Diversity and cultural use of Enset (*Enset ventricosum* (Welw.) Cheesman) in Bonga *in situ* Conservation Site, Ethiopia.

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Research

Abstract

Enset plant diversity and maintenance were investigated through interviews, quantitative and qualitative plant morphological analysis, nutritional analysis and field observations. Forty-two **enset** varieties were identified and grouped into 6 clusters, where the wild variety was an outlier. Principal components analysis also revealed the distinctiveness of the **enset** varieties. The study showed that, farmers in the Kaffa zone maintain many varieties along with associated myths, beliefs, songs/poems, and medicinal and ritual significance. A multidimensional preference analysis suggested the existence of a reasonable degree of consistency among farmers in naming the varieties and utilization aspects. Diversity within and between **enset** varieties was found to be high, and 'perceptual distinctiveness' of **enset** varieties of which farmers were minutely cognizant was significant in the recognition of variation and therefore plays a role in selection and maintenance of the existing diversity.

Introduction

Enset (*Ensete ventricosum* (Welw.) Cheesman) is a plant which closely resembles the banana plant, forming a single corm underground and a pseudostem above the ground. Unlike domesticated bananas the seedy leathery fruits of the **enset** plant are inedible. The main sources of food are the corm, pseudostem and leaf petioles. Although wild species of **enset** are distributed throughout much of central, eastern and southern Africa as well as Asia, its domestication and use as a food and fiber crop is restricted to Ethiopia (Brandt 1996). Taye *et al*. (1967) noted that **enset** has been cultivated as a food and fiber crop in Ethiopia for several years and over 80% of the production is concentrated in the south and south-western part of the country.

Enset is the primary staple for the people in the Bonga *in situ* conservation site, Kaffa zone of Ethiopia (Figure 1). Its cultivation is usually limited to homesteads in the study area. It is cultivated as a staple along with cereals (tef, maize, sorghum, barley and wheat), pulses (faba bean and field pea), and root and tuber crops (taro, yam, Oromo potato and potato). It is well integrated into the culture of the people and is a typical multipurpose crop, of which every part is thoroughly utilised, not only for food but also for several cultural applications (including medicinal and ritual values).

Although the numeric taxonomy of **enset** is not well established, farmers in the study area are capable of differentiating several varieties based on a number of morphological and end-use qualities. They identify these with their respective vernacular names. More than 60 locally named varieties are identified and maintained by the farmers in Bonga *in situ* conservation site, Chenna and Decha districts.

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Traditional **enset** farming systems have so far been studied by agronomists and geneticists, who have attempted to assess the level of morphological genetic diversity found in some parts of the country (e.g., Kefale & Sanford 1991). However, studies which have tried to connect both genetic and ethnobotanical aspects of the maintenance of **enset** varietal diversity are lacking.

The purpose of this study was therefore, to analyse the existing **enset** diversity (using morphological and nutritional parameters) and also to understand the associated indigenous knowledge in the Bonga *in situ* conservation site (Decha and Chenna district), with the ultimate goal of providing information that will help in constructing the scientific basis for the conservation and sustainable use of the plant.

Research Site

The field sites for this study were the Decha and Chenna district (Figure 1) of the Kaffa Zone (Southern Nations and Nationalities), the traditional homeland of the Kaffa people. The Kaffa people are found south of the Gojeb River located about 7.3^{0}N and 36.2^{0}E. The Kaffa people belong to the Omotic language speaking group. The topography is characterized by slopping and rugged areas with very little plain land. The altitude of the zone varies within the range of 700-3400 meters above sea level. **Enset** and taro are widely cultivated root and tuber crops. Forest coffee and spices such as *Aframomum corrorima*, *Zingiber officinale*, *Piper longum*, *Nigella sativa* and *Curcuma domestica* are popular and used as cash crops. The zone was selected as an *in situ* conservation site for root and tuber crops conservation.

