On-farm Diversity, Use Pattern and Conservation of Enset (Ensete ventricosum) Genetic Resources in Southern Ethiopia

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Abstract

Background: Enset is an important source of food for millions and consumed as a staple or co-staple food crop mainly in southern parts of the Ethiopia. Large numbers of enset landraces exist in different administrative zones of Ethiopia with a wide range of altitude. However, limited information is available on the diversity, their distribution and utilization pattern comparatively to the diverse ethno-linguistic as well as socio-cultural communities of the country. Hence, this study was devised to explore and document richness of farmers' tradition and practice on diversity and distribution of enset landraces on farm-level and selection pattern for different purposes in regarding to its production, utilization and conservation of enset genetic resources.

Methods: The study was conducted in four major enset growing administrative zones of Ethiopia namely, Hadiya, Kembata-Tembaro, Gurage and Silte. A total of 240 farm households were surveyed using individual interviews, key informants interviews, focus group discussions and direct on-farm field observations.

Results: A total of 282 farmer-named landraces have been identified, with a range from 2 to 32 on individual homegarden. The largest numbers of landraces was found in the Hadiya Zone (86); while the lowest was scored in the Silte Zone (57). The Shannon diversity index (H') ranged from 3.73 (Silte) to 3.96 (Hadiya). Similarly, landraces revealed a very narrow range of variances in the Simpson's 1-D diversity index, and it ranged from 0.963 (Silte) to 0.978 (Hadiya). Likewise, the similarity index ranged from 0.24 to 0.73 sharing 16-47 landraces in common. Of the 282 landraces, 210 (74.5%) were recorded in more than one zones; whereas, 72 (25.5%) had a narrow distribution and were restricted to single zone.

Conclusions: Farmers have established long term practices and experiences in cultivation, utilization and conservation of a diverse group of enset landraces to fill their domestic purposes in each zone. Therefore, in order to facilitate on-farm conservation as well as sustainable utilization of the enset genetic resources, farmers need to be supported by different stakeholders for all their worth, and also in improvement programs. In addition to this, to clarify the exact nature of synonyms and to see if they are duplicates molecular analysis would be helpful and recommended as a follow-up work.

Background

Enset [*Ensete ventricosum* (Welw.) Cheesman] is a large perennial monocarpic herbaceous plant, similar to the banana in form, in the family *Musaceae* within the monocot order of *Zingiberales* [1]. *E. ventricosum* is domesticated and consumed as food in the south and south-western parts of Ethiopia [2]. Enset is distributed at altitudes between 1500 and 3100 masl and it is chiefly propagated vegetatively [3]. It is noted for its tolerance to environmental fluctuations, storability, and for its multiple uses that play a pivotal role in preventing famine [4, 5]. Moreover, enset in Ethiopia is arguably the most important crop contributing to food security and rural livelihoods for about 1/4 of the Country's population [2, 6, 7]. Ethiopia is both the center of origin and center of diversity for enset and many other crops [8]. Genetic diversity for farmers means varietal diversity, which they can clearly differentiate on the basis of agromorphological traits, phenological attributes, post-harvest characteristics, and differential adaptive performance under abiotic and biotic stresses [9, 10, 11].

Farmers have managed the diversity of enset landraces for centuries with limited influences from outside [12, 13]. Numerous landraces are grown for different uses and site requirements [14, 15]. Some prior studies indicate that numerous enset cultivars were identified in each region and the observed genetic diversity in cultivated enset in a particular area appears to be related to the extent of enset cultivation and the culture and distribution pattern of the different ethnic groups [13, 16, 17, 18, 19]. Enset farmers select landraces based on the quality and quantity of food

products, rate of maturation, disease and drought tolerance, forage quality, medicinal value, ease of scraping, quality of corm and productivity [17, 20, 21].

Shigeta [22] described that different enset landraces are recognized in different growing areas, and are being grown in mixture. Each enset landrace as identified by the farmer has its own name that is uniformly spread across the region that speaks the same language [16, 17, 23]. Farmers differentiate one landrace from the other phenotypically by looking at the colour of petiole, midrib, leaf sheath, angle of leaf orientation, size and colour of leaves and circumference and length of pseudostem [16, 17, 24, 25]. Hence vernacular names are often descriptive and reflect variations of landraces in places of origin, morphology, as well as agronomic and cooking characteristics [12, 26]. However, in some cases there are similar landraces known by different vernaculars and there are also different landraces known by similar vernaculars and with similar phenotypic appearance [23, 27].

The high genetic diversity of enset warrants conservation, as it provides resilience to the enset farming system and thus food security for farming communities [13, 16, 18]. Enset plays a crucial economic role, providing a higher yield under low input conditions compared to other crops in Ethiopia [28, 29, 30]. It is a multipurpose crop and nearly every part of the plant has some sort of uses as food and non-food [2, 31]. Farmers often say that enset is their food, their cloth, their house, their bed, their cattle feed and their plate [2]. The major food types obtained from enset are *qocho*, *bulla* and *amicho*. Furthermore, some enset varieties are used traditionally to cure bone fractures, birth problems, and diarrhea in humans [16, 25, 32].

Enset landraces in south and southwest part of Ethiopia are grown in homegardens with different local names and often with wide distribution and varietal diversity. For the sustainable utilization and on-farm conservation of its genetic resources, understanding the socio-cultural, selection and retention practice of enset landraces diversity in different ethno-lingustic communities is vital, and also important for future improvement of the crop. However, limited documentation is available in relation to the on-farm varietal diversity, its distribution and the pattern of uses in different zones or ethnic groups. Due to this, the present study helps to fill knowledge gap with respect to farmers' traditional practice on enset cultivation and utilization in Hadiya, Kembata-Tembaro, Gurage and Silte zones, the major enset production areas in southern Ethiopia. Therefore, this study was devised to investigate and document the richness of farmers' tradition and practice on diversity and distribution of enset landraces on farm-level. Furthermore, its naming and selection criteria for different purposes with respect to the production, utilization and conservation of enset genetic resources.

Materials And Methods

The study area and site selection

The study was conducted in four enset-growing administrative zones, namely, Hadiya, Kembata-Tembaro, Gurage and Silte of southern Ethiopia (Fig.1). The zones are basically distinguished by distinct languages, cultural background and agricultural systems, and also named based on the name of the predominant ethnic group for that administrative location. The Hadiya and Kembata-Tembaro peoples speak a Cushitic language family, while the Gurage and Silte peoples belong to groups speaking the Semetic language. Generally, the study zones are located between the great Ethiopian Rift Valley and Gibe-Omo River system, and bordered with Oromia region to the north and east, and with Wolaita zone in the south. The zones are structured into different *woredas*, which are further organized in to *kebeles* (the lowest administrative units in Ethiopia). The study *woredas* and *kebeles* were selected from each administrative zone based on enset diversity where prior information was obtained from the departments of Agriculture of the respective zones and *woredas* (Table 1).

Sampling technique and sample size

For this study, multistage sampling method was performed for the selection of individual enset-grower farmers in each zone. Of the four administrative zones, 12 *woredas* (three from each zone) were selected purposefully based on enset frequency of occurrence and production level. From each *woreda*, three *kebeles* were also chosen purposefully according to the information obtained from agricultural office of each *woreda*. Therefore, a total of 36 *kebeles* were selected for data collection. From each *kebele*, six to seven individual farmers were selected randomly that make a total of 240 households (60 household heads from each zone) in the whole study sites.

Data collection

Both primary and secondary data collection methods were conducted in order to assess and document farmers' traditional knowledge regarding on-farm diversity, distribution and utilization of enset crop in the study area. Two rounds of data collection and field observation (the first round on wet season from June to September, 2019 and the second round on dry season from January to March, 2020) were carried out.

