the majority of the recorded edible species were consumed fresh without ripening or processing. The study conducted by Tebkew *et al.,* (2018) indicated that wild edible plants were consumed fresh, dried and cooked, or prepared in different forms. Majority of the edible plants were consumed fresh, while only nine of them were consumed after drying. There was no need for cooking, boiling, or roasting the edible parts for consumption in the majority of wild edible plants in the area (Anbessa, 2016). Seyoum (2017) indicated that nearly half of the identified plant species are consumed raw, and many of them are fruits. Others are used after various food preparation techniques. For instance, leafy vegetables are used after frying and/or boiling or steaming over a fire, and some fruits can be used following non-fire-processing methods.

(he p!rpose and contrib!tion of wild edible plant species in the st!dy area

Wild edible plants are used for various purposes: Among different uses, used as food. It was found that most of the wild edible plants were used for direct consumption. Different parts of wild edible plants such as fruits, were used for edible purposes. Majority of respondents were used for food sources followed by income sources with additional diet along with domestic foods as refreshment. Response of more farmers (in table 7) shown that the reason of consumption were/used as food 55.88%, income 15.88%, as medicinal 15.29% and refreshment 12.94% different agro ecologies. Majority of respondents were used for food followed by income purpose with additional diet along with domestic foods as refreshment.

(able :: Farmers preference for of wild edible fruit trees and shrubs in the study area.

8ariables	Ob;ecti<e !sed of wild edible plants along different agro5ecologies							
	6abile district		%# ballo 0 3# g!t! districts		%etta district		(otal	
P!rposes	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)
Income	33	52.38%	38	62.29%	24	52.22%	95	55.88%
Food	14	22.22%	11	18.03%	2	4.35%	27	15.88%
Refreshme	8	12.69%	8	13.11%	10	21.74%	26	15.29%
Medicinal	8	12.69%	4	6.56%	10	21.74%	22	12.94%
(otal	63	100%	61	100%	46	100%	170	100%

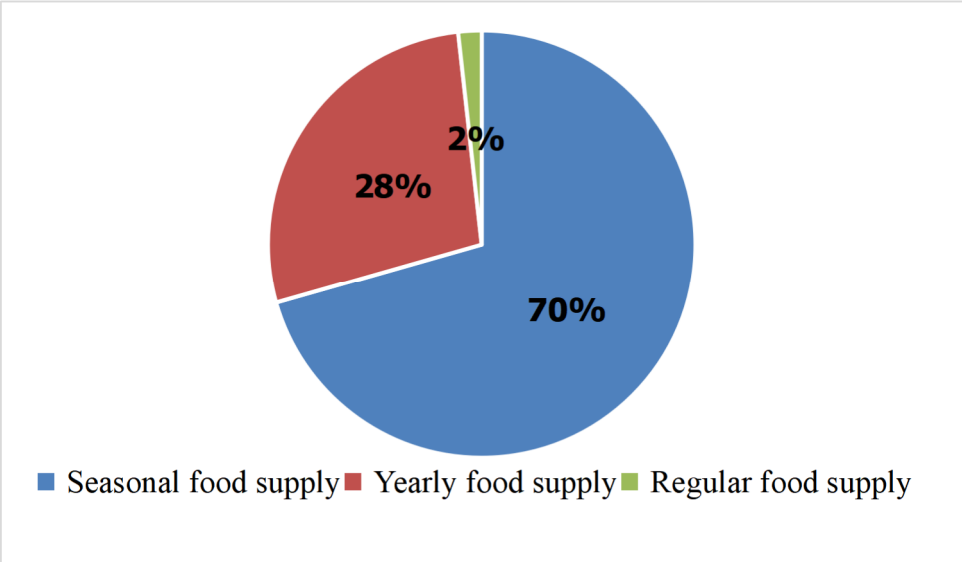
.ontrib!tion of wild edible plant species for the ho!sehold

