Indigenous knowledge of farmers on classification, utilization and on-farm management of Enset (Ensete ventricosum) diversity in Hadiya, southern Ethiopia

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Research Article

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Abstract

Background

Farmers have a wealth of indigenous knowledge on enset cultivation in their communities acquired through the accumulation of experience over a long period. Enset (*Ensete ventricosum* (Welw.) Cheesman) is a multipurpose species and one of the most widely grown perennial crops in southern Ethiopia. Although enset is a high-value and vital crop for local farmers, necessary information is insufficiently documented and still not fully explored at the local level. Thus, this study was designed to assess and record the wealth of indigenous knowledge related to the local identification, naming, categorization, and traditional uses of enset landraces (farmers' varieties) relevant for the maintenance of on-farm landrace diversity in Hadiya Zone, southern Ethiopia.

Results

In this study, we identified 99 locally named enset landraces under cultivation. Farmers regularly identify the name and classify numerous enset landraces based on different criteria, the four morphological traits (namely: leaf, midrib, petiole, and pseudostem colors) are primarily used as criteria for identification. In addition, the local names of some enset landraces are usually indicators and show their uniqueness in morphological traits, places of origin, agronomic features, and quality attributes of products. Based on farmers, cultivated enset landraces are classified into two general groups according to the characteristics regarding the ease of harvesting and processing, rate of fermentation, and quality and values of the end products. Enset products named *qocho*, *bulla* and *amicho* are commonly produced by each family. Furthermore, three types of *qocho* are traditionally produced by local farmers based on types of the landraces used during harvesting, the presence absence of fermentation starter (*gammama*), and the duration of fermentation.

Conclusion

The traditional farming system and associated wisdom contributed to the availability of the present-day on-farm diversity maintained under continuous cultivation and conservation practices. The indigenous knowledge of local farmers regarding the cultural, social, and economic values of enset and its production system is crucial for understanding how the local communities utilize, maintain, and manage the existing enset landrace diversity in their homegardens. It is necessary to integrate indigenous knowledge with the modern system for continuous utilization and conservation strategies of enset genetic resources and their diversity.

Background

Traditional crops are those crops grown by local farmers over a long period, which are well adapted to their local conditions and also well suited to local socio-cultural needs (Villa et al. 2005; Ulian et al. 2020). Farmers have a wealth of indigenous knowledge on crop production in their communities acquired through the accumulation of experience and informal experiments that could be useful for a robust crop breeding program, improving grain quality and storage equipment, designing weed and pest control strategies, organic seed conservation, food preparation and environmental conservation (Tella 2007). On-farm conservation involves farmers' continued cultivation and management of a diverse set of crop populations and accompanied taxa in the agro-ecosystem where the crop evolved, or in secondary centers of diversity (Alvarez et al. 2005).

According to Vavilov (1951), the Ethiopian highlands are both the center of origin and diversity for many crops, including enset. Enset is believed to have been domesticated in Ethiopia by ancient people who migrated out of the lowland grasslands due to an extended dry period and settled in the highlands of southwestern Ethiopia and found enset that they probably started consuming and ultimately/eventually cultivating it (Brandt 1996). Enset (*Ensete ventricosum* (Welw.) Cheesman) is a monocarpic perennial herb that belongs to the order *Zingiberales*, the family *Musaceae*. The *Musaceae* family is subdivided into the genera *Musa* and *Ensete* (Simmonds 1966). The wild form of *E. ventricosum* is common and widespread in tropical Africa from Ethiopia to Kenya and Uganda, south to Mozambique, and west to the Democratic Republic of Congo and Cameroon (Simmonds 1958). *Ensete ventricosum* grows within altitudes of 1500–3100 m above sea level, but scattered plants can also be found at lower altitudes (Abebe 2005) and some scattered cultivation at higher altitudes (3350 m). For optimum growth, the plant requires an average rainfall of 1100–1500 mm per year and a mean temperature of 16–20°C. Enset grows well in drained and fertile soil types (Bezuneh and Feleke 1966), and it takes 8–16 years to reach full maturity (Shank and Ertiro 1996), depending up on environmental conditions, management practices and varietal types.

E. ventricosum is an important crop contributing to food security and rural livelihoods for about 1/4 of the people in the densely populated southern and southwestern parts of Ethiopia (Brandt et al. 1997; Borrell et al. 2020). The enset-based farming system, which is characterized by the cultivation of enset as the main staple or as a co-staple with other crops, is an indigenous and sustainable agricultural system in Ethiopia (Westphal 1975), and it is practiced by the over 45 ethnic groups for food and other household needs (Brandt et al. 1997; Negash 2001; Asfaw 2018). It also guarantees food security and stability to the household economy because processed products can be stored for a long time. In addition, the live plant can be maintained on-farm and harvested any time when the need arises (Negash 2001; Borrell et al. 2020). Farmers in enset growing areas are often heard affirming that "enset is the enemy of hunger, and human and livestock life is impossible without it" (Tsegaye, 2002).

The primary food products obtained from enset are *qocho*, *bulla*, and *amicho*. *Qocho* is fermented starch obtained from scraped pseudostem and pulverized corms. *Bulla* is another enset product obtained by squeezing out the liquid containing starch from scraped pseudostem and pulverized corm and allowing the resultant starch to concentrate into white powder. *Amicho* is an inner fresh cooked enset corm, mainly

obtained from young enset plants that are prepared and consumed similarly to other root and tuber crops (Brandt et al. 1997).

Socially, people in the southern and southwestern parts of the country not only depend on enset for food and cash, but also consider it as part of their cultural heritage and symbol, and it is a unifying crop for the region (Shigeta 1990; Alemu and Sanford 1996). Moreover, enset has ecologically important functions in producing organic matter, creating a nutrient reservoir in the soil, controlling erosion, and contributing to the stability and continuation of the farming system (Woldetensaye 1997). Enset plant architecture makes it suitable for rainwater harvesting and storage. Furthermore, fibrous roots of enset plants form a mat-like structure holding the soil intact and which on decaying also improves the soil. This water harvesting capacity in enset enables farmers to intercrop it with various crops (Kippe 2002) but this is mostly the case in the young stage of the crop as observed in the field.

The folkloric nomenclature (ethnobotanical naming system) gives names to the plants by considering the people's viewpoints. The people create these names in their willingness to distinguish the different types of the plant from one another and to be precise in their verbal communication (Nedelcheva and Dogan 2009). Local names of plants and animals are the roots of traditional biodiversity knowledge. Thus, ethnobotanical systems of naming and classification transmitted from generation to generation are constantly recreated by communities and groups in response to their environment (Khasbagan and Soyolt 2008). Birmeta (2004) stated that numerous local farmers' varieties of enset 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, the culture and settlement pattern of the different ethnic groups. Farmers can clearly distinguish their varieties based on agromorphological traits, phenological attributes, post-harvest characteristics and differential adaptive performance under abiotic and biotic stresses (Brush and Meng 1998; Loko et al. 2018). Moreover, they have names for them and different landraces are understood to differ in adaptation to soil type, time of seeding, date of maturity, height, nutritive value, use, and other properties (Sthapit et al. 2010).

Local farmers grow enset plants for several merits, which are mainly attributed to the food, socioeconomic and cultural benefits. Although enset is a vital crop of high value for local farmers, necessary information on indigenous and local knowledge of its classification, management and traditional utilization practices of farmers in different parts of the country is insufficiently documented and reported. Various authors (Tesfaye 2008; Maryo et al. 2014; Olango et al. 2014) reported that the distribution of indigenous crops such as enset at the local level in Ethiopia remains limited. Hence, the attributes are still less known and not fully explored by the researchers and scientific communities. Thus, our study focuses on one of the indigenous enset culture communities of southern Ethiopia, the Hadiya, and detailed analysis of farmers' indigenous and local knowledge on production, classification, management, and utilization practices to underline its socioeconomic roles and contributions to the development of enset genetic resources conservation strategies for the present and future generations.

Therefore, the objectives of this study were designed to search and document the wealth of indigenous and local knowledge of enset cultivation, landrace identification, naming, categorization and traditional uses of the species and its landraces. A related objective is to investigate and generate reliable data focused to farmers' traditional practices relevant to the maintenance of on-farm landrace diversity in Hadiya Zone of Ethiopia.

Materials And Methods

Description of the study area

The study was conducted in the Hadiya Zone of southern Ethiopia. The zone is located between the latitude of 7^0 07'- $7^0$92'N and $37^0$29'- $38^0$13'E longitude, and topographically lies within an elevation ranging from 501 to 3100 m above sea level. The administrative center of the Hadiya Zone is Hosanna town, which is located 232 km southwest of Addis Ababa. The zone is bordered on the south by Kembata-Tembaro Zone, on the southwest by the Dawro Zone, on the west by the Omo River which separates it from Oromia Region and the Yem *Woreda* (district), on the north by Gurage Zone, on the northeast by Silte Zone, and on the east by the Alaba Zone; the *woredas* of Siraro, Mirab and Misraq Badawacho form an exclave separated from the rest of the zone and bordered in the north by Kembata-Tembaro, in the south by Wolaita, in the southeast by Oromiya Region (Fig. 1). Based on the simplified agroclimatic classification of Ethiopia, the zone has three agroecological zones, namely *Kola or* semi-desert (lowland < 1500 m) covering about 12.9% of the land area, *Woina Dega* or cool semi-arid (mid-altitude 1500–2500 m) about 69.1% and *Dega* or cool and humid (highland > 2500 m) about 18%. Most of the area lies within the mid-altitude zone. For administrative purposes currently, the zone is divided into 13 districts or *woredas*, which are organized into *kebeles* (subdistricts). Inhabitants (Dwellers) of the Hadiya Zone are mainly the Hadiya communities speaking the Cushitic language group, Hadiyissa. For the midland and highland inhabitants of the Hadiya, enset cultivation and utilization is the main cropping system on which the intact farming system is built. Enset is the key food security and livelihood crop for the human and domestic animals of the area.

Study site selection

The study was conducted in seven *woredas* or districts (Misha, Lemmo, Anlemmo, Dunna, Sorro, Gibe, and Mirab-bedawacho) in the Hadiya Zone, southern Ethiopia (Table 1). The sites were selected based on the potential and importance of enset cultivation, diversity, and distribution, the information obtained from the Agriculture offices of the zone and districts. Hadiya Zone is one of the major enset growing areas in the country. Hence, the crop is the major food security and livelihood source, especially for the mid and highland inhabitants. Therefore, the study sites range in altitude from 1858 m.a.s.l (Halelicho-Bero) to 2918 m.a.s.l (Tulla) *kebele*, which covers nearly the entire ecological range of enset in Hadiya Zone (Table 1). This shows that the local people have adequate information on enset farming system, its genetic resources, and uses.