To develop semi-structured interviews, different kinds of discussion were conducted with small numbers of enset farmers in each zone in order to generate needed information to be collected in the study area. In-depth individual interviews were conducted together with trained agricultural extension workers, who are working closely with the communities in the respective selected *kebeles* in local languages (Hadiya, Kembata, Gurage and Silte languages using translator) and in Amharic official language. The principal investigator can also communicate and understand three of the above listed local languages, hence that made our

Table 1

Description of studied areas, number of respondents and altitude ranges

Administrative zone	Study woredas	Sampled kebeles	Number of respondents	Altitude ranges (m)
Kembata-T*	Doyogena	Murasa	7	2145 - 2255
		Hawora-Arara	6	2335- 2565
		Serera	7	2650- 2822
	Angacha	Wasera	7	2550 - 2675
		Qerekecho	7	2225 - 2360
		Funamura	6	2150 -2220
	Damboya	Dato	6	2680 - 2760
		Kazala	7	2250 - 2470
		Bonga	7	2300 - 2435
Hadiya	Misha	Tulla	7	2675 - 2915
		Dengawora-S*	7	2567 – 2784
		Semenwasgebeta	6	2250 - 2465
	Lemmo	Shurmo-Dacho	7	2200 - 2350
		Dijo-Demala	7	2201- 2418
		Lisana	6	2145 - 2250
	Dunna	Somicho	7	2475 - 2676
		Woramera	6	2300 - 2565
		Qenqicho	7	2435- 2550
Gurage	Endegegn	Shewora	7	2210 -2345
		Wolecho	7	2165- 2455
		Zigez	6	2275 - 2335
	Gumer	Esen -Adengez	6	2635 - 2785
		Gura-Fezer	7	2695 - 2750
		Qebul	7	2570 - 2790
	Enamor-Ener	Agata	7	2235 - 2560
		Kochira	7	2195- 2275
		Jatu	6	1850 - 2230
Silte	Mirab A*	Willo	6	2485 - 2560
		Woger-gunjubul	7	2445 - 2585
		Mugo	7	2850 - 3195
	Misraq A*	Awerad	7	2265 - 2310
		Semerdin-D*	6	2220 - 2385

		Gomoro - Bucha	7	2315 - 2425
	Alicho W*	Abzena hulat	6	2775 - 3170
		Kutere	7	2450 - 2575
		Bune saqemo	7	2550 - 2680

Note: A*=Azernet, D*= Derawote, S*=Segamo, T*=Tembaro, W*= Weriro.

field activities less difficult to achieve our objectives properly. The interviews were designed to collect different detail information about enset diversity, distribution, traditional use values and management practices. The farmers were also asked about their perception on names and naming systems. In order to obtain the detail local knowledge of farmers in each zone, 4-5 key informants were also selected based on prior information obtained from *woreda* agricultural expert. For the focus group discussions, from each of the selected *woredas* about five participants were involved from the members of local administration, community elders, agricultural extension workers and other members of participating communities. Additional data was also collected through, preference ranking by involving 12 key informants (three from each zone). Secondary data was also reviewed from the reports of agricultural office of the each zones, different books, research articles and journals.

Data Analysis

All listed landraces throughout the collected sites were checked for known synonyms or local names that refer to the same or different landraces in each study zone and *woreda* (district) with the help of knowledgeable senior farmers. Moreover, some minor dialect variations within the same ethnic group were not considered as different landraces. However, landraces having same names, but originated from different ethnic group or zones, were documented as its. Richness was calculated as the total number of landraces per farm in each administrative zone. Moreover, it is the most simple biodiversity index and it does not take into account any characteristic of species (landrace).

Diversity and similarity indices of species can be quantified in different ways. The Shannon and Weaver [33] and Simpson Index [34] were used to evaluate the landraces diversity. Both of them are widely used tools as measure of heterogeneity [35], and these were calculated for all sample zones to explore on- farm enset diversity. Shannon - Weaver diversity index is the most popular measure of species diversity because it accounts both for species richness (numbers) and evenness, and it is not affected by sample size [36]. The resulting index is high when the relative abundance of the different species or landraces in the sample is even, and is low when few species or landraces are more abundant than the others. It was calculated using the formula: $H' = -\Sigma\, pi \ln pi$[35]. Where pi is the proportional abundance of the i^{th} landrace.

Even though Shannon's index takes into account evenness of the abundance of landraces, evenness (equitability) can also be computed separately. It is a measure of the proportion of the observed diversity with respect to the maximum diversity expected, and was calculated through the Pielou index [37] as the ratio, $E = H'/H'max = H'/\ln S$, where: E is the evenness (equity) index; H' = diversity; H'max is a maximum diversity; lnS**,** in which S refers to the number of landraces in each zone. The higher the value of E, the more even the species is in their distribution within the community or the plots. Similarly, the higher the value of H', the more diverse the community or the plot is. A high evenness, resulting from all cultivars (landraces) having equal abundance, is normally equivalent to high diversity [35].

Simpson's diversity index (**D**) is basically a measure of diversity. It measures the probability that two individuals randomly selected from an area will belong to the same species [34] and hence, as D increases, diversity decreases. The index was, therefore, transformed as 1 – D so that greater diversity corresponds to higher values: The formula for calculating D is presented as:

$$D = \frac{\sum n_i(n_i - 1)}{N(N-1)} \text{ , or } \quad (1\text{-}D) = 1\text{-}\{\Sigma n\ (n-1)/N\ (N-1)\}$$

The value of this index ranges between 0 and 1; the greater the value, the greater the diversity, 1 represents infinite diversity and 0, no diversity. The index was computed for all study zones.

Sorenson similarity index was employed to assess differentiation or beta (*b*) diversity [35], and it compares the similarity of species (landrace) diversity among the study zones. The expected variation in landrace composition that exists between the study zones was computed using Sorenson's similarity coefficient (Cs) [38].

Cs=2J/a+b

Where: *a* is the number of landraces at zone A, *b* is the number of landraces at zone B, and *J* is the number of landraces common to both locations. Sorenson's similarity coefficient ranges in value from zero (no similarity) to one (complete similarity).

Results

Extent of on-farm richness and diversity of enset landraces

In this study, we identified and recorded 282 locally named enset landraces in the Hadiya, Kembata-Tembaro, Gurage and Silte zones of southern Ethiopia. Enset growers easily can distinguish one enset landrace from the other by observing the external and internal features of the enset plants, and they give distinct vernacular names for each landrace. Each local farmer in the studied area cultivated diverse number of enset landraces in his or her homegareden. The number of enset landraces cultivated on individual farms considerably varies. In this study it ranges from two to thirty two (Table 2). According to farmers' report based upon local names: 86 enset landraces from Hadiya, 73 from Kembata-Tembaro, 66 from Gurage and 57 from Silte were recorded. The highest and lowest number of landraces per farm was documented in Hadiya and Silte zones, respectively (Table 2).

Table 2

Enset landrace diversity in the four administrative zones, richness, Simpson (1-D), Shannon (H') diversity indices and Evenness(E)

Zone	Richness(%)	Min[a]	Max[b]	Mean[c]	Unique[d]	1- D	H'	E
Hadiya	86(30.5)	3	32	10.23	22	0.978	3.96	0.89
K-T*	73(25.9)	3	19	8.71	26	0.976	3.88	0.90
Gurage	66(23.4)	4	24	9.52	14	0.975	3.83	0.91
Silte	57(20.2)	2	22	8.24	10	0.963	3.73	0.92

Note: *= Kembata-Tembaro, a = Minimum richness, b= Maximum richness, c= Mean richness / farm, d= Number of unique landraces

To quantify enset diversity for the four studied administrative zones, the Shannon, Simpson and Evenness diversity indices were calculated from the numbers of landraces existing on the 60 farmers' enset fields within each studied zone. The Shannon diversity index (H') had ranged from 3.73 (Silte) to 3.96 (Hadiya), this signifies the existences of a high richness of enset landraces in the study zones. Even though zones varied in richness, they had revealed a very narrow range of variances in the Simpson's 1-D and evenness indices. The Simpson's 1-D ranged from 0.963 (Silte) to 0.978 (Hadiya) and evenness indices ranged from 0.89 to 0.92. All these results specify the presence of high enset landraces diversity in these four zones (Table 2).