The survey results showed that the contribution of wild edible plants for the livelihood of the community in the study area, consumed as supplementary food. The contribution of wild edible plants for food consumption role followed by supplementary role with additional diet according to the major respondents responded. The results showed that the contribution of wild edible plant for the livelihood of the community in study area selected districts, consumed as supplementary food. Seasonal food supply 70.59%, yearly food supply 27.65% and regular food supply 1.76% were contributed. Wild edible plants have little economic importance compared to other economic activities, for some people selling fruits at local markets do provide some income for the poorest so as to supplement food as well as cash in order to meet their basic needs. Some of the wild edible plants were contributed as additional income sources. Thus, conservation and development of wild edible plants should be considered as an integral element of the farming system to avert food insecurity problems and improve the

livelihoods of the rural community in East Hararghe Zone. The role of wild edible plants in bridging the gap in food supply, particularly to resource-poor members of the community, is significant (Teketay *et al.* 2010). The fruit harvesting season and uses vary from place to place, even from species to species. This is due to climatic and intraspecific variations (Teketay *et al.* 2010). Our survey revealed that edible plant were commonly used during periods of food shortage, seasonally during periods of food scarcity. In surveyed respondents reported that the food shortage period occurred in May, June, July and August.

(able): Contribution of wild edible fruit tree and shrub species for the household

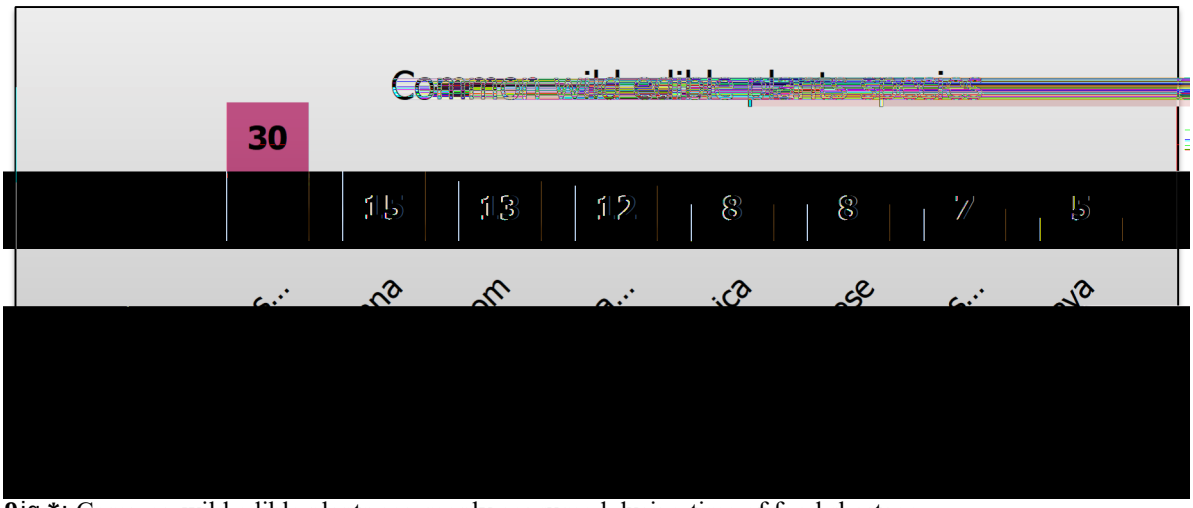
.ontrib!tion	.ontrib!tion of wild edible plants along different agro5ecologies							
	6abile district		%# ballo 0 3# g!t! districts		%etta district		(otal	
	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)
Seasonal food supply	39	61.90%	45	73.77%	36	78.26%	120	70.58
Yearly food supply	23	36.51%	15	24.59%	9	19.56%	47	27.65
Regular food supply	1	1.59%	1	1.64%	1	2.17%	3	1.76
(otal	)*	"-- 7	)"	"-- 7	/)	"-- 7	",-	"-- 7



9ig# $# Consumption method of wild edible plants of the study area

.ommon wild edible plant species commonly cons!med d!ring time of food shortage

The results revealed that some wild edible plant species are only consumed during periods of food shortage, such as *Balanites aegyptiaca* 43%, *Cordia africana* 15%, *Annona senegalenis* 12%, *Rosa abyssinica* 8%, *Cassia Siamese* 8%, *Ziziphus mucronata* 7%, & *Psidium guajava* 6% in the study area. The respondents indicated that most of the wild edible plants have multiple edible uses in the study area. Wild edible Fruit trees have been used as a source of food and medicine since time immemorial and they have become an integral part of the culture of the society throughout the country (Kassaye, *et al.,* 2006). This might be because these species are only used to supplement the normal diets of many rural people (Hidden, 2019).