Sampling

A purposeful random sampling technique was carried out for a selection of sample *woredas* from the Hadiya Zone since enset is primarily cultivated in the midland (1500–2500 m.a.s.l) and highland (> 2500 m.a.s.l) of the study areas. Of the12 *kebeles* found in the seven *woredas*, five *kebeles* from highland, and seven *kebeles* from midland were selected based on consultation with agricultural officers of the Hadiya Zone and respective *woredas*. A total of 240 households (20 from each *kebele*) were selected randomly (Table 1). Four to six key informants were also chosen based on prior information obtained from the agricultural extension workers of *kebeles*, elders, and local leaders.

Table 1
Sampled *woredas*, *kebeles*, elevation range, and number of households interviewed

Administrative *Woredas*	Administrative *Kebeles*	Altitude (m)	No of households
Misha	Dangawora-Sagamo	2465–2784	20
	Shiro	2547–2730	20
	Tulla	2520–2918	20
Lemmo	Dijo-Demala	2245–2418	20
	Shirmo-Dacho	2218–2349	20
An-Lemmo	Bendelicho	2115–2263	20
	Layign-Fonko	2241–2485	20
Dunna	Qenqicho	2430–2568	20
	Somicho	2455–2676	20
Sorro	Qosha	2210–2402	20
Gibe	Halelicho-Bero	1858–2017	20
Mirab-Bedewacho	Danama	1875–1930	20
Total		1858–2918	240

Data collection

A combination of data collection methods was applied to synthesize the diverse features to collect indigenous and local knowledge associated with the enset plant in this study. Primary data collection was employed with the help of individual interviews, direct on-farm observation, key informant interviews, and focus group discussions. The in-depth individual interview was conducted by the investigator and agricultural extension workers in the local language Hadiyissa using pre-prepared semi-structured interview schedule. The agricultural extension workers are working closely with the farmers in each peasant association. The interview questions and free-listing methods assisted to generate detail and

specific information on the enset farming system for specifically assessing farmers' view of landrace diversity, the local naming and classification, meaning of names, traditional utilization approaches, cultural practices of cultivation, and the management system in the center of diversity. Four to six key informant interviews were conducted with individuals who were selected for having good knowledge of a given issue such as information on enset crop, culture, cultivation system, characteristics of landraces, and other related topics. Focus group discussions (one per kebele each with 6 discussants) were also carried out to examine farmers' indigenous knowledge in joint interview sessions. Several issues were taken for discussion such as perceptions, farmers' classification criteria of landraces, naming and naming system, socio-economic values, cultural events, and so forth regarding the contribution of enset agriculture to the local community. These techniques greatly facilitated gaining sufficient information in line with the objectives of implementing this study. Secondary data were also checked to generate information that provided the background context of enset farming systems and cultural links to the farming communities of Hadiya from different published and unpublished sources and reports. Furthermore, on-farm characterizations of landraces were recorded carefully for the identification of each enset landrace at maturity after examining it with individual farmers and key informants.

Data analysis

After recurrent discussion with key informants and knowledgeable senior farmers, we verified some variations and also validated basic information collected from individual interviews. The names of all listed landraces were also cross-checked for minor dialect (known as cognates in ethnobotany) variations after arranging in the group for known synonyms throughout the study *woredas*. The collected data were analyzed by applying descriptive statistics such as frequencies, percentages, and averages using Microsoft excel 2010 and SPSS Ver. 26. Landrace richness was calculated as the total number of individual enset of each landrace per farm named by all farmers dwelling in the studied administrative zone. Frequency was estimated as the number of individuals of a landrace with respect to the total number of landraces composing the enset farm.

Results

Status of enset cultivation in Hadiya

Cultivation of enset is closely associated with the daily lives of the Hadiya farmers, primarily in midland and highland areas. In the study area, farmers indicated that enset is a multipurpose crop available all year-round, and throughout the various growth stages, the leaves in fresh and dried, pseudostem and corm are used for several purposes. Thus, every farming household cultivates, manages, and utilizes diverse landraces of enset in its homegarden. Farmers revealed that enset is the most important crop for livelihoods and food security in the major growing areas of the zone. Therefore, enset has been chosen as a classic multi-use crop, since except for its biological roots the whole part is used for diverse purposes such as food, feed, traditional medicine, construction, material culture and ornamental uses.

During our discussion, many farmers have observed notably that most annual crops are severely disrupted by the changing weather conditions such as prolonged drought, too low or heavy rain, and frost. This results in recurrent crop failures, leading to poor yields and food insecurity. However, different enset landraces can survive such unpredictable harsh climatic situations. Therefore, farmers generally approve that enset is a food and feed security crop, that could not be substituted by other crops for the enset farming communities in the studied area.

The extent of on-farm diversity and richness of enset

Hadiya farmers cultivate and maintain a great level of enset diversity in their homegardens. In this study, 99 vernacular names of enset landraces growing on farmers' fields were documented (Table 2). Based on the farmers' report and field observation, the enset landraces recorded per household ranged from 3 to 35. Most farmers (50.41%) cultivated 7–12 enset landraces, 24.16% cultivated 13–18, 17.5% of the farmers cultivated less than 6 landraces, and only 3.3% of the farmers cultivated 25–35 enset landraces per farm. The cultivation ranges of enset landraces maintained by farmers in the study area were expressed in percentages in Fig. 2.

In the present study, there was a remarkable variation among the enset landraces concerning their distribution. Of the recorded enset landraces, 21% were most frequently mentioned by local farmers and widely distributed enset types. According to farmers, these were multi-use types. The 15% were least mentioned and unique type of enset landraces rarely recorded at a few farmers' homegardens in the studied *kebeles* (Table 2).

Table 2
List of enset names known to the Hadiya community maintained on the farmers' homegarden and their distribution type.

No	Status of enset landraces in Hadiya Zone			
	Common	Medium	Rare	Unique
1	*Agade*	*Agandiya*	*Anchire*	*Ado*
2	*Bedededa*	*Alabite*	*Bequcho*	*Arke*
3	*Beneja*	*Astara*	*Beshiqiya*	*Ashame*
4	*Dirbo*	*Awuneda*	*Bezeria*	*Benqo*
5	*Disho*	*Ayase*	*Boshosha*	*Chalqo*
6	*Gimbo*	*Boicho*	*Bossora*	*Gasupa*
7	*Gishira*	*Dego*	*Butto*	*Gulfea*
8	*Hayiwona*	*Etine*	*Danxicho*	*Kerqerea*
9	*Hiniba*	*Gariya*	*Feraziya*	*Laddare*
10	*Merza*	*Hanzena*	*Gagabo*	*Ladore*
11	*Moche*	*Jegireda*	*Gemmera*	*Lokanda*
12	*Oniya*	*Kaseta*	*Geremeda*	*Mazawora*
13	*Separa*	*Kekera*	*Ginawe*	*Qeteqeta*
14	*Shate*	*Korina*	*Gomersa*	*Wee'a*
15	*Sherafire*	*Lechebo*	*Gozoda*	*Xiggo*
16	*Shewora*	*Manduluqa*	*Gudere*	
17	*Sisqella*	*Mariye*	*Haqucho*	
18	*Unjame*	*Mesmesia*	*Hyrio*	
19	*Uzguruza*	*Mutite*	*Lendwesa*	
20	*Xorora*	*Necho*	*Leqeqa*	
21	*Zobira*	*Orada*	*Meqelwesa*	
22		*Qiniwara*	*Michorera*	
23		*Qombotira*	*Ososa*	
24		*Quina*	*Qargae*	
25		*Shellege*	*Qebere*	

No	Status of enset landraces in Hadiya Zone			
	Common	Medium	Rare	Unique
26		*Soqido*	*Qenchowa*	
27		*Tegadeda*	*Qeshqashe*	
28		*Wonade*	*Qitira*	
29		*Woshamaja*	*Sheraqa*	
30		*Xessa*	*Sinera*	
31			*Suwandiya*	
32			*Wocherda*	
33			*Wohee*	
Total	21	30	33	15
%	21.2	30.3	33.3	15.2
Grand total				99

N.B: Common = Enset landrace in all studied *Kebeles*, Medium = Enset landraces exist over 4 *kebeles*, Rare = Enset landraces recorded in 2–4 *kebeles*, and unique = Enset landraces recorded in only one *kebele* of studied area.

During the discussions and interviews with farmers, it was also found that the local people in the study area cultivated different enset landraces based on several selection criteria such as end-product quality and quantity, fermentation and maturity rate, medicinal values, disease resistance, and drought tolerance.

Farmers' Traditional Categorization Of Enset Landrace

In Hadiya Zone, farmers regularly identify and classify numerous enset landraces based on different criteria. Some of the criteria that farmers frequently use to distinguish one enset type from others are: color of pseudostem, petiole and midrib, size (width and length), angle of leaf orientation, various end uses, disease, and drought tolerance characteristics. Generally, the local farmers follow three main traditional categorization steps for their enset landrace under cultivation. First, they identify the landraces, second, they give different local names and finally they classify them into various groups based on common characteristics.

The Indigenous practice of enset identification

All the informants in the study area reported that they can distinguish all of their enset landraces growing in their homegarden based on combinations of some common identification features. They commonly used three identification characteristics and these are (i) four morphological characters, which include the color of pseudostem, petiole, midrib, and leaf blade (Fig. 3), (ii) agronomic characters (reaction to drought and disease, susceptibility to pests, maturity time and vigorousness), (iii) end-use value (*qocho* and *bulla* yield and quality, *amicho* use and tastiness, fiber quality and medicinal value). In some cases, farmers also use limited characters such as fluid color and angle of leaf orientation for identification of their enset landraces. During our discussions with local farmers for key selection criteria, the morphological characters of a landrace were identified as the major and the first one (Fig. 3). However, the agronomic and use-value characteristics identification criteria came only after morphological characteristics. Identification criteria such as fluid color were used for the identification of landrace *Xiggo*,

which means 'the bleeding type', referring to the red fluid color as compared to the watery fluid of most of the other enset landraces when the parts of the leaves and/or pseudostem are cut. Similarly, angle of leaf orientation as a descriptor was used for some landraces (e.g. landraces *Hiniba* and *Beneja*) known for their narrow-leaf orientation or erect leaf arrangement, whereas landraces *Oniya* and *Sisqella* were identified by most farmers as more bent or wide type of leaf orientation as compared to the other enset landraces (Fig. 4a).

Pseudostem color, petiole strips colors, and midrib color were the most frequently used characteristics (Figs. 3 and 5) while the leaf lamina color, fluid color, and angle of leaf orientation were descriptors mentioned less frequently for the identification of enset landraces by the farmers in the study area.

Almost all recorded enset landraces (Table 3) had green leaves except one enset landrace named *Meqelwesa* with deep red leaf lamina (Fig. 4b). For the color of the midrib, the dominant colors were: 35% red; 33% green; 26% white-yellow pigmented and the black and dark-red pigments accounted for only 4% and 2% of the landraces, respectively. For petiole, the green color was in 37% of the landraces, red in 29%, brown in 19%, grey in 9%, and black color in 6% of the landraces. Green and white-yellow were the major pseudostem color in 31% and 28%, respectively, whereas grey (6%), black (4%), and dark-red (2%) were the least occurring pigments of landraces. As regards leaf shape and pattern, the intermediate leaf orientation was dominant which accounted for 91% while narrow-erect and wide-dropping patterns each accounted for 4% (Fig. 4a). With sap or fluid color, only one enset landrace, *Xiggo*, was recorded as red fluid.