Material and Methods

Plant Materials

In order to illustrate the existing variations within and between **enset** varieties, 3-5 individual, 3 year old matured plants of forty-two named varieties were characterized for eleven morphological traits (eight qualitative and three quantitative traits) and five nutritional parameters (crude protein, fiber, fat, nitrogen, mineral ash and total carbohydrates). Pseudostem and corm of each variety were sampled for the nutritional proximate analysis. The plant parts were chopped and oven dried and analysed for their nutritional status in the Institute of Biodiversity Conservation (IBC) Nutrition Laboratory.

Sampling

In order to document and synthesize the indigenous knowledge associated with the **enset** plant in the study area (Kaffa zone), interviews, discussions and field observations were undertaken in the 1999/2000 growing season. A total of 80 farmer households (HH) from the two

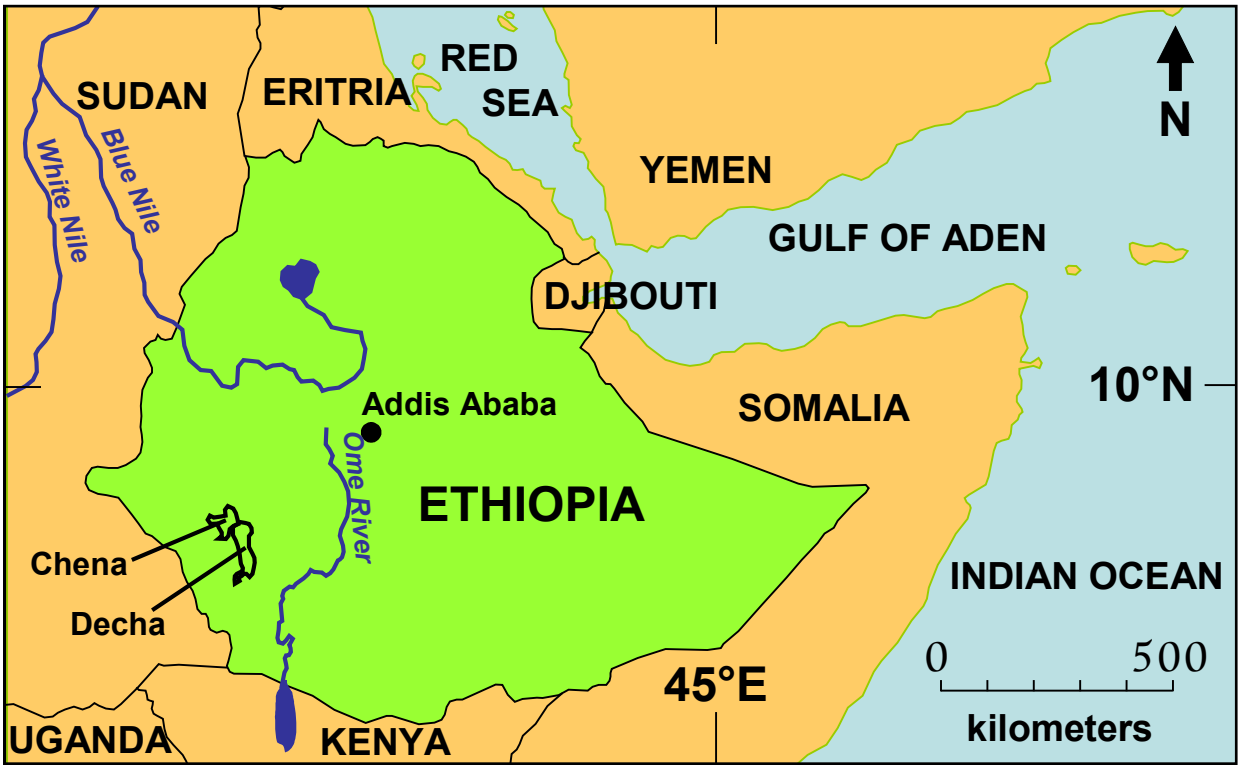

Figure 1. Ethiopia. Field sites in the Bonga *in situ* conservation site (Chena and Decha districts), Kaffa zone.

districts, Decha and Chenna, participated in interviews using a structured questionnaire. The questionnaire was pre-tested and modified accordingly. To explain the pattern of diversity (farmers' management of **enset** diversity) that exists in the area, farmers were asked about their perception of intra-specific diversity, **enset** variety names, meaning of the local names, variety identification criteria, uses, origin, maintenance and more general information on **enset** culture history including myths, legend and songs attached to use and cultural practices. Questions relating to the socioeconomic characteristics of the farm households such as age, level of literacy, land holdings, family size and resource ownership, were also included.