Similarities and differences of enset landraces diversity among zones

The similarity among pairs of zones with respect to farmers named landraces was evaluated using Sorenson's similarity index (Table 3). Generally, the similarity index ranged from 0.24 to 0.73 and the number of commonly shared landraces varied from 16 to 47. Hadiya and Kembata-Tembaro were the most similar zones, followed by Gurage and Silte in relation to enset landraces (Table 3). On the other hand, pairs of zones with relatively least similarity were Kembata-Tembaro and Silte, and Gurage and Kembata-Tembaro 0.24 and 0.25 for each pair, respectively. The dissimilar pairs of zones were among those geographically located relatively farther apart from each other.

Table 3

Enset landraces shared (bold) and Sorensen similarity indices between pairs of zones

Zone	Hadiya	K – T*	Gurage	Silte
Hadiya		**47**	**38**	**35**
K-T*	0.59		**17**	**16**
Gurage	0.50	0.24		**45**
Silte	0.49	0.25	0.73	

Note: *= Kembata-Tembaro

Distribution and abundances of enset landraces

Distribution of the enset landraces throughout the study sites were varied across zones. Out of 282 enset landraces recorded, 15 (5.3%) were widely distributed in all four zones. These were *Agade*, *Astara*, *Bededete/ Badade*, *Gimbo/ Gimbuwa*, *Heniwa/ Hiniba/ Enba*, *Kasete*, *Manduluqa/ Mande*, *Mariye*, *Merza*, *Mesmesia*, *Moche*, *Separa/ Sebera*, *Torora*, *Weshemeja* and *Zobira* (Table 4). Similarly, 33 (11.7%) farmers named enset landraces were commonly cultivated and found in three (Hadiya, Gurage and Silte) out of four zones (Table 4). Likewise, 72 (25.5%) of the enset landraces had a narrow distribution and were specific to a single zone (Table 4). But the remaining 210 (74.5%) were recorded in more than one administrative zone.

In addition to the distribution, enset landrace abundance also varied among the study zones. Few enset landraces such as *Gimbo*, *Hiniba* and *Separa* were relatively a high abundance at all four study zones. *Agade*, *Bedededa* and *Zobira* were also other most frequent enset landraces in the three out of the four zones (Table 4). Some landraces were well encountered in two zones, but virtually absent from the other study zones. For example, *Sisqella* and *Gishira* were most abundant landraces of the enset farms visited in Hadiya and Kembata- Tembaro zones but almost absent or rare in other zones. Moreover, some landraces such as *Abate-Merza*, *Dego-Merza*, *Dirbo* and *Unjame* in Kembata-Tembaro, and *Amerate* and *Lemat* in Gurage zones were dominant but outside these zones, they were found with a low

abundance. Enset landraces namely: *Manduluqa*, *Mariye*, *Mesmesia*, *Moche* and *Torora* described in this study were found in limited number of farms and widely spread in each zones.

Table 4

List of farmers- named landraces and its richness in the four administrative zones

No	Hadiya	N	K-T*	N	Gurage	N	Silte	N
1	*Addo*	2	*Abatmerza*	55	*Agade*	51	*Agade*	59
2	*Agade*	38	*Agade*	6	*Agoregure*	11	*Agermir*	12
3	*Alabite*	3	*Aganche*	8	*Ahiro*	18	*Ahiro*	31
4	*Anchire*	5	*Arke*	4	*Amerate*	49	*Ameret*	6
5	*Arke*	2	*Ashure*	26	*Ankufuye*	28	*Ankufaye*	8
6	*Astara*	21	*Astara*	8	*Ashaqit*	4	*Ashaqit*	6
7	*Awunada*	12	*Ayase*	15	*Astara*	42	*Astara*	28
8	*Banko*	2	*Bededed*	9	*Awunad*	6	*Awunade*	7
9	*Bedededa*	32	*Banko*	12	*Aywogna*	5	*Aywongna*	29
10	*Beneje*	18	*Cherquwa*	11	*Bededet*	37	*Bededet*	36
11	*Bequcho*	6	*Danxia*	7	*Benezhe*	32	*Manduluqe*	3
12	*Beshiqiye*	3	*Degomerza*	39	*Bezeria*	23	*Beneje*	30
13	*Bezeriya*	4	*Dereqeta*	8	*Bitena*	3	*Bezeria*	4
14	*Birwesa*	3	*Derga*	6	*Bossora*	21	*Bossora*	16
15	*Boicho*	12	*Dirbo-n**	12	*Chehoyet*	8	*Bushawesse*	4
16	*Boshosha*	2	*Dirbo-qey*	38	*Dare*	26	*Dem-worad*	11
17	*Danxia*	6	*Disho*	21	*Demyetrnech*	7	*Deriye*	12
18	*Dego*	31	*Uskuruz*	14	*Demyetrqey*	4	*Ferezeye*	6
19	*Dirbo*	21	*Etene*	29	*Egendye*	26	*Fenqo*	3
20	*Disho*	39	*Fechache*	6	*Enba*	38	*Fugnaqir*	2
21	*Egandiya*	6	*Felegede*	4	*Fenqo*	4	*Garado*	6
22	*Etine*	11	*Fello*	3	*Ferezeya*	17	*Guariye*	31
23	*Fechecha*	4	*Ferchase*	9	*Gazner*	8	*Gefate*	3
24	*Fello*	2	*Gagabo*	6	*Gegered*	11	*Gimbo*	41
25	*Feraziya*	3	*Gimbuwa*	39	*Gimbuwa*	28	*Gudero*	6
26	*Gagabo*	2	*Ginawa*	11	*Ginad*	6	*Hanzana*	5
27	*Gariya*	25	*Ginjona*	13	*Gozoda*	12	*Hiniba*	39
28	*Gimbo*	57	*Gishira*	29	*Guarye*	24	*Kaset*	11
29	*Ginjowona*	2	*Guderete*	3	*Gumbura*	3	*Kembat*	12
30	*Gishira*	38	*Gomorsa*	6	*Hanzana*	12	*Kemele*	2
31	*Gomorsa*	5	*Gunze*	3	*Kanchewa*	8	*Kombotir*	4
32	*Gozoda*	4	*Hargema*	5	*Kaset*	9	*Megribe*	3