9ig *: Common wild edible plants commonly consumed during time of food shortage

(he main so!rces of income for the ho!sehold in the st!dy area

The main sources of income of the sampled households were farming (100%). Some income source revealed by the respondents included crop sale 40%, livestock products 24%, coffee and chat sales 17%, edible plants 13%, charcoal selling 3.53% as well as fuel wood selling 2.35%. The income generated from sales of wild edible fruit trees is marginal because of several social, economic, and cultural factors. This finding suggests that future promotion efforts towards enhancing the commercialization of wild edible fruit trees should be designed with packages that comprise cultural and social suits targeted to address specific local conditions. Domestication and integrating promising wild edible fruits trees into the existing land use systems in such a manner will eventually contribute to improved rural livelihoods (Asfaw & Tadesse, 2001, Teketay *et al*., 2010).

(able ,: Farmers preference for income adjacent to farming

ncome so!rces	Income of respondents along different agro5ecologies								
	6abile district		%# ballo **0** 3# g!t! districts		%etta district		**(**otal		
	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)	&an=
Crop sale	26	41.26%	22	36.07%	20	43.47%	68	40.00	1st
Livestock products	17	26.98%	13	21.31%	11	23.91%	41	24.12	2nd
Coffee and chat	7	11.11%	10	16.39%	5	10.87%	29	17.06	3rd
Edible fruit trees	9	14.29	11	18.03	9	19.56	22	12.94	4th
Charcoal selling	3	4.76	2	3.28	1	2.17	6	3.53	5th
Fuel wood selling	1	1.59	3	4.92	0	0	4	2.35	6th
(otal	**)***	"-- **7**	**)"**	"-- **7**	**/)**	"-- **7**	**",-**	"-- **7**	

Some of the common products are vegetables, grains, agricultural produce, fruits, animals, and their by-products sold in the village, local and road sides markets. The frequency of the market days and the demand for goods depends on the socio-economic conditions of the people in the area. In the study area, wild edible plants in limited quantities sold in door to door or on the roadside around villages. The respondents were sold wild edible plant at Villages market, local markets, road sides market and district markets. The respondents state that the value addition of wild edible plants may increase the price of the product by three to four times. For example, mango in raw fruit form is sold in villages markets, at 30 birr/kg whereas, it may increase to 60 birr/ kg if processed into mango juice.

Diversification of products is expected to increase profits, which are a good source of income for the

household economy. It was noted that people from areas closer to the wild and forests tend to collect and sell edible wild plants more than those from distant areas. Wild edible plants have been associated with the traditions and culture of local peoples (Medley & Kalibo 2007; Addis *et al.* 2013).

(able +: Household members collected wild edible fruit tree

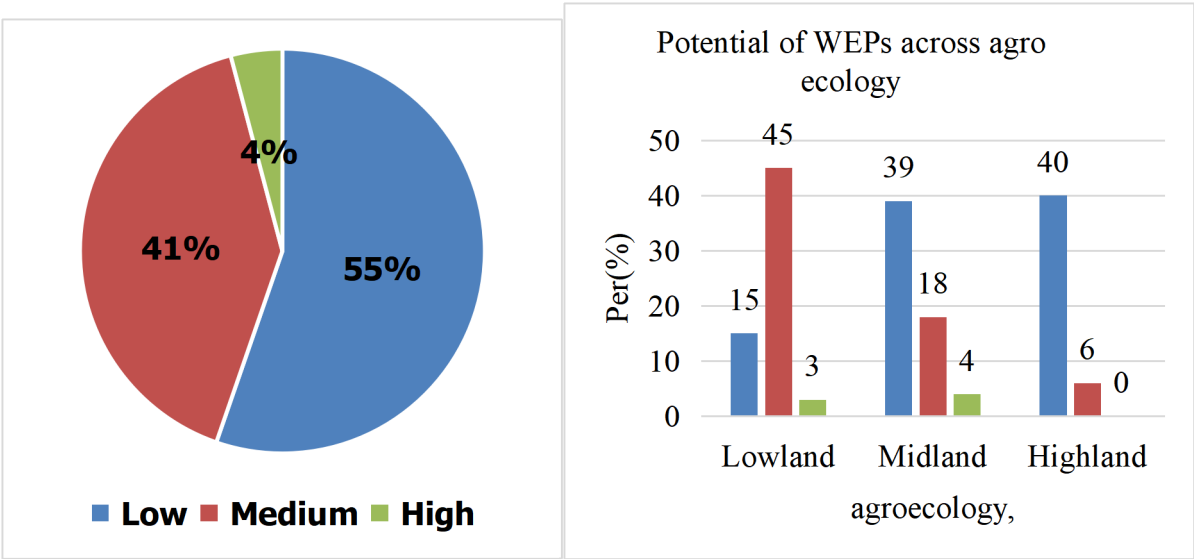
Wild edible plant collected	. ollector of wild edible plants along different agro5ecologies							
	6abile district		%# ballo 0 3# g!t! districts		%etta district		(otal	
	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)
Women	26	41.26%	23	37.70%	18	39.13%	67	39.41%
Young children	23	36.51%	23	37.70%	16	34.78%	62	36.42%
Youth	14	22.22%	14	22.95%	10	21.74%	38	22.35%
Elder peoples	0	0.0	1	1.639	3	6.52	4	2.35%
(otal	)*	"-- 7	)"	"-- 7	/)	"-- 7	",-	"-- 7