Statistical Analysis

An approach that allows quantitative and qualitative data to be combined for statistical analysis (Rodgers *et al*. 1997) was used prior to cluster analysis. Two dissimilarity matrices, one for the numerical variables and the other for the categorical variables, were constructed and weighted according to the number of variables considered, thus producing a combined dissimilarity matrix. Arithmetically, this procedure produces the square of the Euclidean distances between different varieties. After generating the dissimilarity matrix, an agglomerative, hierarchical classification technique with incremental sums-of-squares sorting strategy (Ward 1963) was used for clustering the varieties. This method summarises the pattern of diversity by assigning **enset** varieties to clusters, by minimising within-cluster sums of squares (Everitt 1980). On the basis of the pseudo-t2 statistic, six clusters were considered as the optimum partition (SAS 1999). The genetic distance between clusters was assessed by the Mahalanobis's distance (D^2). Principal components analysis was also run on the quantitative morphological traits and nutritional characters (excluding the three qualitative traits) to validate the groups obtained from the cluster analysis.

Farmers' ranking (1= poor, 2= intermediate, 3= best) of twenty-nine **enset** varieties that were acknowledged by all the informants (almost all the informants were aware of them) based on the uses such as, **bulla** (water insoluble starchy product obtained by squeezing the scrapped leaf sheath and corm) quality, **amicho** (inner part of the corm eaten boiled) quality, **kocho** (fermented material obtained from a mixture of decorticated leaf sheath and corm) quality, fiber quality, fermentation quality, earliness, yield, por-

Table 1. Morphological traits and nutritional parameters measured from **enset** varieties from field sites in the Bonga *in situ* conservation site (Chena and Decha districts), Kaffa zone, Ethiopia.

Character	Code	Qualitative categories or quantitative measure
Leaf color	LC	1 = light green, 2 = deep green, 3 = light red, 4 = dark red, 5 = purple
Midrib color	MC	1 = light green, 2 = deep green, 3 = greenish yellow, 4 = greenish red, 5 = light red, 6 = dark red, 7 = dark brown
Petiole color	PC	1 = light green, 2 = deep green, 3 = yellowish green, 4 = light red, 5 = dark red, 6 = reddish yellow, 7 = yellowish green
Pseudostem color	PSC	1 = light green, 2 = deep green, 3 = greenish black,4 = light red, 5 = dark red,6 = reddish yellow, 7 = reddish yellow, 8 = dark brown, 9 = purple 10 = yellowish green, 11 = dark red at one side and yellowish grey in the other, 12 = light red at the base, and brownish yellow above the base, 13 = light red at the base, deep green above the base
Pigmentation	PT	1 = none, 2 = light red stripe, 3 = light red patches, 4 = dark red spots, 5 = dark brown patches, 6 = green stripe, 7 = green patches, 8 = greenish yellow patches, 9 = greenish yellow stripes, 10 = yellowish grey stripe
Corrugation	CR	1 = none, 2 = slightly corrugated, 3 = highly corrugated
Petiole length	PEL	meters
Pseudostem length	PSL	meters
Girth Circumference	GIC	meters
Crude fat	FA	percent of total
Crude fibber	FI	percent of total
Crude protein	PR	percent of total
Nitrogen	NI	percent of total
Mineral ash	AS	percent of total
Total Carbohydrate %	TCH	percent of total

ridge quality, medicinal value, ritual significance and tolerance (resistance) to the destructive bacterial wilt (*Xanthomonas musacearum*) disease locally called **nusho**, were converted to binary data and the summarized data were subjected to multidimensional preference analysis (MDPRE) to assess the possible association between the **enset** landraces and various attributes mentioned by the farmers and also to understand whether the knowledge on various attributes is shared or not. The analysis was conducted using SAS (1999) Release 8.02.