33	*Gudere*	8	*Hella*	22	*Kebere*	3	*Mariye*	6
34	*Hanazana*	7	*Heniwa*	29	*Kembat*	11	*Merza*	3
35	*Haqucho*	3	*Keset*	4	*Kemele*	4	*Mesmesia*	2
36	*Hayiwona*	29	*Ketane*	2	*Kemota*	2	*Moche*	8
37	*Hella*	24	*Korbo*	2	*Kona*	5	*Nechewo*	5
38	*Hiniba*	41	*Lenbona*	3	*Lemat*	22	*Orad*	6
39	*Hyro*	8	*Leqeqa*	28	*Manduluqe*	2	*Qeshqeshe*	4
40	*Jegirada*	7	*Lokande*	5	*Mariye*	5	*Qiniware*	26
41	*Kaseta*	12	*Manduluqa*	12	*Merza*	4	*Separa*	38
42	*Kekera*	9	*Mariye*	18	*Mesmesia*	7	*Sherafire*	12
43	*Kerqere*	2	*Mesmesa*	15	*Mishirad*	3	*Shewrad*	15
44	*Korina*	8	*Moche*	9	*Moche*	6	*Shigez*	4
45	*Lechebo*	5	*Morala*	3	*Nechewa*	21	*Shireteye*	31
46	*Lendwese*	3	*Mutite*	3	*Oniya*	8	*Sino*	12
47	*Leqeqa*	13	*Nejawro*	2	*Oret*	24	*Sisqella*	2
48	*Lokanda*	6	*Oniya*	21	*Qeshqeshe*	6	*Tegeded*	6
49	*Manduluqa*	3	*Qeqile-ne*	12	*Qibnare*	39	*Tem-wese*	3
50	*Mariye*	11	*Qeqile-qe*	16	*Separa*	42	*Torora*	5
51	*Meqelwesa*	18	*Qerqere*	5	*Shewatia*	6	*Wonade*	9
52	*Merza*	34	*Qorate*	2	*Shewora*	5	*Woshemaja*	6
53	*Mesmesia*	18	*Quina*	22	*Shireteye*	29	*Yekechere*	2
54	*Moche*	25	*Sebera*	37	*Sisasir*	3	*Yetibare*	2
55	*Mutite*	3	*Shate*	2	*Tegeded*	18	*Zegizik*	2
56	*Nechewo*	7	*Shelleqe*	16	*Tereye*	8	*Zerbededet*	9
57	*Oniya*	22	*Sinera*	4	*Torora*	7	*Zobir*	28
58	*Orada*	11	*Sisqella ne*	44	*Wonadia*	11		
59	*Ossosa*	4	*Sisqella tik*	12	*Woshemadia*	6		
60	*Qebere*	7	*Sorpie*	8	*Yeqesewa*	18		
61	*Qenchewa*	2	*Unjame*	41	*Yeshirafire*	12		
62	*Qeshqeshe*	6	*W'ea*	12	*Yeshiraqinqe*	15		
63	*Qeteqeta*	2	*Wachiso*	7	*Zegirad*	9		
64	*Qiniwara*	26	*Wellanche*	5	*Zerbededet*	12		
65	*Qombotira*	15	*Weshemeja*	2	*Zobir nech*	3		

66	*Quiena*	9	*Woio woe*	3	*Zobir qey*	27
67	*Separa*	43	*Wolegella*	8		
68	*Shate*	29	*Wongorate*	3		
69	*Shelleqe*	3	*Xebare*	22		
70	*Shereqa*	2	*Xessa*	29		
71	*shewora*	7	*Xorore*	27		
72	*Shirafire*	14	*Zinke*	4		
73	*Sinera*	3	*Zobira*	6		
74	*Sisqella*	53				
75	*Soqido*	18				
76	*Suwandiya*	2				
77	*Tegeded*	6				
78	*Unjame*	19				
79	*Uskurusa*	5				
80	*Wea*	3				
81	*Wonade*	6				
82	*Woshamaja*	7				
83	*Xessa*	13				
84	*Xiggo*	9				
85	*Xorore*	27				
86	*Zobira*	39				

Note: N=Number of respondents who are growing enset, K-T*= Kembata Tembaro

Diverse local names of the enset landraces among zones

The local names of enset (*Ensete ventricosum*) and its different growth stages vary from one ethnic group to another. Enset is called *wessa* in Hadiya and Kembata-Tembaro, *wesse* in Silte, and a*set* in Gurage. Moreover, each growth (transplanting) stage has a distinct name by which it is identified. The Hadiya and Kembata-Tembaro farmers share almost the same local names for all sucker stages. These are known as *dubbo*, *simma*, *ero/ kiniba* and *balwesa*, but in Silte one and two years old suckers are called *bosho* and *daporo*, respectively, and the other two stages are nearly similar to the Hadiya and Kembata-Tembaro zones (Fig. 2a-d). In Gurage, one year old sucker is *fonfo* but the second and third stages are named the same as other studied zones.

According to the interviewed farmers, the same enset landraces are sometimes known by different names in different administrative zones (Table 5). In this study, 11farmer named the same enset landraces were known by different names in the other studied zones (Table 5). The landrace names given by enset farmers mostly reveal distinct morphological appearance or other culinary characteristics such as taste or use values. Each ethnic group has its own series of local names for enset landraces. For example, landrace *Shate* in Hadiya, and *Shirteye* in silte and Gurage is the same landrace with different local names often represents with the bitter taste of all its parts. Enset landrace *Xiggo* in Hadiya

called *Qeqile-nech* in Kembata-Tembaro and also known as *Dem-wored* in Silte, which is well known to the enset farmers as it's bleeding (red liquid) when parts are cut. The origin of certain cultivated enset is evident from the name. One such example in this study is *Kembat* it may be originated from Kembata, however, its name in Kembata-Tembaro and in Hadiya is called *Disho* (Table 5).

In addition, according to enset farmers some landraces were named based on the color of pseudostem and leaf (*Bushawese* in Silte meaning red enset), but this landrace in Hadiya is given the name *Meqelwesa*, meaning placental enset, which is related to use characters. Similarly, landraces *Soqido* is salt (taste of boiled corm or *amicho*) in Hadiya whilst in Silte and Gurage it is *Kemele* meaning Ape (may be the color of the pseudostem or petiole) (Table 5). In general, this is observed due to the use of various local names in the different communities of the study area, having their specific characters and method of perceiving by the local farmers. Based on key informants response and focus group discussion, some cultivated enset landraces were named with the minor or slight dialect differences forms in the local names among study zones. Those include landraces: *Gimbo/ Gimbuwa*, *Hiniba/ Heniwa/ Enba*, *Jegirada/ Z'girad*, *Hyro/ Ahiro*, *Qibnare/ Qinare/ Qiniwara* and *Guary/ Gariya*. This reveals that sometimes the same landraces are often known by different names in different or the same regions.

Table 5

Different local (vernacular) names for the same enset plants within or among zones

No	Hadiya	Kembata-T	Silte	Gurage
1	*Shate/Shatedegn*	*Shate*	*Shireteye*	*Shireteye*
2	*Disho*	*Disho*	*Kembat*	*Kembat/ Hambediya*
3	*Xiggo*	*Qeqile-Nech*	*Dem-worad*	*Demyertete nech*
4	*Meqelwesa*	*Qeqile- Qey*	*Bushawese*	*Demyertete qey*
5	*Bequcho*	-	-	*Sisasir*
6	*Shereqa*	-	*Megrib*	*Yeqisew/Qesew*
7	*Soqido/Soqe*	-	*Kemele*	*Kemele*
8	*Qombotira*	-	*Ashaqit/Kombotir*	*Ashaqit*
9	*Dego*	*Degomerza*	-	-
10	*Merza*	*Abatemerza*	*Merza*	*Merza*
11	*Boshosha/Qebere*	*Xebere*	*Tem-wese*	-

Pattern of use and management practices undertaken by farmers

In the study area all enset landraces were primarily cultivated for food and feed use, except landrace *Meqelwesa* or *Qeqile-qey* which was rarely used as food. This landrace is one of the most traditionally preferred medicinal enset landraces recommended for human and cattle ailments (Table 8). Based on the information we acquired during the individual interview and focus group discussion, enset farmers preferred landraces with early maturity and vigorous growth, easily harvestable, early fermenting, high *qocho* and *bulla* yielding, and with good cooking qualities. In addition, in all four zones, generally multiuse enset landraces were highly chosen and more cultivated than specific use landraces. However, in some situation there was regional or ethnic preference across the study zones. According to a

result of the key informants ranking from the five commonly shared and other two, *Gimbo* became the first, *Separa* the second and *Agade* the third most preferred enset landraces for their *qocho* and *bulla* quality; *Astara* and *Agade* scored highest points for both their *amicho* (cooked corm) tasty and medicinal value, and *Sisqella*, *Bedededе* and *Gimbo* stood first to third, respectively for their fiber quality (Table 9). For instance, extracting *bulla* from other harvested mass of enset (Fig. 2e) in Gumer *woreda* of Gurage zone by women is not common practices unlike other *woredas* and zones. But they purchase it from other adjacent *woreda* markets for different purposes. In the same pattern, the using and producing of fiber, which is another enset product obtained from the decorticating of petiole and pseudostem is decreasing in most of the studied zones. Because it's traditional way of production requires more labor and time. In addition, nowadays most of the traditional fiber made products are replaced by other plastic materials. However, some enset farmers in Hadiya and Kembata-Tembaro preferred more droughts tolerant and high fiber quantity and quality while those in Gurage and Silte favored easily harvesting and processing, early fermenting and less fibrous landraces (Table 7).