Farmers’ names and naming of enset landraces at locality level

In Hadiya, after identification, enset growers give distinct vernacular names for each landrace based on several attributes, which can either be external appearance or internal quality. Farmers can easily distinguish from others based on their local names. The names of landraces were often consistent and shared among the farmers, and also each name usually reflects a clear variation of each landrace from the others. However, in this study we observed that some enset landraces have alternative local names

given by farmers; e.g. *Ayase*, *Butto*, and *Gulfea* are also known as *Hella*, *Birwesa*, and *Fecheche*, respectively.

Table 3
The four common frequently used morphological characteristics (leaf, midrib, petiole and pseudostem colors) and other two descriptors

Identification criteria (Enset morphology)	Color (descriptor state)	Examples of representative landraces	Percentages of color (frequencies)%
Leaf blade color	Green	*Gimbo*, *Agade*, *Merza*, *Sisqella*	99
	Red	*Meqelwesa*	1
Midrib dorsal color	Dark-red	*Meqelwesa*, *Korina*	2
	Red	*Gimbo*, *Astara*, *Wonade*, *Etine*	35
	White- yellow	*Moche*, *Anchire*, *Sinera*, *Gudere*	26
	Green		33
	Black	*Hiniba*, *Shewora*, *Kaseta*, *Agade*	4
		Qebere, *Boshosha*	
Petiole color	Green	*Quina*, *Shewora*, *Shate*, *Agade*	37
	Red	*Gimbo*, *Wonade*, *Etine*, *Jegirada*	29
	Brown		19
	Black	*Hella*, *Gozoda*, *Merza*	6
	Grey	*Lokanda*, *Qebere*, *Boshosha*, *Soqido*	9
		Hayiwona, *Sherafire*, *Awunada*	
Pseudostem color	Dark-red	*Korina*, *Meqelwesa*	2
	Green	*Hiniba*, *Agade*, *Kaseta*, *Xorora*	31
	Red	*Gimbo*, *Astara*, *Wonade*, *Etine*	19
	White-yellow		28
	Brown	*Moche*, *Anchire*, *Sinera*, *Gariya*	10
	Black	*Separa*, *Gozoda*, *Merza*, *Unjame*	4
	Grey		6
		Boshosha, *Qebere*, *Soqido*, *Lokanda*	
		Hayiwona, Awunada, Ososa	

Identification criteria (Enset morphology)	Color (descriptor state)	Examples of representative landraces	Percentages of color (frequencies)%
Pattern of leaf growth	Narrow-erect	*Hiniba*, *Hyrio, Beneja*	4
	Intermediate	*Gimbo*, *Wonade*, *Boicho*, *Separa*	92
	Wide-dropping	*Oniya*, *Qebere*, *Sisqella*	4
Fluid (sap) color	Red fluid	*Xiggo*	1
	Watery fluid	All other landraces	99

In the study area, farmers always refer to the local names of enset landraces when propagating, planting, managing, harvesting, utilizing, and exchanging enset planting material. A general vernacular term used as a local name for *E. ventricosum* in Hadiya is *Wesho* (singular) and *Wessa* is the plural form of the name for the enset plant. The local names given to some enset landraces are usually indicators of variation and reveal the uniqueness of landraces in morphological traits, places of origin, agronomic features, and quality attributes (taste and color) of end products (Table 4). For instance, the local names reflect a broad spectrum of information and may include the indication of observed phenomenon (e.g. *Benqo*, the Thunder), names of places to the landrace names (e.g. *Gudere*, the name of the local river) and animals (e.g. *Bequcho*, mule and *Moche*, wild) (Table 4). Local farmers also used different criteria to distinguish their enset landraces in homegarden such as literally used words in local language to describe the specific morphological characters (e.g. *Jegirade*, tall, *Ado*, milk), and growth attributes (e.g. *Gimbo*, the huge), and cooking quality attributes of specific landraces (e.g. *Soqido*, salt referring to taste of the boiled corm or *amicho*). Sometimes, the local names are given based on the functional attributes (e.g. *Meqelwesa*, placental enset, *Sisqella*, repels/break the scraping bamboo and *Unjame*, gets less attention by growers and users) and other peculiar characters (e.g. *Xiggo*, bleeding; red fluid from its parts and *Lendwesa*, girl's enset) (Table 4).

Table 4
Examples of local enset landrace names with their meanings, descriptions and identification criteria of naming in Hadiya, southern Ethiopia

Examples of local landraces name with their meaning	Description of the landrace name	Local naming of landraces after the:
Ado (milk)	Referring to white or creamy color of the pseudostem and midrib	typical morphological trait
Xiggo (bleeding)	Referring to the red fluid from the midrib	
Butto (mixture of black and white)	Indicating the spotted petiole and pseudostem	
Chalqo (weak, unable to stand)	Leaf and pseudostem strength	
Qeshqeshe (fragile) *Qombotira* (fragile)	Implying pseudostem and corm strength	
Necho (thin)	Referring the size of leaf	
Gimbo (huge), *Jegirada* (as tall as pillars), *Benqo* (the thunder)	Implying size and length	
Gagabo (fast)	Indicate early maturity of the landrace	typical agronomic feature
Lendwesa (girl's enset)	Easily harvestable	
Unjame (gets less attention)	Implying fewer managements and care to cultivate it.	
Qebere (wide, bended)	Implying the pattern of growth	
Bequcho (mule), *Moche* (wild)	Indicating strength during harvesting	name of animals, person, local river and origin of the place or source
Gudere (name of local river) *Mesmesicho* (Clan group in Hadiya)	Referring the place where landrace was obtained	
Lechebo (name of the people) *Gemera* (name of the person)	Implying name of person who introduced landrace to the area	
N.B: (*) and (**) = landraces may be borrowed with their names from Gurage and Silte, respectively, from the neighboring zones		

Examples of local landraces name with their meaning	Description of the landrace name	Local naming of landraces after the:
Soqido (salt), *Shate* (bitter)	Implying the taste of *amicho* and other parts	cooking or other qualities of landraces
Sisqella (break bamboo, the screptors)	Implying the strength during harvesting	traditional harvesting tools
Meqelwesa (placental enset)	Implies its importance to expel placenta	typical traditional use of landrace
*Bezeria** (gust)	Indicating suitability of the corm to feed the visitors	landraces may be borrowed with their names from the neighboring ethnic group
*Feraziya** (horse) *Wonade** (mare)	Referring the size of the enset	
*Hyiro*** (the sun)	Implies the color of the landrace	
N.B: (*) and (**) = landraces may be borrowed with their names from Gurage and Silte, respectively, from the neighboring zones		

The majority of enset local names are single expressions, 'semantically unitary', however, a limited number of the identified landrace names are organized to 'secondary' names by adding modifiers that further describe the landrace. For instance, landrace local names *Qedel- sisqella*, *Hemach-sisqella*, *Buch-xorora*, *Buch-gariya*, *Kesher-bedadeda* and *Hemach-bedadeda* are derived from 'primary' landrace names *Sisqella*, *Xorora*, *Gariya*, and *Bedadeda*, respectively, the additional modifiers describe color of the landraces. In general, the local names regularly describe some salient features and information of the enset landraces or their parts, in which the local farmers are interested, and it renders easier communication. However, the majority of enset landrace names do not refer to anything obvious, just simply names for differentiating one enset type from others or else the linkage is no longer traceable to the original name due to modification over a long period.

Farmers grouping systems of enset landraces

In Hadiya, enset growers after identification and naming, classify their enset landraces according to their cultural competence, experience, and interest. Local farmers in the study area use different traditional classification systems for their enset landraces. Almost all of the respondents agree that enset landraces are primarily cultivated for food, fodder, fiber, and medicinal purposes. However, landrace *Meqelwesa* is cultivated only for medicinal value. Generally, all other enset landraces were cultivated for both food and non-food uses.

Based on focus group discussion and key informants, cultivated enset landraces are classified into two general groups according to their functionality or the characteristics regarding the strength of harvesting and processing, rate of fermentation, and quality of end value (product and usage). These were grouped

as ‘soft’ (*qechalwesa*) and ‘hardy’ (*qoxalwesa*) enset landraces. According to them, ‘soft’ enset (*qechalwesa*) landraces are easily harvestable and involve simple processing, early fermenting, less fibrous, and more preferable products. In addition, this group includes most numbers of medicinally important landraces. Regarding corm cooking quality or palatability (*amicho* taste), farmers also classify ‘soft’ enset landraces into three subgroups: sweet, medium, and inedible types. Farmers in Hadiya listed out over 31 enset landraces with sweet *amicho* (tender corm). Some examples of those landraces were *Soqido*, *Leqeqe*, *Xorora, Astara, Qiniwara, Orada, Gariya, Qebere, Quina, Qombotira, Qorate, Mazawora, Ososa, Arke, Qeshiqeshe, Korina, Agandiya, Boshosha, Boicho, Gozoda, Xessa*, and *Shereqa*. The enset landraces with edible corm (*amicho*) but they were placed at the second position (medium *amicho* tasty) include *Agade, Separa, Tegededa, Mutite*, *Ancheqera, Hayiwona, Hiniba, Shewora, Gimbo, Kekera, Etine* and *Zobira.* The ‘soft’ enset landraces with inedible corm types include *Shate*, *Woshemaja*, *Necho*, *Menduluke*, *Moche*, *Oniya*, *Hanzana*. The landrace *Shate* is known by most farmers for the bitter taste of all its parts.

According to the local farmers' characterization, ‘hardy’ enset (*qoxalwesa*) landraces have also specific characteristics that differ from ‘soft’ enset group such as difficulty in harvesting and processing, late fermenting, more fibrous, unpalatable corms, less attractive to mammalian pests, and more tolerant to drought. These landraces include *Sisqella, Disho, Unjame, Bequcho, Gishira, Anchire, Shelleqe, Beshiqiya, Dirbo, Qitira, Lendwesa, Sisasira, Dego, Hella*, and *Lokanda*. Some are early maturing (e.g. *Sisqella* and *Disho*), while landraces such as *Anchire* and *Shelleqe* are late maturing. *Sisqella*, *Disho*, and *Gishira*, were more common landraces whereas *Bequcho*, *Lendwesa*, and *Anchire* were rare in all the study sites. Farmers in the study area select *Sisqella, Unjame*, and *Disho* landraces to be the best not only in terms of yield but also in quality such as strength, length and durability of fiber production. These enset landraces are among those most used types for livestock fodder during the scarcity of grasses. Out of the described ‘hardy’ enset landraces, only *Gishira* was perceived as medicinal for humans and livestock, but most of the others belong to the ‘soft’ enset landraces.

In the study area, very few farmers used other classification criteria to classify enset landraces based on adaptability to different ecosystems at higher elevation areas. They grouped *Hansawa wesa* - high altitude and *Kala wesa* -low altitude enset landraces. However, the majority of the landraces can be adapted to both highlands and lowlands, the farmers claim that some ‘soft’ enset landraces are specifically adapted to *Hansawa* ecosystems.