Ab!ndance of wild edible plant species in the st!dy area

The potential of wild edible plants varied from site to site with altitudinal differences. The distribution of wild edible plant varied between agro ecology. A total of potential are low 55.29%, medium 40.59% and high 4.18%. The lowland area had the medium potential, midland area had the lowest and highland area had the lowest potential of wild edible fruit trees. Overall, potential production from trees and shrubs were highest than herbs and climber.

(able >: Potential of wild edible plants in the land use system in the study area

Potential of wild edible plants	Potential of wild edible plants along different agro5ecologies							
	6abile district		%# ballo 0 3# g!t! districts		%etta district		(otal	
	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)
Low	15	23.81%	39	63.93%	40	86.96%	94	55.29%
Medium	45	71.43%	18	29.51%	6	13.04%	69	40.59%
High	3	4.76%	4	6.56%	0	0.0%	7	4.18%
(otal	)*	"-- 7	)"	"-- 7	/)	"-- 7	",-	"-- 7



9ig#*# Distributions of edible wild plants in different agro-ecologies in the study area

The number of wild edible plants species were higher in highland next to mid-land agro-ecology than in lowland agro-ecologies of the study area. Lowland was the least agro-ecology in the distribution of wild edible plants in study districts (see fig. 3).

The distribution of different wild edible plants in different agro-ecologies indicates the adaptation of these species in different environmental conditions. This indicates that plants adapted to variable climate are generally drought intolerant. The response of majority respondents to abundance of wild edible plants species in the study area now day comparing to the past is decreasing 94.71% and increasing 5.29%. Most of the respondents believed that, the abundance is decreasing followed by those who said it is as previous and no increasing happened to them. These plants grow abundantly in the wild and have economic potential as a source of household income. However, efforts should be made to domesticate or cultivate them in the communities'

farmlands.

(able "-: Current abundances wild edible fruit trees

.!rrent ab!ndances	.!rrent ab!ndances of wild edible plants along different agro5ecologies							
	6abile district		%# ballo 0 3# g!t! districts		%etta district		(otal	
	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)	Freq.	Per (%)
Decreasing	59	93.65%	60	98.36%	42	91.30%	161	94.71%
Increasing	4	6.35%	1	1.64%	4	8.69%	9	5.29%
No change	0.0%	4.76%	0.0%	6.56%	0.0%	0.0%	0.0%	0.0%
(otal	)*	"-- 7	)"	"-- 7	/)	"-- 7	",-	"-- 7

Demographic and socio5economic characteristics of ho!sehold respondents

The farmers in the study area live under different socioeconomic conditions in terms of gender, age, family size, education, marital status, household relationships, occupation, farming experience, and wealth status. A total of 170 respondents were interviewed through both household survey and key informant interviews. The study were observed that the respondents relationships and consumed by the community, and they were the most useful species among those listed for the studied areabKK*W*kEFWWOXVbmFE*WEFO(Vx*kFmFFOOVE*Fx@K@OnVbE*@FmKI

formal education 47.65% followed by primary school 43.53% and secondary schools 8.14% and lastly, tertiary schools (post-secondary) (0.59%). Marital status, the majority of the respondents were married, with a share of more than 96.47%, followed by single and widowed 1.76% and 1.18% respectively, as well as those divorced were less 0.59% ((able $).