Table 6

Enset landraces selected by farmers for *Amicho*

No	In Hadiya zone		In Kembata-T		In Silte zone		In Gurage zone	
	Landrace	N=60	Landrace	N=60	Landrace	N=60	Landrace	N=60
1	*Soqido*	52	*Leqeqe*	58	*Qinare*	60	*Qinare*	60
2	*Qiniwara*	51	*Xebere*	51	*Astare*	60	*Astare*	60
3	*Astara*	51	*Quena*	50	*Gariye*	57	*Guarye*	58
4	*Gariya*	47	*Xorore*	50	*Ashaqit*	50	*Kemele*	43
5	*Leqeqe*	39	*Astara*	46	*Agade*	48	*Ginad*	35
6	*Xorore*	38	*Sebara*	36	*Oret*	36	*Oret*	36
7	*Quena*	37	*Etene*	35	*Torore*	35	*Torore*	37
8	*Qombotira*	37					*Qesew*	39
9	*Qebere*	36					*Ashaqit*	37
10	*Orada*	35					*Bezeria*	36

Moreover, interviewed farmers in Kembata-Tembaro grouped enset landraces into two major sex categories: female enset and male enset. The division as male and female is not linked to the biological reproduction but it is based on perceived features of the landraces. The female groups are known by ease of decorticating, early fermentation, corm palatability, more susceptibility to different disease and low strength of fiber whereas the male groups contrast to these characters. In contrast, farmers in Hadiya, Gurage and Silte not tend to classify enset plants into sex designation.

According to farmers report, we identified a total of 32 landraces which was applied in different proportions by each ethnic group : 10 in Hadiya, 9 in Silte, 7 in Kembata-Tembaro and 6 enset landraces in Gurage as traditionally medicinal useful to treat various health problem in human and cattle (Table 8). Out of the total listed, 12 medicinally used enset landraces shared the identical name in at least two zones, so that the total number decreased to 20. Landrace like *Astara* mentioned by the farmers is an example of enset that has multiple uses of traditional medicinal purposes in the all study area. Furthermore, landraces such as *Qinare*/ *Qiniwara*, *Gishira*, *Guary*, *Xessa*, *Hayiwona* and *Agade* were also

the most frequently used medicinal enset present in home gardens of two or more ethnic communities (Table 8). On the other hand, some medicinal landraces (*Cherquwa* and *Wolegella*) were identified as narrow distribution in the study zones (Table 4). However, in some cases the same kinds of enset those known with alternative local names used as medicines for different problems among the study communities.

Table 7

Enset landraces selected for strong and long fiber

Hadiya zone		Kembata-T zone		Silte zone		Gurage zone	
landraces	N =60	Landraces	N =60	landraces	N =60	Landraces	N =60
Sisqella	60	*Sisqella*	60	*Kembat*	52	*Kembat*	53
Disho	56	*Gishira*	57	*Bededet*	50	*Yeshirenqinke*	49
Unjame	54	*Unjame*	55	*Gimbo*	41	*Bededet*	48
Gishira	55	*Disho*	48	*Separa*	40	*Gimbuwa*	40
Dirbo	42	*Dirbo*	41	*Agade*	35	*Sebara*	38
Dego	40	*Shelleqe*	39				
Bequcho	39	*Hella*	38				
Bedededa	36	*Degomerza*	37				

For instances, landrace *Xiggo* in Hadiya mainly traditionally used to treat kidney and liver problems, whereas the same variety with different names (*Qeqile-nech* in Kembata and *Dem-word* in Silte) quoted by many farmers to remove delayed placenta and for aborification purposes (Table 8).

Table 8

Enset landraces selected for medicinal purposes

Admin. zone	Landraces	N=60	Product uses to treat ailment
Hadiya	*Agade*	38	*Amicho* with yoghurt to cure bone fracture.
	Astara	48	*Amicho* with milk to cure bone and muscle problems in human.
	Bedededa	35	*Amicho* to initiate milk production in cattle.
	Gishira	60	*Amicho* and roasted *bulla* with milk to treat bone fracture,
			in humans and corm to cure broken bone in cattle.
	Hayiwona	45	*Amicho* with yoghurt to remove spines and swells
			with pus from the human body, and to initiate milk
			production in human and cattle.
	Meqelwesa	60	*Amicho* for human, leaf and pseudostem for cattle to discharge
			delayed placenta after birth.
	Qiniwara	50	*Amicho* with dairy products to cure bone problems in human.
	Qombotira	32	*Amicho* with yoghurt to treat muscular cramps and waist
			problem in human.
	Xessa	42	*Amicho* with milk is eaten to relief broken bone in human.
	Xiggo	48	*Amicho* to cure kidney problems and hepatitis.
K- T*	*Astara*	38	*Amicho* to treat bone problems in human.
	Cherquwa	56	*Amicho* with dairy products to remove spines and swells from
			human body.
	Gishira	58	*Amicho* and roasted *bulla* with dairy products to treat bone
			problem in human and raw corm to heal broken bone in cattle.
	Qeqile-ne	46	*Amicho* for aborification purposes and to treat kidney problem.
	Qeqile-qey	60	*Amicho* to remove delayed placenta after birth in human, and
			pseudostem and leaf for the same purpose in cattle.
	Wolagella	36	Water squeezed from pseudostem to treat skin problem in human.
	Xessa	58	*Amicho* with dairy products to cure broken bone in human.
Gurage	*Astare*	60	*Amicho* with milk to treat bone and muscle problems, and
			for the initiation milk production in human after delivery.
	Dare	41	*Amicho* to cure damaged parts of the human body.
	Dem-yeter	45	*Amicho* with milk to remove delayed placenta in human.
	Guary	56	*Amicho* with milk to heal bone fracture in human.
	Oret	39	*Amicho* with dairy products to expel swells from human body.
	Qibnare	60	*Amicho* with cheese or yoghurt to treat broken bone and lung

			diseases in human.
Silte	*Agade*	47	*Amicho* with milk to cure bone problems of human and cattle.
	Ashaqite	38	*Amicho* with yoghurt to treat waist problem in human.
	Astare	60	*Amicho* with dairy products to repair broken bone, muscles,
			and to initiating milk production in human.
	Demworad	55	*Amicho* with milk to remove delayed placenta, to cure kidney
			and liver problem in human.
	Deriye	43	*Amicho* to heal damaged parts of the human body.
	Guary	56	*Amicho* with milk to cure bone fracture.
	Hayiwogn	48	*Amicho* with yoghurt to expel swells and any spiny materials
			from human body.
	Qiniware	60	*Amicho* with dairy products to treat broken bones, muscle
			and lunge problems in human.
	Sino	42	*Amicho* with dairy products to expel swells from human body.

Note: K-T*= Kembata Tembaro

This is may be due to each ethnic community has its own ways, practice and believes to utilize enset plants. Based on information obtained from farmers in this study, all of the traditionally medicinal enset landraces were also selected for sweet *amicho* (cooked corm) production except landraces *Gishira*, *Dare and Bedededa.* In the same manner, the most chosen parts of enset for medicinal use was corm but the landrace *Meqelwesa* (in Hadiya) or *Qeqile-qey* (in Kembata) all its part used as traditional medicine. In some cases farmers also used cooked *qocho* or porridge prepared from *bulla* to treat different health problems in the study zones (Fig. 2f and g). In terms of connection to the ailments shared by the farmers and the medicinal enset landraces used in their treatment, we observed that bone fracture, swelling the pus and to expel the delayed placenta from humans and cattle were the most shared health problems in the study area and among the communities.