Indigenous Use Of Enset

The traditional food of enset

In Hadiya, every household cultivates enset in their homegarden as the main staple or co-staple food crop and different dishes are derived from three primary enset products (*wassa* or *qocho, Buoo* or *bulla* and *Hamicho* or *Amicho*). In Hadiya the term ‘*wassa’* represents both steam-baked flat bread and the

fermented mixture of the decorticated pseudostem, grated corm, and *gammama* (starter). Of the primary enset products, *qocho* is the most commonly consumed and largely produced. According to interviewed farmers, the favored *qocho* type is white in color while the lowest grade is brown. They also identified that most enset landraces have good *qocho* quality when harvested immediately upon flower setting. Based upon the information obtained from the individual interviews, the key informant, and focus group discussions, Hadiya farmers distinguish three types of *qocho* (fermented enset products): (i) *Tiqoota* is the *qocho* type prepared from mixing the decorticated psedostem and grated corm of enset with early fermenting landraces without the need for adding starter or *gammama*. The *gammama* is mostly prepared from *Gimbo*, *Shirafire*, *Uzguruza*, and others. This *qocho* can be ready for consumption within 8 to10 days. It is considered 'poor household's food, regularly eaten in seasons of food scarcities. The favored enset landraces for *tiqoota* is 'soft' enset types. (ii) *Buhesso* is also a type of *qocho* prepared from the early fermented enset groups but by adding the starters or *gammama*. It is also available for consumption within 10–15 days. (iii) *Gojjo'o* is the *qocho* type prepared from the scraped psedostem and grated corm of any enset ('hard' and 'soft') types mixed with starter (*gammama*). It is available for feeding after a month usually; in addition, it can be stored for a long period. In the community, *gojjo'o* is considered the best type of *qocho* because of its longer fermentation period. People in the study area believe that the longer the fermentation period, the higher the *qocho* quality.

Bulla, locally called *Buoo*, is obtained by squeezing a mixture of the unfermented decorticated pseudostem and pulverized or grated corm. It is considered the best quality enset food and is obtained mainly from fully mature enset plants. The local farmers frequently mentioned that enset landraces such as *Gimbo*, *Sepera*, *Hiniba*, *Hayiwona*, *Awunada*, *Beneja*, *Astara, and Etine* are known for the production of quality *bulla* as they give white and visually more attractive food products. The Hadiya community indicated that a variety of dishes prepared from *bulla* are traditionally incorporated into different cultural and religious events, such as births, male circumcision ceremonies, weddings, and festivals. During births, a postnatal mother eats *moqqa*, which is a special porridge prepared from *bulla* by mixing it with butter and spices. The traditional festival of New Year in Hadiya, called Yaa-hode (in September, *Masqala*), is celebrated by eating the special enset foods. The main and most known of it is called *atakana*. *Atakana*, is made mainly from the dried, powdered and roasted *bulla* on flat clay or iron material, and then cooled. It is spiced with different substances and softened by adding purified butter and milk (yogurt) or cheese until it is good enough to be taken with a spoon. This is consumed on the eve of Yaa-hode and throughout the celebration weeks. *Atakana is* also prepared for special guests (visitors) and some other special occasions. Different *bulla dishes* also serve as traditional medicinal value to treat different health problems in humans.

Hamicho (*Amicho*) is the cooked enset corm, usually of a medium- aged or before the flowering of plant and eaten directly with no processing separately like other tubers or with other food such as dairy products and vegetables. Therefore, it is commonly harvested for immediate consumption. In Hadiya, the enset growers distinguish and prefer some enset landraces for *hamicho* (cooking type). Landraces such as *Astara*, *Soqido*, *Qiniwara*, *Leqeqa*, *Gariya*, *Quina, Orada, Qebere, and Xorora* were highly recognized by the local people for their *amicho* consumption. These enset groups are conserved and managed with

special care. For instance, before the harvesting stage supplying wood ashes and other household wastes are preferable in the local communities rather than using animal manure for the *amicho* (cooking type) landraces. Farmers consider that frequent manuring will reduce the palatability of *amicho* (cooked corm). However, manuring these landraces at early stages is a common practice by local farmers, and also it is used to keep mammalian pests (e.g. porcupines) out of enset field. In the study area, female farmers indicated that the amount and quality of corm is one of the best factors that determine the quality and yield of *qocho* and *bulla*. Generally, corms of the enset plant have more use - values than their leaves and pseudostem.

Traditional medicinal use of enset

Many enset landraces have played a crucial role as a source of traditional medicine in the study area from the time immemorial to combat different human and livestock ailments. Local farmers consider some of enset landraces for medicinal purpose among these *Qiniwara*, *Astara*, *Gishira*, *Xessa*, *Gariya* and *Agade* were commonly used by most of the local community members for problems related to bones and joints (Table 5). Enset landraces that are said to have medicinal values are also used for food and other purposes indicating that enset is a nutraceutical plant. However, it needs to be noted that the landrace *Meqelwesa* has deep red color in all its parts and was reported only for medicinal purposes where the cooked corm is recommended for humans and all parts for livestock to discharge delayed placenta afterbirth and as an abortifacient. In the study area, local farmers indicated that the corm was the most frequently utilized part of the enset plant for purposes of traditional medicine. In a few cases, other plant materials including inflorescence, leaves, and pseudostem were mentioned connection to medicinal value (Table 5).

Table 5
Enset landraces selected for medicinal purposes to treat various ailments

Enset landraces	Traditional treatment of ailments	Enset part (product) used and additives recommended
Qiniwara, *Xessa*, *Gishira*, *Gariya*, *Astara*, and *Agade*	Bone fracture and joint displacements	Cooked corm (amicho) with yoghurt
Hayiwona and *Orada*	a painful infected swelling, to heal the damaged part of the body	
Qombotira	Muscular cramps, waist problem	
Xiggo	Kidney problems and hepatitis	
Meqelwesa	Delayed placenta	
Shate and *Moche*	Most skin infections or problems in humans.	watery fluid squeezed from the pseudostem
Separa	Coughing in children.	soup prepared from the inflorescence
Hayiwona and *Bedededa*	Stimulate milk production in dairy cows after delivery.	the raw corm
Gimbo	Used to cure hepatitis in humans.	the prepared fresh *bulla* with milk
Most enset landraces	for curing dysentery.	processed *qocho* from well fermented product

The cultural and economic value of enset

Based on the respondent's information, cultivating and conserving a large number of enset plants around the homegardens has special cultural value and meaning for the midland and highland dwellers of Hadiya communities. For the local people, enset is not only a food crop, but also it is a multi-use crop and an expression of their identity. According to the informants from the study area, enset farming system is an age-old agricultural practice, and this indicates that local farmers and enset have been highly intimate for many generations. The local community members in the study area are heard frequently asserting "Enset is life for us and our cattle". The cultivation of enset and rearing of cattle are directly linked to the local people. In the study area, cultivation of enset is understood as family inheritance and is starting from childhood. However, interviewed farmers affirmed that they independently initiated cultivating enset standing on the plot of land with various landraces they inherited from their parents in adulthood after getting married. In Hadiya, most households offer a plot of land, a cow, and an ox with diverse enset landraces to an adult married son as a common longstanding tradition passed from generation to generation.

The respondents indicated that enset farming plays a key role in cultural, economic, and family daily life. Enset farmers with a large number and more mature enset plants around their homegardens obtain local

community appreciation and special respectful local titles (names) such as *Asmache*, *Gerada*, *Berkafatta, Abaa-gadda, and so on* for men, and *Ajete* or *I'tee* for women. These farmers and their households are considered rich in the community. This reveals the cultural values of enset in determining social position or recognition as a higher social class and its strong intimacy with the community. As much as placing one in a higher social class, the extent of enset ownership also places one in a higher wealth status and hence in a higher economic status.

The gender roles in management and use of enset

According to informants' responses and our field observation, female farmers conduct key roles in different kinds of day-to-day activities with enset plants such as in manuring, landrace selection, harvesting, processing, storing, preparing different kinds of daily meals from the different products of enset, and marketing. Local farmers in the study area noted that if women would not involve in harvesting and processing the enset crop, it would be very difficult to obtain *qocho* and *bulla* from it. Moreover, female farmers are able to easily recognize the different landraces, their detailed features and uses, and quality and quantity of the product of each landrace. On the other hand men are involved in preparing the land, propagating, planting, and transplanting activities.

The enset plant is symbolically linked to the female farmers' identity where clear gender boundaries can be recognized. The farmers in the study sites also indicated that women have control over and entirely manage the enset field because it is an important source of daily income from the sale of products and materials extracted from it. They sell *qocho*, *bulla*, fiber, fresh leaves, and mattresses (local beds). In the study area, all activities related to the enset cultivation can provide women with reliable and mutual support and also a means for social independence and economic self-sufficiency.

Indigenous cultivation and management practice

In Hadiya Zone, farmers regularly cultivate mixtures of enset landraces to maintain on-farm landrace diversity, and to compensate harvested enset for different consumption throughout the year. This traditional cultivation pattern involves three consecutive stages: vegetative propagation, transplanting and harvesting.

Perpetual propagation

In the study area, enset propagation is a common practice conducted by all local farmers every year, to regulate enset cycle and to maintain on-farm landrace diversity. Enset growers regularly propagate diverse landraces available in the homegarden. Farmers choose an appropriate place and mixtures of landraces for propagation. Based on our field observations and interviews all farmers use vegetative propagation from the corm of a four-year-old enset plant, locally called *kiniba* (Fig. 6a). They uproot and cut it with sharp knife or sickle at the junction of the pseudostem and corm. The center of the corm is removed and filled with soil to eliminate the central growing bud (apical meristem), and stored in a shade upside down for one or two days. The propagation is usually carried out in November (most highland area) to January (commonly midland area) on the offset of the moon. The informants indicated that

eliminating the central portion helps to produce more suckers, otherwise, only one large sucker, locally known as *morra*, may be formed. The newly developed suckers, locally called *dubo*, emerge mostly after three months and remain on the mother corm for a year.

Based on being favorite types and availability, some landraces are more frequently propagated, almost every year. According to farmers' reports and the researcher's field observation, the number of suckers obtained from a single mother plant varied due to different factors such as types and size of landraces, the season of propagation, management practices, and amount of rainfall. Farmers in the study area reported that 30 to 150 suckers will be obtained from a single mother plant (*kiniba)* of four years old (Fig. 6b). During the interviews, farmers asserted that they believe some enset landraces are mothers or ancestors for most of the phenotypically similar and the same end value use landraces. For example, they said that *Gimbo* is considered a mother for most landraces of red (pseudostem, petiole, and midrib) color with edible *amicho* groups.