Household occupation also assessed, the majority of the respondents were farming occupation 90% and followed by government employment were 8.23% and local trader were 1.76%. All of the respondents had inhabited the area in average years for 35 at the category of 21 to 40 years lived were 52.94%, next 15 to 20 were 31.18% and the last were 15.88% lived more than 41 years in the area ,in the three agro ecologies.

The Farming experience of the respondents were analyzed, the respondents were accounted in average 15 years' has farming experience ranged from 10 to 20 were 57.06% followed by 21 to 40 years were 31.18% and lastly, the respondents greater > 41 year were 11.76% in thee agro ecologies.

(able *: Demographic and socio-economic characteristics of households respondents (n = 170)

8ariables	&espondents information along different agro5ecologies							
	2owland ?6abile woreda@		%idland ?%# ballo 0 3# g!t! woreda@		Highland ?%etta woreda@		(otal	
Occ!pation	Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
Farming	59	93.65%	51	83.61%	43	93.47%	153	90.0%
Employer	4	6.49%	7	11.48%	3	6.52%	14	8.23%
Trading	0	0%	3	4.91%	0	0%	3	1.76%
(otal	63	100%	61	100%	46	100%	170	100%
Aear li<ed	Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
15-20	18	50.79%	17	27.89%	18	58.69%	53	31.18%
21-40	33	30.16%	34	55.74%	23	32.61%	90	52.94%
>41	12	12.69%	10	11.46%	5	4.35%	27	15.88%
(otal	63	100%	61	100%	46	100%	170	100%
EBperience	Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
"-5$-	36	55.56%	32	36.06%	29	52.17%	97	57.06%
$"5/-	16	26.98%	24	49.21%	13	34.78%	53	31.18%
C/"	11	9.52%	5	8.19%	4	8.69%	20	11.76%
(otal	63	100%	61	100%	46	100%	170	100%
W# stat!s	Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
Rich	2	31.75%	6	9.84%	7	15.22%	15	8.83%
M. income	32	50.79%	39	63.93%	23	50.0%	94	55.29%
The poor	29	46.03%	16	26.22%	16	34.78%	61	35.88%
(otal	63	100%	)"	100%	/)	100%	",-	"-- 7

Analysis among households with different wealth status were assessed. Wealth status of the households from middle income were 55.29% and followed by from poor households were 35.88%, and last of respondents from rich households in wealth status were 8.83% ((able *).

.orrelation of Age, 3ender, 9amily Si'e, Ed!cation, Occ!pation and Wealth stat!s with (raditional Knowledge of People on Edible Wild Plants in the st!dy area

Traditional knowledge of respondents on wild edible plants positively correlated with age, gender, family size, and wealth status and negatively correlated with education, occupation and marital status of household of respondents. Traditional knowledge of respondents in the study area significantly correlated with age, gender, family size, and wealth status ($p<0.05$). There was some knowledge difference between genders. The gender, age, family size and wealth status have a direct proportion with traditional knowledge of respondents on edible wild plants. There was some knowledge difference between genders (Table 7).

(able ,: Pearson's correlations of gender, age, family size, education, occupation and wealth status with indigenous knowledge of respondents on wild edible plants

Demographic and socio5economic characteristics	ndigeno!s =nowledge with P <al!e
Gender	0.013*
Age	0.027**
Family Size	0.04**
Education	0.221
Occupation	0.661
Marital status	0.402
Wealth status	0.020*

The analysis showed that female households relatively collector of wild edible plants more than male-

headed household do significant mean differences (P<0.05) were observed. The gender distinction in collected of wild edible plants from wild were ascribed to many different reasons, including that it was a job familiar to females, it was a work during feul wood collection, and female income is low. Differences between genders in the collected of wild edible plants are influenced by different objectives, perceptions, interests, and access to resources between communities. It was noted that female from areas closer to the wild and forests tend to collect and sell edible wild plants more than those from distant areas.

The relation of age and wild edible plants results of differences in knowledge among average age groups of farmer households. The results of the study showed that middle age (40 age) informants identified wild edible plants relatively more knowledge than younger people, with a significant difference (P<0.05).This agrees with the general fact regarding age-wise distribution of indigenous botanical and ecological knowledge among rural farming communities. On the other hand, the number of edible wild plants listed by youths is smaller than mentioned by older persons that might be by fast westernization and lack of interest for their culture as noted by (Wiryono *et al*., 2017) in Central Bengkulu District, Bengkulu Province, Indonesia.