Most enset growing farmers in the study area are familiar with maintaining and use of their different preferred landraces to stabilize many situations over long period of time without external inputs of planting materials. Farmers in the study zones frequently produce their own planting materials or suckers from home-gardens but few farmers obtain freely from neighbors, family and friends as gift or by purchasing from other farmers.

During our discussions with farmers and field observation, we observed that in two local markets: Alicho in Silte and Gumer in Gurage zones, enset suckers were purchased from January to April. These two sites are situated at higher altitude than other studied woredas (Table 1). Moreover, some elder farmers mentioned that enset cultivation practice and its distribution into their *woreda* and villages relatively late than others. They said that “We haven’t been familiar with enset production and managing before 65 years ago.” To some extent, this verifies that enset farming systems in the studied area is not equally and uniformly experienced among communities.

Table 9

Preference ranking for 5 commonly shared and other 2 localized enset landraces cultivated in southern Ethiopia

Use value	landrace	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	Total	Rank
Qocho & *B** quality	*Agade*	7	8	7	6	7	6	8	8	7	9	8	9	90	3
	Astara	8	7	7	6	6	7	7	8	7	8	7	7	85	4
	Bededed	5	6	7	5	4	6	6	7	8	7	8	7	76	5
	Gimbo	10	9	10	9	8	10	9	8	7	8	7	8	103	1
	Gishira	4	3	3	4	5	4	-	-	-	-	-	-	23	7
	Separa	8	9	8	9	9	7	8	8	9	9	8	8	98	2
	Sisqella	6	5	6	7	6	7	6	-	-	5	4	-	52	6
Amicho tasty	*Agade*	7	8	8	6	7	7	8	9	8	9	7	9	93	2
	Astara	10	10	10	10	10	10	10	10	10	10	10	10	120	1
	Bededed	1	1	1	1	1	1	1	1	1	1	1	1	12	5
	Gimbo	6	7	6	7	5	6	6	5	6	7	5	6	72	4
	Gishira	1	1	1	1	1	1	-	-	-	-	-	-	6	7
	Separa	7	6	7	7	7	6	7	7	6	7	7	7	81	3
	Sisqella	1	1	1	1	1	1	1	-	-	1	1	-	9	6
Fiber quality	*Agade*	5	5	4	3	6	4	6	5	7	5	5	6	61	5
	Astara	4	5	4	3	4	3	5	6	3	6	4	3	50	6
	Bededed	7	6	7	6	6	7	7	7	6	8	6	7	80	2
	Gimbo	5	7	7	4	7	6	7	7	6	7	7	6	76	3
	Gishira	8	9	8	8	7	9	-	-	-	-	-	-	49	7
	Separa	5	6	6	7	5	4	7	4	5	6	6	4	65	4
	Sisqella	10	10	10	10	10	10	10	-	-	10	10	-	90	1
Medicinal use	*Agade*	7	6	8	4	5	3	8	7	9	6	7	7	77	2
	Astara	10	10	8	7	8	9	10	10	10	10	10	10	112	1
	Bededed	8	8	6	6	7	6	6	7	6	6	4	6	76	3
	Gimbo	6	3	2	4	3	1	3	1	3	1	2	3	32	6
	Gishira	10	10	10	10	10	10	-	-	-	-	-	-	60	4
	Separa	5	4	4	6	5	4	3	2	1	4	2	1	41	5
	Sisqella	3	2	1	2	1	1	1	-	-	1	-	-	12	7

Note: R for respondents, 10 for most valuable and 1 for least valuable, R1-R3 from Hadiya, R4-R6 from Kembata-Tembaro, R7-R9 from Gurage and R10-R12 from Silte zones; B* *Bulla*.

Discussion

Extent of on-farm richness and diversity of enset landraces

Our study revealed that each zone has cultivated and maintained numerous enset landraces for several generations within the family in their homegarden for a number of years. Enset agriculture is rich in its landrace diversity. A total of 282 different farmers named enset landraces were documented from 12 *woredas* of the four study zones, which is relatively higher number of record than those previously reported. Tsegaye [17] recorded 146 different enset landraces from three zones (59 from Hadiya, 55 from Wolaita and 52 from Sidama) while Negash [16] also described 146 different enset cultivars from four zones (65 landraces from Kefa-Sheka, 30 landraces from Sidama, 45 landraces from Hadiya and 6 from Wolaita). Likewise, Birmeta [18] described 111 enset landraces from nine enset growing localities of Ethiopia, but this is in contrast to what has been identified in this study and in some previous studies on enset richness and farmers' landraces diversity. For instant, in other earlier studies, Yemataw et al. [13] and Zeberga et al. [19] described the same numbers of (312) different enset landraces from eight ethnic groups, out of these 69 from Silte, 66 from Kembata-Tembaro, 63 from Gurage and 51 from Hadiya. Furthermore, Yemataw et al. [24], who described 218 different enset landraces from seven zones, 59 landraces from Hadiya, 43 from Kembata, 41 from Dawuro, 39 landraces from Wolaita, 34 landraces from Gamo Goffa, 31 landraces from Gurage and 30 landraces from Sidama. Some of these values are slightly comparable to the findings of present study but such records are impossible to make a direct comparison of the number of enset landrace diversity with results of current study due to variation in the method and size of sampling area.

However, in most cases the richness of enset landraces recorded in the current study is far higher than the reports of the previous studies. The number of enset landraces in the present study could be attributed to the technique of sampling, the area the study covered, and the nature of the agro-ecological condition of the study area, which embraces midland and highland that is suitable for enset cultivation. Moreover, the study zones like Hadiya are bordered by all the other study zones, so the exchange and earning of suckers are common traditions among farmers. In the same manner, Tsegaye [17] and Yemataw et al. [24] stated that the exchange of enset landraces from the neighboring ethnic groups perhaps contributed to the richness in enset landrace diversity in Ethiopia.

According to Rosenzweig [39], the value of a diversity index increases when both richness and evenness increase and is maximized when all species are nearly equally abundant. In biodiversity studies, Shannon diversity indices (H') typical values ranges between 1.5 and 3.5 and the index is rarely greater than 4 [40]. The higher the value of H', the more diverse the communities and the Shannon index increases as both the richness and evenness of the communities increase. In this study, the diversity indices were calculated from the number of landraces existing on 60 farmers' homegarden within each zone. Of the study zones, Hadiya had the highest enset landrace diversity (H' = 3.96) while the lowest diversity index (H' = 3.73) was computed for Silte zone (Table 2). Moreover, the results of this study showed that the relative high value of the Simpson's 1-D was obtained from Hadiya (0.978), followed by Kembata-Tembaro (0.976). Findings also revealed that overall evenness indices in the study zones had showed a very narrow range of variances. This finding is in line with the reports of [13, 19].

Similarities and differences of enset landraces diversity among zones

The Sorneson's similarity indices and the number of enset landraces shared among pairs of zones presented in Table 3, revealed that there is highest similarity between Hadiya and Kembata-Tembaro, Gurage and Silte, based on farmers-named enset landraces. Hadiya also shared 38 and 35 enset landraces with Gurage and Silte zones, respectively. This high sharing of enset landraces among zones may be due to sociocultural and linguistic similarities, and geographical locations. For instance, Hadiya is bordered by the all study zones, so the informal exchange of enset suckers from the

adjacent zones possibly contributed for the highest similarity of enset landrace diversity among zones in the present study. This agrees with the work of Zeberga et al. [19] and Yemataw et al. [24], who reported the existence of a high amount of sharing similar enset landraces among Hadiya and Kembata, Gurage and Silte, and Wolaita and Dawuro zones of Ethiopia. The least similarity was revealed between Kembata-Tembaro and Silte, they had 16 enset landraces in common. This may be due to geographical distance between the two zones and also variation in sociocultural factors.