Frequent transplanting

Enset farmers in Hadiya do not plant suckers directly in a permanent enset field as a first and last operation. Transplanting enset at different levels takes four or five growth stages before harvesting. Each stage of transplanting enset has different local names (*dubo*, *simma*, *lammo*, *ogojaa*, *erro* or *kiniba* and *ballwesa*), as it shows the growth stage of enset (Fig. 6a-f). Farmers regularly cut all leaves, uprooting the suckers and removing roots to transplant at the newly prepared homegarden site. Transplanting is usually carried out at the onset of the rainy season (normally January and March). Farmers are not interested to plant in February. They consider that enset planted in February becomes more rooted and with the large corm at early stages, such a situation is not preferable by farmers since frequent transplanting at each stage requires more labor and time. Enset growers in the Hadiya Zone specified the following transplanting stages and names to indicate these stages:

i. The first sucker production stage is called *dubo*, it is the stage where suckers (new shoots) usually grow in mass (clumps) on the mother corm. It takes one year before detaching and planting in a nursery.

ii. The second stage is locally called *simma* (seedlings are split into individual plants) where the suckers are split from the mother corm and planted into a single hole as groups of four to six suckers in batches. Suckers (*simma*) at this stage remain for one year.

iii. In the third year, the *simma* is transplanted in groups of two or three and this is called *lammo.* The *lammo* suckers are transplanted in the middle rows of *ogojaa*, and it also lasts for a year. *Ogojaa* suckers are the larger *lammo* suckers planted individually in a row; it remains in the same place and it takes the name *erro* after the third year.

iv. During the fourth year, the *erro* enset, which has spent two years in the same place, is ready to transplant to its permanent site, and it takes a local name called *kiniba*. Farmers use *kiniba* for the suckers (*dubo*) production and to plant in the permanent field.

v. The last stage is locally known as *ballwesa*; it is the stage where the enset plant remains permanently until harvesting and flowering. An inflorescence stalk is locally called *qelimma*. This stage is selected to harvest by most women for the best quality of *qocho* and *bulla*.

Indigenous management practice of enset diversity

Farmers in the study area maintained and managed diversified landraces of enset with limited inputs in the homegardens to meet their subsistence needs. Based on our field observation and informants' report their landrace composition varies according to age (*dubo, simma, lammo*, *ogojaa*, *erro* or *kiniba and ballwesa*) (Fig. 6), fermentation and maturity rate (early and late), yield and qualities, taste attributes, medicinal requirements, and many other values and needs. Traditionally farmer-to-farmer communications ensure the maintenance of landrace composition in homegardens. Most of the interviewed farmers (80.2%) use corms of the *kiniba* enset from their farms as sources of planting materials, but a few farmers indicated that purchase from other farmers, gifts from neighbors and relatives, and exchange for other landraces at *kiniba* stage (Fig. 7). In the study area, enset as a source of planting material in an open market at any stage is not a common tradition, except for its final products and other materials. However, gifts for the young farmers are common traditional practices to enrich and maintain their homegardens.

In Hadiya, the enset homegardens have specific arrangements and placements for each stage of landraces and a specific order for different purposes. In the study area, well-managed and conserved enset landraces fields show attractive and respectful values for the household, which also encourages other farmers to maintain and cultivate more diverse enset landraces in their homegardens. The arrangements of enset in the homegarden around the living houses vary in composition and diversity based on age and end use-value and preferences. On average, most of the studied enset crops in the farming sites have a typical planting pattern or arrangement. The patterns taking the living house as a reference point are as follows. The part in front of the house is for rearing livestock (Fig. 8b) and other social purposes, one side of the homegarden is for the cultivation or growth and transplanting of different ages of enset suckers from *dubo* to *kiniba* (the closeness to the living house is decreasing from *dubo* to *kiniba*). The other side of the living house comprises mixtures of enset (*ballwesa*) including the flowering stages (*qellima*) (Fig. 8a). The cultivation pattern also follows different arrangements on this site.

The enset landraces selected for *amicho* based on palatability and other attributes such as medicinal importance (e.g. *Astara*, *Leqeqe*, *Soqido*, *Qiniwara*, *Xiggo*, *Gariya*, *Orada*, *Xessa*, *Hayiwona* and *Xorora*) are planted very close to the house or/and in hideous sites in the enset plantation, because they are also highly selected by wild mammalian pests like porcupines. Therefore, local farmers usually give special care and more protection strategies for those favorite landraces. Other enset groups known for their

vigoursity, yield and fermentation qualities (*Gimbo*, *Agade*, *Zobira*, *Merza*, *Hayiwona*, *Awunda*, *Boicho*, *Beneja*, etc.,) are cultivated close to living houses. But some enset landraces such as *Sisqella*, *Unjame*, *Disho*, *Dego*, *Lokanda*, *Gishra*, *Dirbo*, *Shelleqe* and *Anchire* are planted at peripheral sites of enset field. This is related to the fact they do not attract and are not damaged by mammalian pests. These landraces are described as requiring only limited management and protection compared to other groups.

Discussion

Status of enset cultivation in Hadiya

Based on farmers, enset cultivation is the most important agricultural system for the rural community of the Hadiya. Enset is the plant of choice and a vital food security source for humans and livestock of the midland and highland community of the study area. Many local farmers consider that enset is less vulnerable to changes in agricultural systems and environmental conditions. This local farmers' perception agrees with other earlier studies on the importance of the enset crop (Alemu and Sanford 1996; Olango et al. 2014; Borrell et al. 2020). There is no part of the enset plant not used, except the root (Brandt et al. 1997; Negash 2001). Local farmers also confirm that the production of enset does not comprise the use of chemical inputs, and this practice is still active in the present generation. In the same manner, Brandt et al. (1997), Negash (2001), Tsegaye and Struik (2002), Olango et al. (2014), and Yemataw et al. (2016) indicated that enset is a well-established, sustainable, and environmentally resilient farming system that contributes to food safety of farmers and in particular it serves as food security crop in densely populated areas of the south and southwest parts of Ethiopia. The findings that showed more landraces in the rare category (33) and less number in the unique category (15) may be probably related to declining phase or new introduction in the former case and may be a case of highly localized knowledge in the latter case. However, still, the common category is dominant and widely distributed in the most of the farmer's homegarden. This was also supported by Tsegaye and Struik (2002), and Yemataw et al. (2016), who reported that multipurpose landraces have got a wider distribution and abundance than uncommon landraces within and between regions.

Extent of on-farm diversity and richness of enset

Our results from this study show that farmers maintain a relatively high diversity of landraces than any other crop in their homegarden. The 99 enset landraces recorded in the present study are much higher than the 59 enset landraces reported in a previous diversity study from two sites involving 105 households in the Hadiya Zone (Tsegaye 2002). It is also higher than the 59 landraces reported by Yemataw et al. (2014) from two *woredas* involving 40 respondents from the same zone. The earlier reports are far below the number of enset landraces reported in the present study. However, a direct comparison of landrace richness documented in this study with prior reports is difficult because of differences in the number of farmers interviewed and visited, the number of sampled *woredas* and *kebeles*, and the approaches followed. Moreover, the study area is bordered by other major enset growing areas such as Kembata-Tambaro, Gurage, Silte, Dawro, and Wolaita zones and Yem special *woreda*

where the suckers are easily exchanged, and also all the study areas comprise midland and highland that is more suitable for enset cultivation.

In the same manner, different ethnolinguistic communities in southern Ethiopia maintain diverse enset landraces in their homegarden, which is similar to what we have recorded in this study. For instance, 78 landraces from Ari by Shigeta (1992), 65 from Kaffa- Shaka by Negash (2001), 79 from Sidama by Tesfaye and Ludders (2003), 105 from Gamo Gofa by Shara and Diro (2012), 111 from Kembata-Tambaro by Maryo et al. (2014), 67 from Wolayita by Olango et al. (2014) and 93 from Yem *woreda* by Zerfu et al. (2018). Tsegaye (2002) also stated that most farmers of the study area tend to grow and keep a diverse range of enset types on their farmlands because concentrating on a single variety with a particular trait cannot meet different needs and address constraints.

Farmers' traditional Categorization of enset landraces

The study revealed that the local farmers have an amazing knowledge of the enset plant, which has accumulated over many years and transmitted from generation to generation through oral tradition. It has played key roles in the classification, utilization, and maintenance of the available genetic diversity of enset in the study area.

In the study area, farmers as the main growers and experts, have their identification, local naming, and classification system to distinguish one enset landrace from the other. The same trend was reported from Wolaita and Sidama in using indigenous knowledge of biosystematics for enset landraces (Tesfaye and Ludders 2003; Olango et al. 2014). In the present study, traditional identification and naming of the recorded landraces were primarily based on morphological features, unique traits, and end use-value of the plants, this agrees with the descriptors reported from other enset producing regions, such as Ari, Kefa-Sheka, Sidama, Wolaita in southern and western Ethiopia (Shigeta 1990; Negash 2001; Tesfaye 2008; Olango et al. 2014). As indicated by Zippel and Ludders (2002), Tsehay and Kebebew(2006), and Yemataw et al. (2016) in the southern part of Ethiopia enset growing farmers usually distinguish and classify enset plants based on their morphological traits such as leaf, midrib, petiole and pseudostem color, length and width, types of use, quality (taste, palatability, color, etc.) and quantity of each distinctive product. These identification features are consistent with our results in this study.

In the studied areas, enset farmers give various local names for their landraces after identifying different features, such as morphology, its supposed origin or sources, cooking qualities and different end uses as shown in (Table 4). Nonetheless, the meanings of the names for the majority of the recorded landraces were not explained by the enset farmers in the studied areas. Similar findings have also been reported that unexplained meanings of folk names were common in other enset culture areas of the country (Tesfaye and Ludders 2003; Olango et al. 2014; Yemataw et al. 2016). The same pattern was also perceived in other crops such as sorghum in Ethiopia (Mekbib 2007), banana in Indonesia (Hapsari et al. 2017), and cassava in Uganda (Nakabonge et al. 2020). The unexplained meaning of the name could partly be related to the loss of local knowledge that may have been obvious to the knowledgeable cultivators of enset in the past. Those names that cannot be easily associated with obvious things tend

to be remembered by fewer members and as time passes, this can be further compounded if the landrace does not have special features and uses that could be associated with the name. We can probably explain it with language dynamics that some terms exist but their meanings are no longer known by members of the community. Some names may have been borrowed from other crops. However, before taking the absence of meaning for a landrace as a true statement, thorough surveys have to be made within the entire area where that language is spoken targeting search for the meaning of the name of a particular landrace. Some landrace names recorded in this study were also described from other neighboring ethnolinguistic communities (Spring et al. 1996; Maryo et al. 2014; Yemataw et al. 2016). This might be due to farmer-to-farmer exchange of planting material among adjacent communities and could indicate such 'borrowed' landrace names between ethnolinguistic groups (Olango et al. 2014; Nakabonge et al. 2020). Farmers always refer to the folk names when planting, transplanting, managing, utilizing, giving, and exchanging enset (Shigeta 1990; Tesfaye 2008; Olango et al. 2014; Yemataw et al. 2014; Yemataw et al. 2016).