The family size have a direct proportion with traditional knowledge of respondents on edible wild plants. This might be people having large family member are more dependent on edible wild plants. An increase in the household size by one member, increases the likelihood of collecting wild edible plants (Kebede *et al*., 2017). Larger households with sufficient labor source tend to collect wild edible plants compared with those of small households. Analysis among households with different wealth status were assessed. Wealth status of the households from poor households were used edible wild plants than rich households. A majority of poor respondents agreed that edible wild plants are important part of their traditional diet. Traditional knowledge related to eating and harvesting wild edible plants are still passed on, while at some extent declining.

*#/# %a;or threats factors ⟫ disappearances of wild edible fr!it tree and shr!b species

In the study area, most of the people were using variety of wild edible plants from forests. They were using roots, leaves, fruit or berries and other parts as a source of food and medicinal values for many years. But now day those plants are threatened comparing to the past by many factors. Despite their importance, wild edible plants face serious anthropogenic and environmental threats. Most of the respondents stated the factors for disappearing of wild edible plants were expansion of agriculture, deforestation, overgrazing, charcoal production/ fuel wood collection, tree pest and diseases, urbanization, drought and age of trees. So, agricultural expansion contribute 45.88%, deforestation 23.53%, overgrazing 13.53%, charcoal production 5.88%, and charcoal production/fuel wood collection were 5.29% found to be the most threatening factors. Due to these reason, many wild edible plants were became scarce in the study area. This finding was in agreement with the report by Tigist *et al.* (2006). It is also similar with results obtained in different investigation by Endashew (2007) which showed agriculture and population pressure severely threatened plant species in general. This is also similar to the a report which states the most common threats reported to wild edible plants were agricultural expansion, overgrazing/overstocking, deforestation and urbanization (Addis, 2009; Asfaw, 2009; Tilahun T and Mirutse G., 2010).

(able: Responses to the factors / disappearances of wild edible fruit trees and shrubs species

%a;or threats factors wild edible plants	&espondents information along different agro5ecologies					
	2owland	%idland	Highland	(otal	Percent ? 7 @	&an=
Exp. of agriculture	30	28	20	78	45.88	1st
Deforestation	12	16	12	40	23.53	2nd
Overgrazing	7	8	8	23	13.53	3rd
Charcoal production	8	2	0	10	5.88	4th
Tree pest and diseases	3	4	2	9	5.29	5th
Urbanization	1	1	2	4	2.35	6th
Drought	1	2	1	4	2.35	7th
Age of trees	1	0	1	2	1.18	8th
(otal	)*	)"	/)	",-	"--	

.onser<ation⟫ strategies commonly practiced by in r!ral comm!nities for wild edible plants species

According to the respondents, the conservation measures taken to minimize challenges to wild edible plants were retain wild edible wild edible plants on farm, keeping existed plants from danger , prevent the miss use of plants , no cutting of wild edible trees , replanting the deforested areas ,and restoring with community and youth in the study area. Majority of respondents said that the conservation measures were retain wild edible plants on farm 34.12%, keeping existed plants from danger 28.82%, prevent the miss use of wild edible plants 18.24%, no cutting of wild edible plant 15.88%, replanting the deforested areas by traditional way 1.76%, and restoring in collaboration with community and youth 1.18%. This finding was in agreement with the reviewed research outputs on wild edible plants of the country indicate the need for conservation as well as documentation (Tekle

and Giday, 2010; Fantahun and Hager, 2010). Conserving Ethiopian wild edible plants (Tekle and Giday, 2010). Conservation measures that combine domestication of potential wild edible plants into the existing production systems contributes towards diversification of food sources, ensuring food security and dietary diversity as well as maintaining biodiversity and environmental integrity (Asfaw & Tadesse 2001, Teketay et al. 2010).