Distribution and abundances of enset landraces

Enset farmers in the study zones inherited and maintain a great number of mixed landraces from preceding generations according to their need and attributes. Of the 282 enset landraces encountered in this study, a few landraces 5.3% were widely distributed in all studied zones. On the other hand, the majorities of the enset landraces had limited distributions and were of importance in more than one studied zones. The finding of this study was in line with previous study of Tsegaye [17], Zeberga et al. [19] and Yemataw et al. [24] from the same or different zones in Ethiopia. Enset landrace preferences sometimes differed among farmers of neighboring zones (Table 9). For example, *Sisqella* and *Gishira* were of the most frequently cultivated landraces in Hadiya and Kembata -Tembaro but rare or almost absent in Gurage and Silte zones. This may be due to the environmental adaptability of the landraces or/and different attributes of farmers. Negash [16] and Tsegaye [17] also reported that enset landrace diversity and distribution was influenced by factors such as household resources, cultural background, population pressure and agro-ecology. Unlike widely distributed landraces, some almost localized landraces such as *Amerat* and *Lemat* in Gurage, *Shewrad* in Silte, *Disho* and *Bequcho* in Hadiya, and *Dirbo* and *Unjame* in Kembata-Tembaro were relatively abundant in the farmers' field of each zone. In the same manner, Yemataw et al. [13] and Zeberga et al. [19] indicated that household features, distance among locations and ethnic preference contributes to the landrace diversity and abundance.

Diverse local names of the enset landraces among zones

Enset farmers have accumulated overall traditional knowledge on the different landraces for the generations in naming, maintaining and utilizing its products over long period of time. Each enset landrace bears a local name known and preserved by farmers as a unit of diversity in the study area. Overall, 282 farmers named landraces (Table 4) have been identified in this study which confirms that farmers maintain a high diversity of enset in their homegarden. This finding corroborates the findings of Yemataw et al. [13] who reported over 300 landrace names of enset from southern Ethiopia. The method of naming of landraces as indicated by farmers in our study is also similar to what has been reported in other enset growing zones. For instance, Olango et al.[12], Tesfaye [15], and Shigeta [22] reported that the naming criteria of some enset landraces in the Wolaita, Sidama and Ari respectively, is mostly based on morphological and agronomic traits, place of origin, various uses and culinary attributes. In the study areas, farmers use their own local language in everyday speech and communication in each zone. There are numerous enset landrace names and synonyms in these different languages and dialects were recorded throughout the study zones (Table 4). For instance, in this study 15 identically named enset landraces were identified from all four studied zones. In the same manner, three zones (Hadiya, Silte and Gurage) commonly share 33 the same named enset landraces in the present study. A similar observation was notified by Olango et al. [12], Yemataw et al. [13] and Tesfaye [15], they also described that the existence of identically named enset landraces in more than one ethno-linguistic communities. This may be occurs due to getting the enset planting materials and a long lasting practice of farmers in sharing with their respective landrace names from adjacent administrative zones. Similarly, Olango et al. [12] stated that the presence of 'borrowed' landrace names between ethno-linguistic groups. Similar trends were also observed in different traditional crops such as sorghum Timu et al. [11], banana Hapsari et al. [26], sweet potato Glato [27], cassava Nakabonge et al. [41] and common bean [42, 43]. Our study has also shown that enset growers sometimes delivered various names for the same landrace within the zones. For instance, the landrace named *Ayase* is known as *Hella* in Hadiya Duna *woreda*,

Qombotira is called *Asheqit* in Silte, and also *Gegard* is known as *Heniwa* in Endegegn *woreda* of Gurage zone. Bareke et al. [42] and Abera et al. [43] also reported similar results from Ethiopia for common bean. Likewise, the different names for the same enset landrace also exist among zones (e.g. *Disho* in Hadiya and in Kembata-Tembaro is known as *Kembat* in Silte and Gurage, *Tem-wese* in Silte is also called *Xebere* in Kembeta-Tembaro or *Qebere* in Hadiya) (Table 5). Moreover, the names of some enset landraces have the same meaning but it was locally known with different folk names throughout study zones. For instance, *Xiggo* in the Hadiya, *Dem-wored* in the Silte and *Dem-yeteret* in the Gurage refer to bleeding because of exudes red fluid when any parts of the enset is cut. This is similar to the findings of Abera et al. [43] who found that common bean producers provided different names in terms of seed color in two areas but the names have the same meaning.

Pattern of use and management practices undertaken by farmers

Traditionally, farmers in the study area had familiar with the utilization and management of enset from earlier generations to meet their requirements. The current study revealed that farmers grow enset mainly for their food security and other household needs. This was in line with previous studies [2, 4, 12, 16, 17]. The present study also indicated that there were slight differences in terms of perceiving enset end-uses across the study zones. According to the our results, relatively a high numbers of enset landraces was grown for their high quality of fiber in addition to *qocho* and *bulla* yield in the Hadiya and Kembata-Tembaro zones, whereas farmers in Gurage and Silte grew a high proportion of enset landraces for *amicho* (boiled corm) production. Tsegaye [17] also reported that the relation to the difference in food culture, socio-cultural preferences for different enset products and farming systems of the regions. Similarly, Kujawska et al. [44] described that the influence of cultural background on plant species diversity and the uses of plant species for different purposes.

In the areas we studied, enset growing farmers apart from being used as food, fodder and fiber they use some enset landraces as a traditional medicine counter to different ailments. According to surveyed farmers and our field observation, we observed that some ethnic groups (e.g Silte and Gurage, Hadiya and Kembata-Tembaro) share more medicinal enset landraces and show a greater similarity in patterns of using enset crop (Table 8). In the same manner, Kujawska et al. [44] stated that the intercultural sharing may be explained by the pharmacological effectiveness of shared medicinal plants among ethnic groups.

Farmers in the studied area, maintain great enset landraces diversity within traditional cultivation and production systems insight towards meeting domestic subsistence requirements. Yemataw et al. [13] also described that farmers observe and select the landraces based on their planting intentions for the coming year than the proportion to the quantity they have. The on-farm maintenance of biodiversity requires understanding by the farmer of how specific varieties should be grown, stored and maintained in order to maximally realize the characteristics these farmers value [45].

Conclusion

This study provides information on enset landraces existing in four major enset producing administrative zones of Ethiopia based upon locally farmers-named in each of the zones. The results obtained from this study indicates that farmers have developed diverse practices and experiences over the course of time to cultivate, utilize and conserve a great extent of enset landraces in each zone. In addition, they understand the need to grow a mixture of enset landraces as this can role in the socio-economic and cultural life of communities. Our results have revealed that out of the cultivated enset landraces, a small proportion of landraces were widely distributed and abundant throughout the study zones. However, a larger number of landraces were highly localized in one or two studied zones and less distributed in other zones. Our study also confirms that farmers are able to differentiate their enset landraces by using their own

different local names. In this context, some enset landraces were commonly known and referred to by the same local names in all studied zones by different farmers. In contrast, enset of the same landraces were named differently by different farmers within and among studied zones. Moreover, results from this study also show that enset farmers have developed their own way of selection and characterization of landraces with some slight differences among in terms of use pattern based upon their tradition and cultures in the study areas. Based upon results of this study, the on- farm diversity existing in these landraces needs to be studied in detail (e.g molecular characterization) for duplicates identification and clarification of synonymies, and in order to facilitate their on- farm conservation as well as sustainable utilization of enset farming communities and also in its improvement programs.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analysed during this study are included in this manuscript.

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Competing interests

The authors declare that they have no competing interests.