In the study area, farmers maintain and categorize their enset landraces based on external appearances and internal features. Moreover, they not only identify each landrace and give it a unique place in their homegarden but also elucidate its life history, quality of end products, and specific use-values. According to the reports from Ari, Kefa-Sheka, Wolaita, and Kembata of southern Ethiopia, farmers categorize enset landraces as male or female features (Shigeta 1992; Alemu and Sanford 1996; Negash 2001; Tsehay and Kebebew 2006; Maryo et al. 2014; Olango et al. 2014). According to them, the male enset landraces are drought tolerant. Female landraces are described by farmers as less vigorous, susceptible to disease, having a higher *qocho* quality and producing edible and tasty *amicho*. In addition, they are early maturing and have poor fiber strength. But Zippel and Ludders (2002) reported three categories of enset local varieties; male, female, and intermediate categories from North Omo of Ethiopia. However, in the present study categorization of enset as male or female was not common practice, instead the primary criterion was the stiffness of landraces during harvesting and processing, rate of fermentation, and quality of end value (product and usage). Based on these, local farmers generally grouped their enset into ‘soft’ or ‘hardy’ landraces. These results are consistent with findings reported by Kippe (2002) from Gedeo in southern Ethiopia.

Indigenous uses of enset

The traditional food

The results of this study indicated that enset is a multi-purpose crop that provides the local community with food and non-food materials. In the studied area, farmers cultivate enset in their homegarden as the main staple or co-staple food crop. The different dishes are derived from the three primary enset products namely: *wassa* or *qocho*, *buo’o* or *bulla*, and *hamicho or amicho*. This agrees with previous studies conducted in other enset growing regions of Ethiopia (Brandt et al. 1997; Negash 2001; Tesfaye and Ludder 2003; Olango et al. 2014; Daba and Shigeta 2016). Working with farmers, the three types of *qocho* (fermented enset products) were two (*tiqoota* and *buhesso*) were prepared from ‘soft’ enset types without

and with additions of *gammama*, respectively. The other third *qocho*: *gojjo'o* is prepared from the mixture of both 'soft' and 'hardy' enset types with the addition of starters (*gammama*). In the study area, local communities are considered the recipes from *tiqoota* as poor food, usually consumed in seasons of food shortages. A similar result was reported from Wolayita, southern Ethiopia (Olango et al. 2014). Farmers asserted that *wassa* or *qocho* is produced in large quantities and consumed frequently, whereas *bulla* is considered the best and most favored enset food product in the community. The specialty of *bulla* food in the Hadiya community is seen by the different dishes prepared from it traditionally served for different medicinal values for cultural and religious events. On the other hand, *amicho* is harvested for its immediate use as food with no processing. Similar findings were reported by Brandt et al. (1997) and Tsegaye (2002) in their country-level studies.

Traditional Medicinal use of enset

Farmers in the study area maintained several enset landraces for medicinal purposes with other landraces. According to their reports, the cooked corm (*amicho*) with dairy products is often used to cure different ailments in humans. Out of the mentioned landraces, most are traditionally used to cure bone and joint problems (Table 5). Some of these landraces with similar folk names were also described by Maryo et al. (2014) and Ayenew et al. (2016) from Kembata-Tembaro Zone, and Nuraga et al. (2019) from 5 zones and one *woreda*. Likewise, our results are consistent with the findings reported by Tsegaye and Struik (2002) from the same study area. In the study area, *Meqelwesa* is a landrace known for a deep red leaf, midrib, and pseudostem. The *amicho* (cooked corm) of this enset with milk stimulates the delayed placental discharge after delivery in humans In the same manner, some enset landraces were also reported from different study areas for similar treatment purposes such as *Qeqille* by Maryo et al. (2014) from Kembata, *Asikala* by Assefa and Fitamo (2016) from Sidama, and *Choro* by Tsehay and Kebebew (2006) from Bonga, southern Ethiopia. This may indicate either the independent development of similar cultures or the diffusion of cultures or both the utilization and management of crops over years (Kujawska et al. 2017).

Cultural and Economic values of Enset

Enset has played a significant role in many cultural and economic needs of the rural communities than any other crop in the study area. This study showed that farmers in Hadiya previously as being either poor or rich, a main difference is made based on the several mature enset crops and the numbers of livestock. Enset and cattle are highly interrelated in the studied areas, since different parts of enset are used as fodder for cattle, and their wastes are also used as organic fertilizers for enset crops. These imply that enset plants have a long history and strong bondage with humans and animals. Sirany et al. (2022) also stated that enset crops and animals are closely linked to win-win strategies. Similarly, Alemu and Sandford (1996), Tsegaye and Struik (2002), and Waktola (2009) had described a similar situation in other enset-producing communities of Ethiopia. Moreover, farmers in Hadiya obtain many social appreciations, notable respectful titles or names, and ranks from the local community based on the number and size of enset crops. Likewise, Sirany et al. (2022) indicated that enset plants have special cultural meaning, value, and an expression of identity for enset producers of Ethiopians. Therefore, enset

cultivation in the community plays a major socio-cultural value. In the same manner, Zippel and Alemu (1995), and Olango et al. (2014) reported that in Wolayita a farmer with a large enset plantation and many mature (big) enset plants can immediately be recognized by outsiders as a rich and respected man. Enset is a versatile crop in the Hadiya community, besides food, medicinal and socio-cultural values; it also serves as a source of income for the rural communities. Alemu and Sanford (1996) also showed that enset plants can be sold sometimes and processed products like *qocho* and *bulla* are sold anytime in the rural markets and towns. Therefore, it is an immediate year-round cash income source for a household to buy their regular requirements.

The gender roles in management and use of enset

According to Mukhopadhyay and Pieri (1999) in most farming systems, there is a division of labor. This determines the different tasks for which men and women are responsible. Similarly, farmers in the study areas indicated that women have managed most activities of the enset since they are exclusively accountable for harvesting, processing, storing, preparing, and marketing the products. In our study farmers revealed that male farmers were regularly involved in the early stages of the activities such as land preparation, planting, and transplanting. This corroborates with the reports of Tsgaye (2002), who described that according to the men 'it is a shame for the male to process or watch his wife processing or carry enset products to the market'. Negash (2001) also stated that men believe that enset processing is purely a woman's task. This indicates that in the absence of women it would be difficult to gain any fermented enset products.

Female farmers in the study area also regulate extracted products such as *qocho*, *bulla*, fiber, and other materials like fresh leaves and mattresses (local beds) as an important source of regular income, which provides female farmers with social independence and economic self-sufficiency. The same situation was also reported by Shigeta (1992), Habtewold et al. (1996), Brandt et al. (1997), and Negash (2001) described that the fermented products, fresh and dried parts of enset are the main source of income for women in other enset growing regions of Ethiopia. Generally, female farmers in the Hadiya Zone due to their more intimacy to enset plant, have more knowledge and experience. These opportunities qualify them easily to recognize the different landraces, their detailed features and life cycle, and the yield and quality of the harvested products of each landrace. This has significant implications for women's roles in enset diversity, management, utilization, and conservation of its genetic resources.

Indigenous cultivation and management practice

In the Hadiya, farmers regularly cultivate a mixture of enset landraces to conserve on-farm landrace diversity, to balance harvested enset for different consumption throughout the year. Traditionally, farmers follow three consecutive cultivation stages, which include vegetative propagation, transplanting, and harvesting. Our results indicated that enset propagation is a cultural practice carried out by all farmers every year, to regulate enset cycle and to maintain on-farm landrace diversity. This agrees with the reports of early studies in different enset growing areas of the country (Negash 2001; Tsegaye 2002; Karlsson et al. 2015; Yemataw et al. 2016; Borrell et al. 2020). Based on our field observations and interviews most

farmers use vegetative propagation from the corm of a four-year-old enset plant, locally called *kiniba*. A similar observation was also reported from other enset growing areas (Tsegaye 2002). The propagation is usually carried out from November to January on the offset of the moon. Similar traditional practice was also observed by Olango et al. (2014) in Wolayita. According to farmers in the study area, multiuse landraces are more frequently propagated than functionally specific landraces. Similarly, Yemataw et al. (2016) also indicated that multipurpose landraces are propagated almost every year. Based upon farmers' reports, the number of suckers found from a single mother enset varied due to different factors such as genotypes and size of landraces, age of landraces, management practices, and amount of rainfall. A similar report was observed by other researchers (Karlsson et al. 2015; Bosha 2018). Most farmers in the study area mentioned that 30 to 150 suckers will be obtained from a single mother plant of four years old *kiniba*.

The results of our study revealed that transplanting enset at different levels takes four times or five growth stages before harvesting. Each stage of transplanting has various local names in the Hadiya community (*dubo*, *simma*, *lammo*, *ogoja*, *erro* or *kiniba* and *ballwesa*). In the same manner, Negash (2001) and Tsegaye (2002) stated different growth stages and transplanting steps of enset in different zones of Ethiopia. Transplanting of *kiniba* to *ballwesa* usually occurs during the dry season, especially in January. However, transplanting of other stages is regularly performed at the beginning of the rainy season (normally in March). Comparable reports were shown by Negash (2001), Tsegaye (2002), and Olango et al. (2014) from Keffa-Shaka, Sidama, and Wolayita, respectively. Furthermore, all enset growers in the study area regularly prune most of the leaves at each stage, except *ballwesa*, particularly in June and the end of August. A similar observation was reported by Tsegaye and Struik (2002). Olango et al. (2014) indicated that the third stage in the Wolaiyta area is used as both the source of mother corm for sucker multiplication and harvested for consumption when there is less amount of food in the stock. In the same way, *kiniba* or *erro* stages are also used as the source of mother plants for sucker production in the study area. However, harvesting for human consumption at any stage, except *ballwesa* is not common practice in the studied area of the Hadiya community.

Conclusion

The information obtained from this study indicates that local farmers have a great wealth of knowledge on the classification, utilization, and management of enset landraces in the Hadiya Zone. In the study area, enset is a vital and multipurpose crop; throughout the growth stage, every part is used for food and non-food purposes by most of the farm households. Enset, a food and fodder security crop could not be substituted by other crops for the enset farming communities in the study area. With their daily association and knowledge accumulated over the years, the Hadiya farmers have been cultivating and maintaining a great level of enset diversity in their homegardens for many generations. In this study, 99 vernacular names of enset landraces on farmers' fields were documented. Local farmers in the study area use a combination of methods to identify, name, and classify enset landraces in their homegardens.

The morphological characters of a landrace are the major and key identification criteria used by local farmers. Farmers in the study area give distinct local names for each landrace they grow based on their identifying characteristics. Moreover, the names are often consistent and shared among the people, and also they reflect variations among the landraces. Generally, landraces were named on places of origin or sources, morphology, culinary features, maturity period, growth attribute, and functionality. However, for most enset landraces farmers did not know the meaning of the names in the study area. Local farmers also classify enset landraces into different groups using their long-term experiences and enriched traditional knowledge of the crop.

The results from this study also provide information about the indigenous knowledge of local farmers regarding the cultural, social, and economic values of enset and its production system. Such knowledge is crucial for understanding how local community members classify, utilize, maintain and manage the existing enset landrace diversity in their homegarden.