(able: the conservation measures of wild edible fruit trees and shrubs species in the study area

.onser<ation meas!res of wild edible plants	&eposes of respondents along different agro5ecologies					
	2owland	%idland	Highland	(otal	Per#?7@	&an=
Retain wild edible fruit trees	26	17	15	58	34.12	1st
Keeping existed plants from danger	16	17	16	49	28.82	2nd
Prevent the miss use of plants	13	13	5	31	18.24	3rd
No cutting of wild edible l trees	4	14	9	27	15.88	4th
Replanting the deforested areas	2	0	1	3	1.76	5th
Restoring with community and youth	2	0	0	2	1.18	6th
(otal	)*	)"	/)	",-	"--	

Domestication of wild edible plants species in the st!dy area

According to the respondents responded that they were not to domesticated because lack of convenience domestic wild edible plant species were 29.41%), slow growth rate were 28.82%, long productivity cycle 14.18%, wild edible plant yield less 14.18%, and no available all times 13.53% in all agro ecology of study area.

&easons of not domesticating	&eposes of respondents along different agro5ecologies					
	2owland	%idland	Highland	(otal	Per#?7@	&an=
Lack of domestic wild edible trees	22	21	7	50	29.41	1st
Slow growth rate of wild edible trees	17	12	20	49	28.82	2nd
Long productivity cycle	5	7	12	24	14.18	3rd
Wilde edible fruit trees yield less	11	9	4	24	14.18	4th
No available all times	8	12	3	23	13.53	5th
(otal	)*	)"	/)	",-	"--	

/# .oncl!sions and &ecommendations

Our survey study were identified 26 wild edible plants species represents 4 life forms: Trees, Shrubs, Herbs, and Climbers. The majority of the wild edible plants were recorded in the wild, but the integration of some plants in farm lands and home gardens indicate their potential to be used in different land use systems (wild and domestic). The wild edible plant species belong to four life forms namely trees, shrubs, herbs and climbers. Trees contributed 69%, shrubs 15%, and herbs 8%, while climbers contributed only 8% of all identified wild edible plant species. The life forms of wild edible plants in this study were diverse and accordingly the largest number of wild edible plant species found. Six edible parts of wild edible plants recorded in the districts. These are fruits, barks, seeds, leaves, stem, and root. Fruits comprise 82% of edible parts whereas bark 5%, seed 4%, leaf 4%, stem 3% and root were 2% provided. Most wild edible plants parts were eaten directly in fresh forms as raw fruit for consumption method.

The local people reported that about 80% of wild edible plants consumed raw fruits. Majority of respondents were used for income and food sources with additional diet along with domestic foods. It contribute as seasonal food supply and yearly food supply. Wild edible plant species are only consumed during periods of food shortage, such as *Balanites aegyptiaca*, *Cordia africana*, *Annona senegalenis*, *Rosa abyssinica, Cassia Siamese*, *Ziziphus mucronata*, and *Psidium guajava* in the study area. The main sources of income of the sampled households were farming (100%) and wild edible plants contribute income sources about 13%. Though the total size of the population involved in wild edible plants collection is less significant, the result provides an indication that women and children are responsible in wild edible plants collection. The distribution of wild edible plant varied among agro ecologies and the total potential of wild edible plants in the study area are low.

Distributions of edible wild plants in different agro-ecologies higher in highland than lowland area of wild edible plants. The current abundance of wild edible plants species in the study area comparing to the past is decreasing. The relationships of farmer's respondent of traditional knowledge on wild edible plants positively correlated with age, gender, family size, and wealth status and negatively correlated with education, occupation and marital status of household of respondents. Despite their importance, wild edible plants face serious anthropogenic and environmental threats. The threats factors for disappearing of wild edible plants were expansion of agriculture, deforestation, overgrazing, and charcoal production/ fuel wood collection. Some conservation measures taken to minimize challenges to wild edible plants were taken retain wild edible plants on farm, keeping existed plants from danger, prevent the miss use of plants, no cutting of wild edible trees. Not to domesticated because lack of convenience domestic wild edible plant species, slow growth rate.

&ecommendations:

- ✓ There is an urgent need for research on the more domestication of wild edible plants in home gardens, mixing with domesticated crop plants in the study area to enhancing the wild edible plan species production for food security and dietary diversity in East Hararghe Zone therefor.
- ✓ Further research also targeted to collect and conserve, propagation and management activities of the wild edible plants identified species in the study area are.
- ✓ Further study must be carried out on nutritional contents of the wild edible plants species.
- ✓ Further study must be on strengthening botanical information, germplasm collection and genetic improvement, production, increasing the supply of high-quality planting materials, and promoting on-farm cultivation in the form of agroforestry systems to recognize the identifying and selecting preferred species,

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