Authors' contributions

TD: carried out the field work, prepared figures, analysis and discussion of data, and drafted the manuscript; TF: Conceived the study, followed up the field work and drafted the manuscript; ZA: conceived the study, followed up the field work, suggested in writing and proof reading of the manuscript; AZ: Conceived the study and drafted the manuscript. All authors read and approved the final manuscript.

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Figures

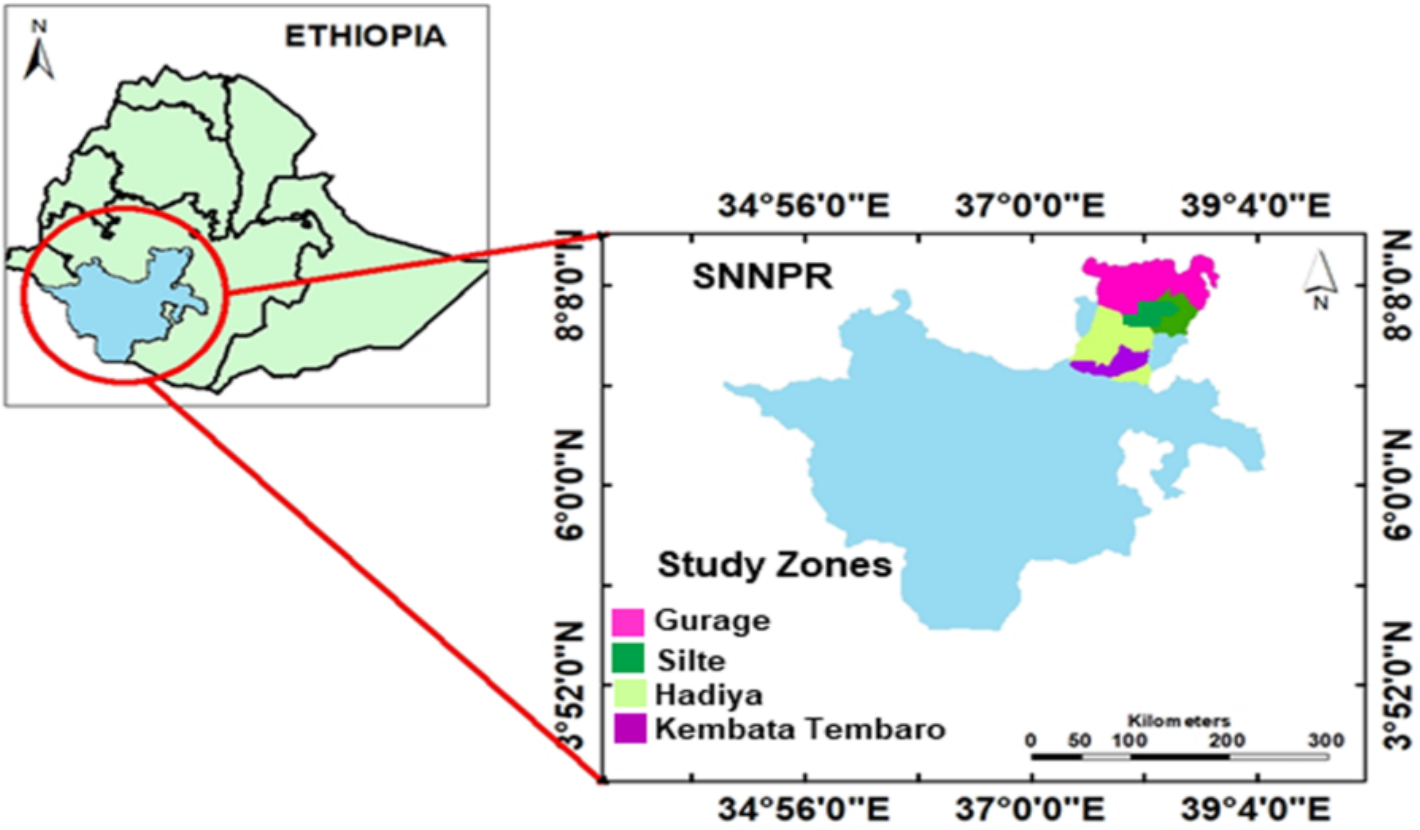

Figure 1

Location of the Southern Nations Nationalities and Peoples' Region (SNNPR) in the map of Ethiopia (left) and the four study zones in the SNNPR (right).

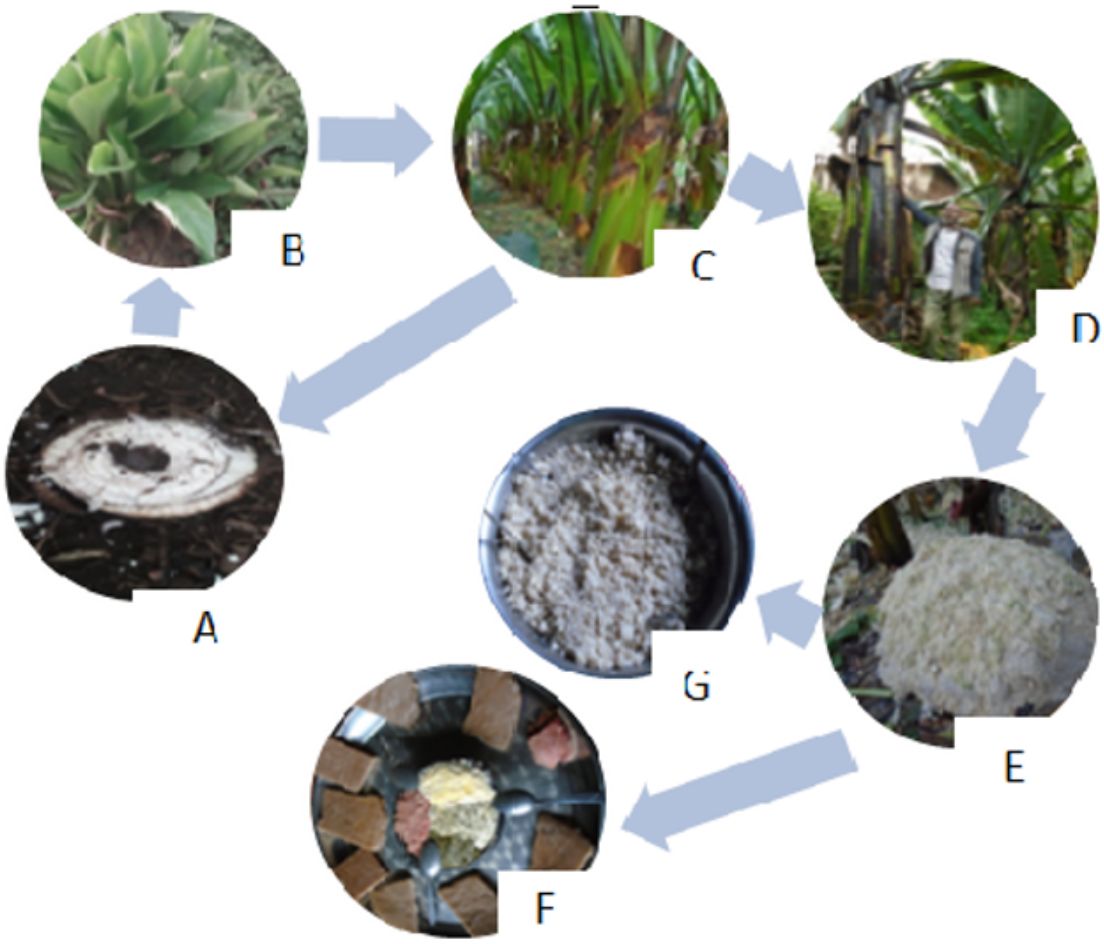

Figure 2

Examples of the main enset propagation stages and its end products: **a** mother corm; **b** multiple suckers from mother corm; **c** young enset ready to give mother corm and transplanted to permanent field; **d** matured enset; **e** mass of processed product; **f** and **g** example of dishes that prepared from the primary products.