Declarations

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Authors' contributions

TD is the principal author, designed the study, carried out the field work, analyzed and interpreted the information, prepared figures, wrote the draft and final manuscript. **TF** and **ZA** conceived the study and supervised the research work by suggesting on the field work, in writing and proof reading of the manuscript, and finally reviewing and editing the final manuscript. **AZ** supervised the research work closely, helped to draft manuscript and editing the final manuscript. All authors read and approved the final manuscript.

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Ethics approval and consent to participate

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Competing interests

The authors declare that they have no competing interests.

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Figures

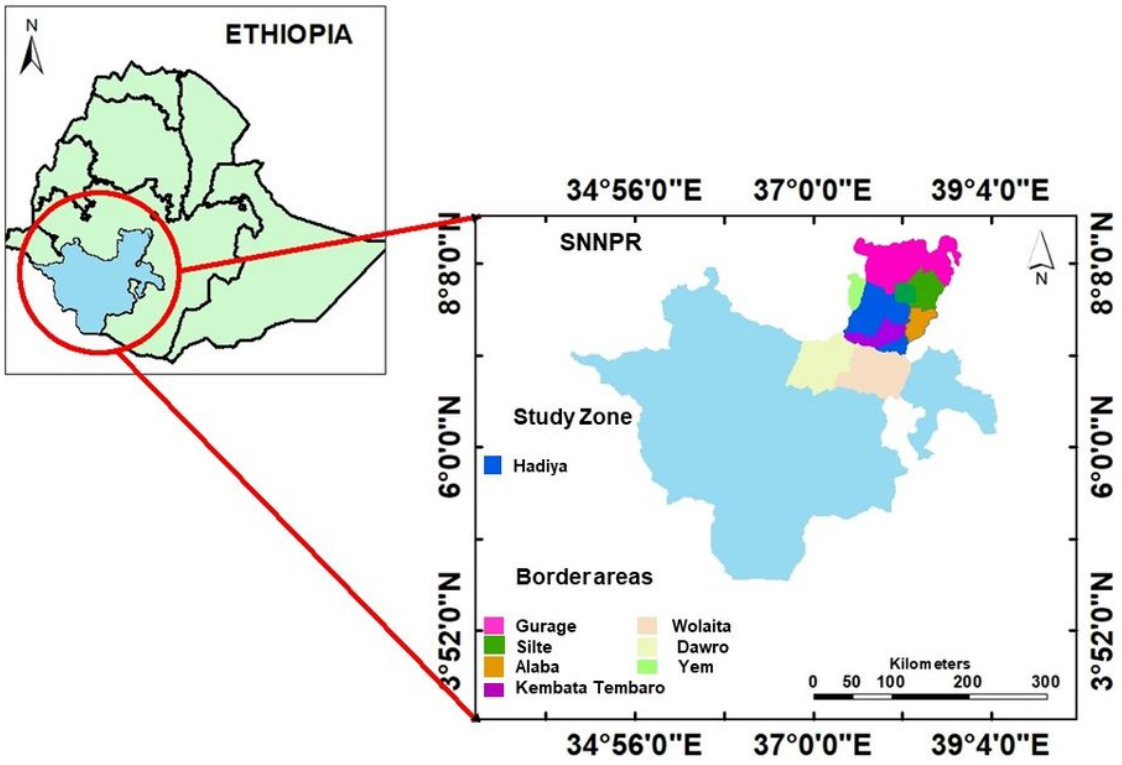

Figure 1

Map of the Southern Nations Nationalities and Peoples' Region (SNNPR) in Ethiopia (left) and location of the Hadiya Zone with the zones bordering it (right).

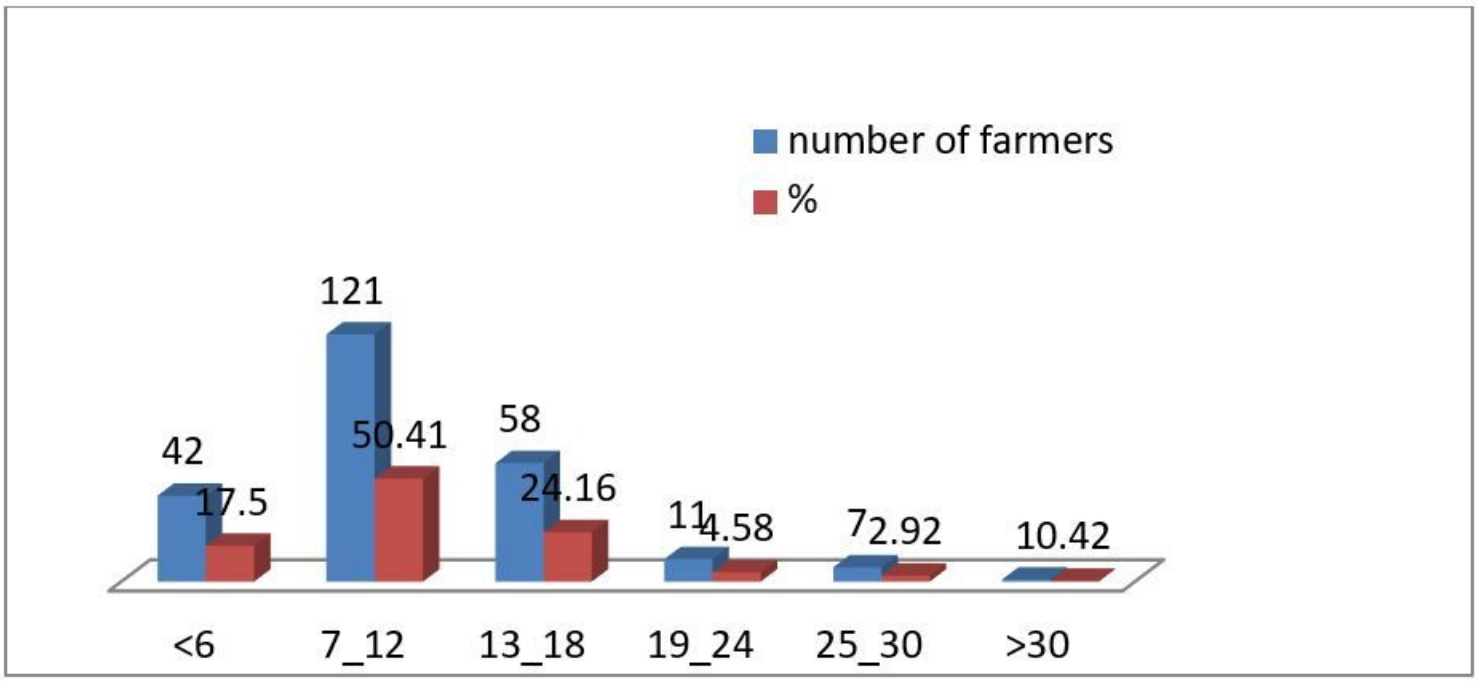

Figure 2

Cultivation range of the enset landraces recorded in the homegardens of the studied area in Hadiya, Ethiopia

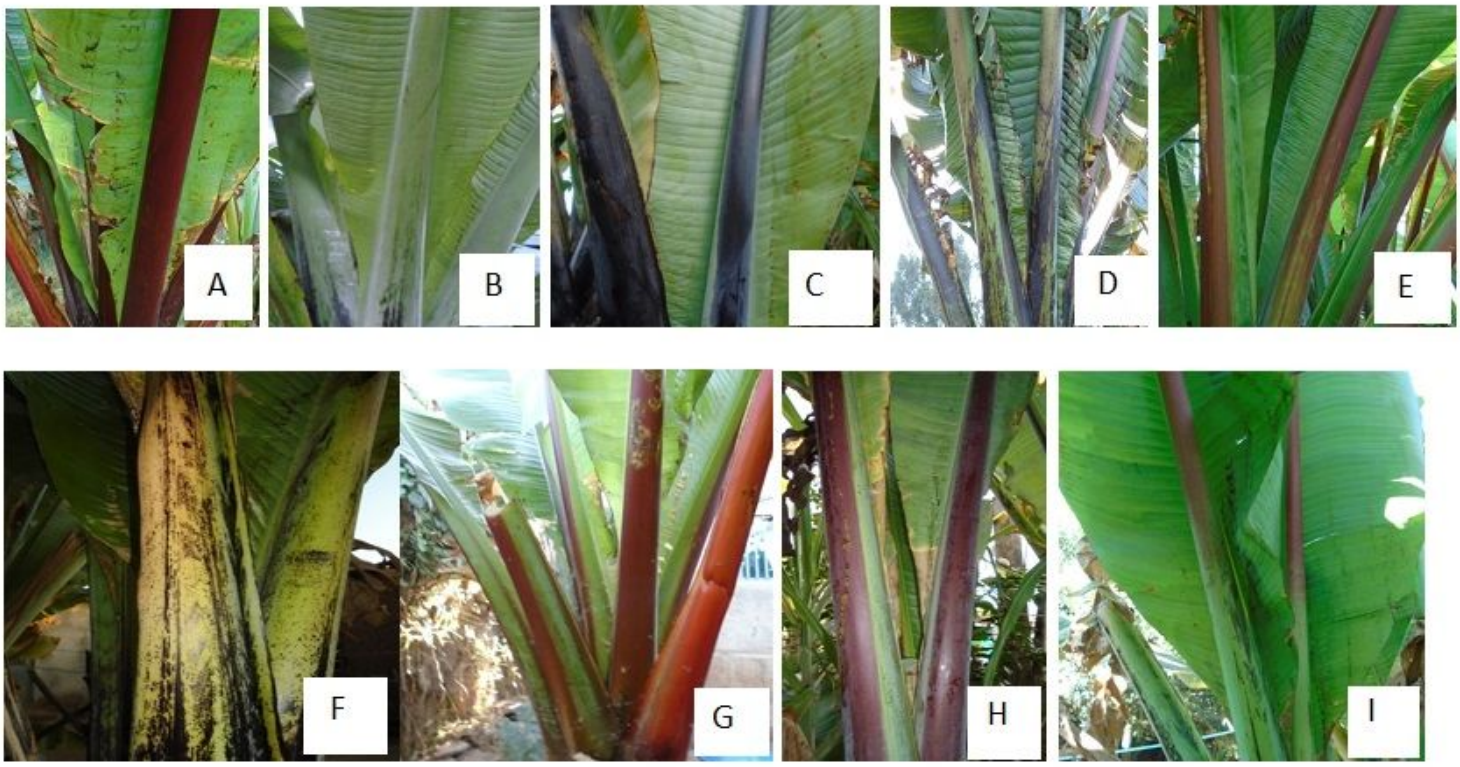

Figure 3

Representative morphological variation in midrib and petiole color farmers used for identification in Hadiya: a) *Korina*; b) *Boicho*; c) *Qebere*; d) *Separa*; e) *Qombotra*; f) *Hella*; g) *Etine*; h) *Astara*; i) *Kaseta*

Figure 4

Variation in the angle of leaf orientation or bending and color of lamina for farmers' identification as descriptors: a) from left to right, *Sisqella* (wide-dropping), *Hiniba* (narrow-erect) and *Separa* (intermediate); b) color of leaf lamina, red for only landraces *Meqelwesa*, green for all others.

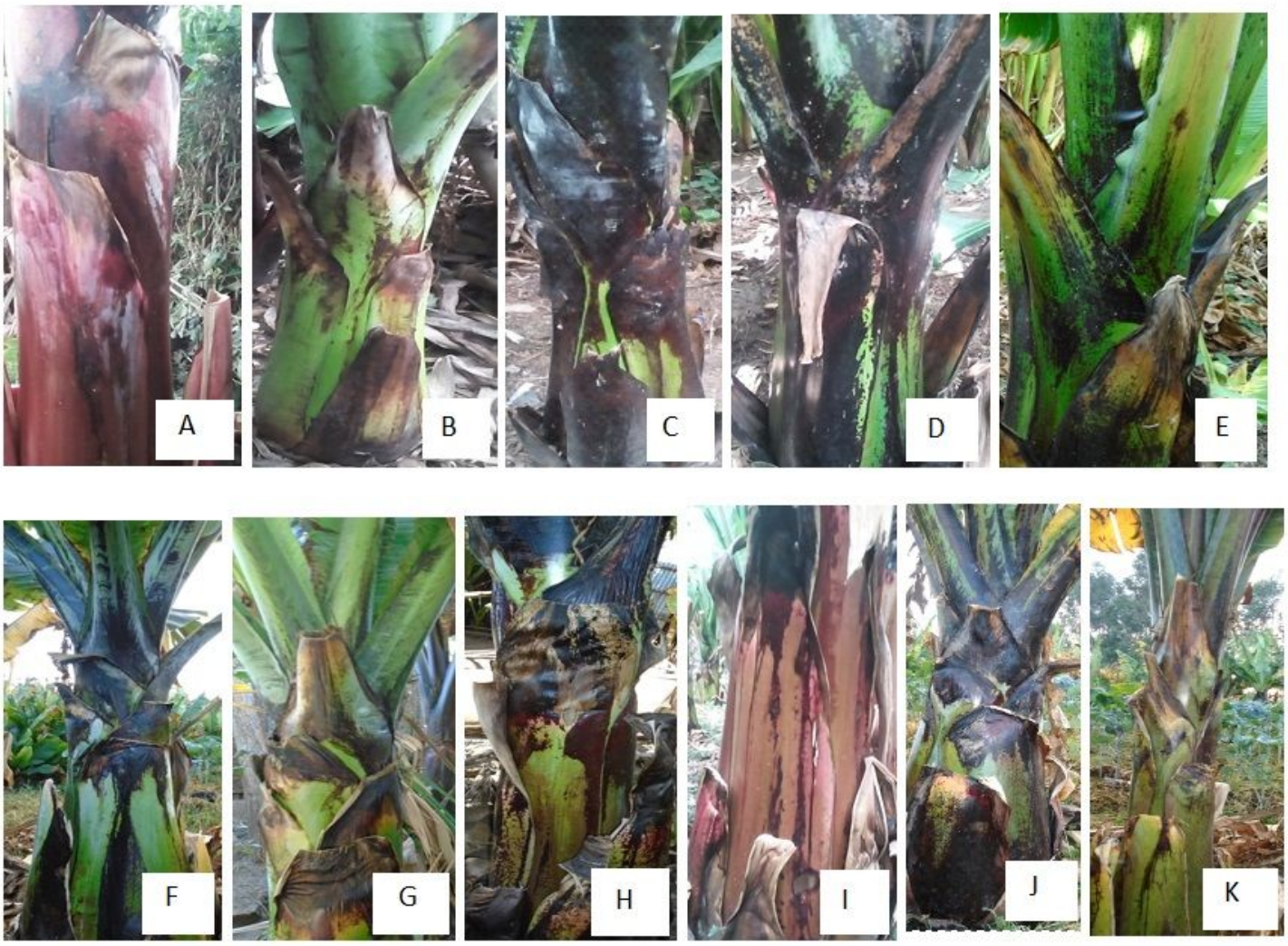

Figure 5

Examples of pseudostem variation in color and in end use-value: (a-e) landraces with sweet *amicho*, *Astara*, *Leqeqa*, *Qebere*, *Xesa* and *Orada*, respectively: (f-h) landraces with non-edible and hard *amicho*, *Sisqella*,*Gishira* and *Hella* from left to right; (i-k) landraces considered as best in fermented products (*qocho* and *bulla*), *Gimbo*, *Separa* and *Hiniba* from left to right.

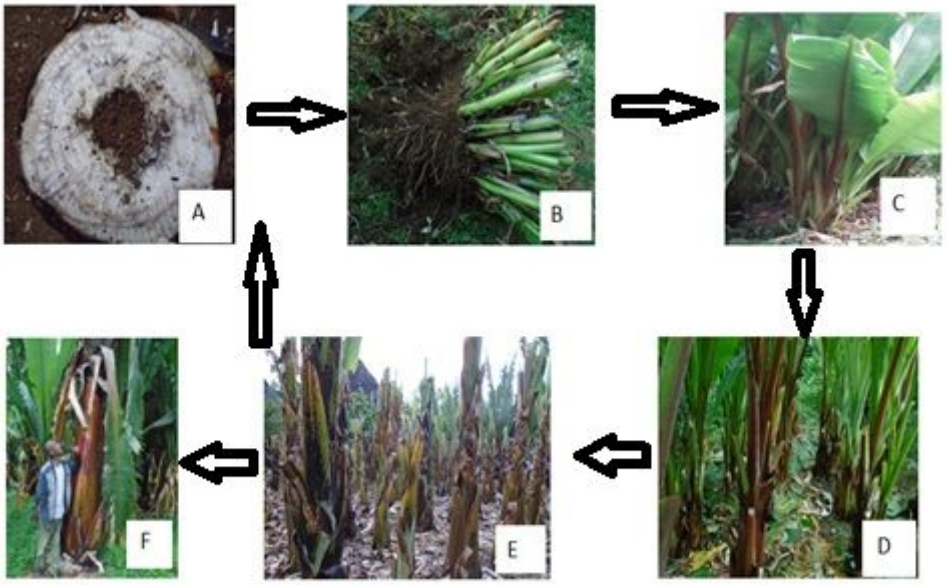

Figure 6

Enset propagation and transplanting practices in Hadiya: a) A mother corm (*Hamicho*) selected from *kiniba*; b) Emerged multiple suckers (*dubo*) ready for transplanting; c) *Simma,* the suckers detached from mother corm and planted into a single hole as groups of 4 to 6 in batches; d) The *lammo* suckers are transplanted in groups of 2 or 3 in the middle rows of the larger suckers known as *ogojaa*, which are planted individually in a row; e) *kiniba* stage is ready to transplant in the permanent field and/or for the suckers (*dubo*) production; f) *Ballwesa,* the last stage where the enset remains permanently until harvesting.

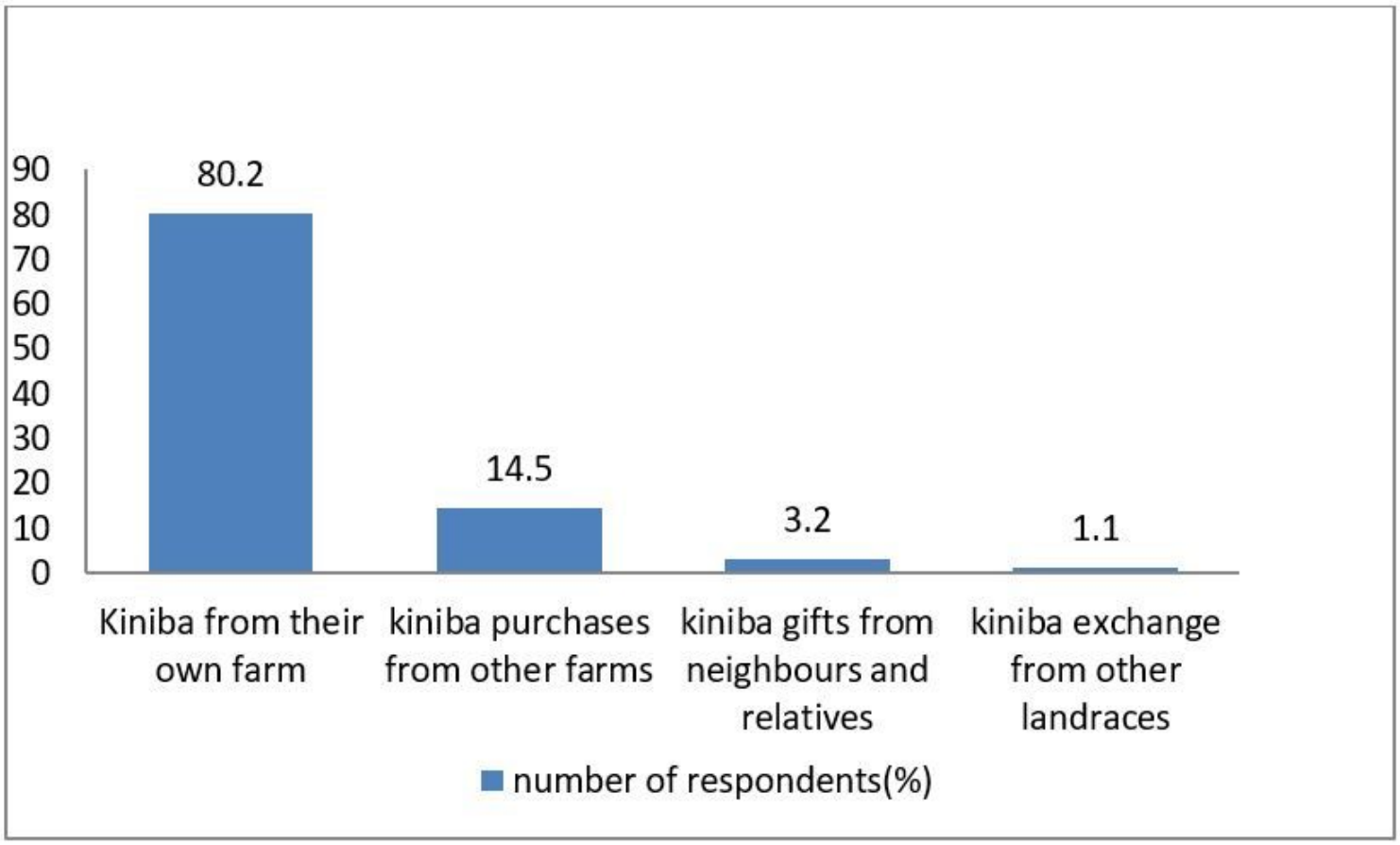

Figure 7

Proportion of the source of planting material (*kiniba*) in the Hadiya zone

Figure 8

Representative example of enset plantations and cattle feeding by enset product in a homegarden of Hadiya area: a) left side of traditional house (*balwesa* stage) enset plantation until harvesting, right side include all other stages (*dubo* to *kiniba*); b) a calf feeding on the corm of enset.