Results

Grouping of enset varieties

The dendrogram obtained from the Ward's (1963) hierarchical cluster analysis grouped the original 42 **enset** varieties into 6 clusters (Figure 2) based on the 42 x 42 data matrix that resulted from the statistical approach that allows quantitative and qualitative data (Table 1) to be combined for analysis (Rodgers *et al*. 1997). Cluster means for each quantitative characters character are given in Table 2.

Cluster A: Varieties in this group encompass a two-colored pseudostem with a deep red at the base and brownish yellow above the base and characterized by having a deep red midrib, high nitrogen, crude protein, ash content and large girth circumference (Table 2).

Cluster B: This cluster was well defined on the basis of pseudostem, midrib and petiole color. Varieties in this group contain dark red pseudostem, midrib, and petiole color. The two varieties having ritual significance (Choro and Akbaro) are part of this group. Choro and Akbaro are known to have a deep red colored pseudostem, midrib, petiole and leaves. Farmers in the conservation area mentioned that they usually plant these two varieties in front of their **tikuls** as a safe guard against attack by devil's and evil spirits'. Members of this group were slightly corrugated. Varieties belonging to this cluster were known to contain high crude fat as compared to others (Table 2).

Cluster C: This cluster was the outlying cluster containing only one variety, the locally known wild type called **Koch Seytana** (meaning the devil's **enset**). This variety is propagated by seeds under natural conditions. It is found in areas not disturbed by routine agricultural activities or other forms of human intervention, which include riverbanks, forest and swampy areas. This wild **enset** variety was characterized by having high fiber, nitrogen, crude protein, ash, large petiole and pseudostem length and low carbohydrate content.

Cluster D: This cluster contained the largest number of **enset** varieties (15). Members of this group have a greenish dark pseudostem and light red midrib and petiole color. Almost all of these varieties have slightly corrugated petiole sheaths. Members are characterized by having high total carbohydrate and shorter petiole length.

Cluster E: Members of this cluster comprise varieties having a deep green colored pseudostem, midrib, petiole and leaves and dark brown patches in the pseudostem. Members also have high total carbohydrate and large girth circumference.

Cluster F: This cluster was the second largest, composed of 10 **enset** varieties. The varieties have two-colored pseudostems with a deep red at the base and brownish yellow above the base and deep red midrib and petiole color. These varieties are characterized by having high total carbohydrate and low crude protein and nitrogen content.

Distance among clusters

The Mahalanobis's distance (D^2) calculated for the six clusters are given in Table 3. A highly significance divergence was shown between cluster C and the rest of groups. The maximum distance was found between clusters C and F ($D^2 = 91.4$). Other clusters with significant divergences were C and E ($D^2 = 82.8$), C and A ($D^2 = 54.9$), F and A ($D^2 = 28.2$) and F and B ($D^2 = 19.5$). This result confirms the distinctness of the **enset** varieties grouped into different clusters. The largest distance obtained be-

Table 2. Mean of the quantitative and biochemical characters for each cluster of **Enset** varieties.

Cluster	Fat	Fiber	Nitrogen	Protein	Ash	Petiole Length	Pseudo-stem Length	Girth Circum-ference	Total Carbo-hydrate
A	0.27	8.25	1.05	6.53	10.42	0.36	2.00	1.94	70.75
B	0.30	8.89	0.95	5.91	9.30	0.59	2.36	1.89	73.03
C	0.29	21.48	1.26	7.89	12.02	0.65	3.00	1.80	69.30
D	0.23	6.89	0.71	4.41	6.81	0.45	1.98	1.65	76.99
E	0.21	5.46	0.55	3.43	5.99	0.51	2.70	1.97	78.92
F	0.21	5.62	0.48	2.96	5.83	0.52	2.19	1.84	78.73
Total	0.24	7.14	0.71	4.42	7.28	0.49	2.21	1.81	76.34

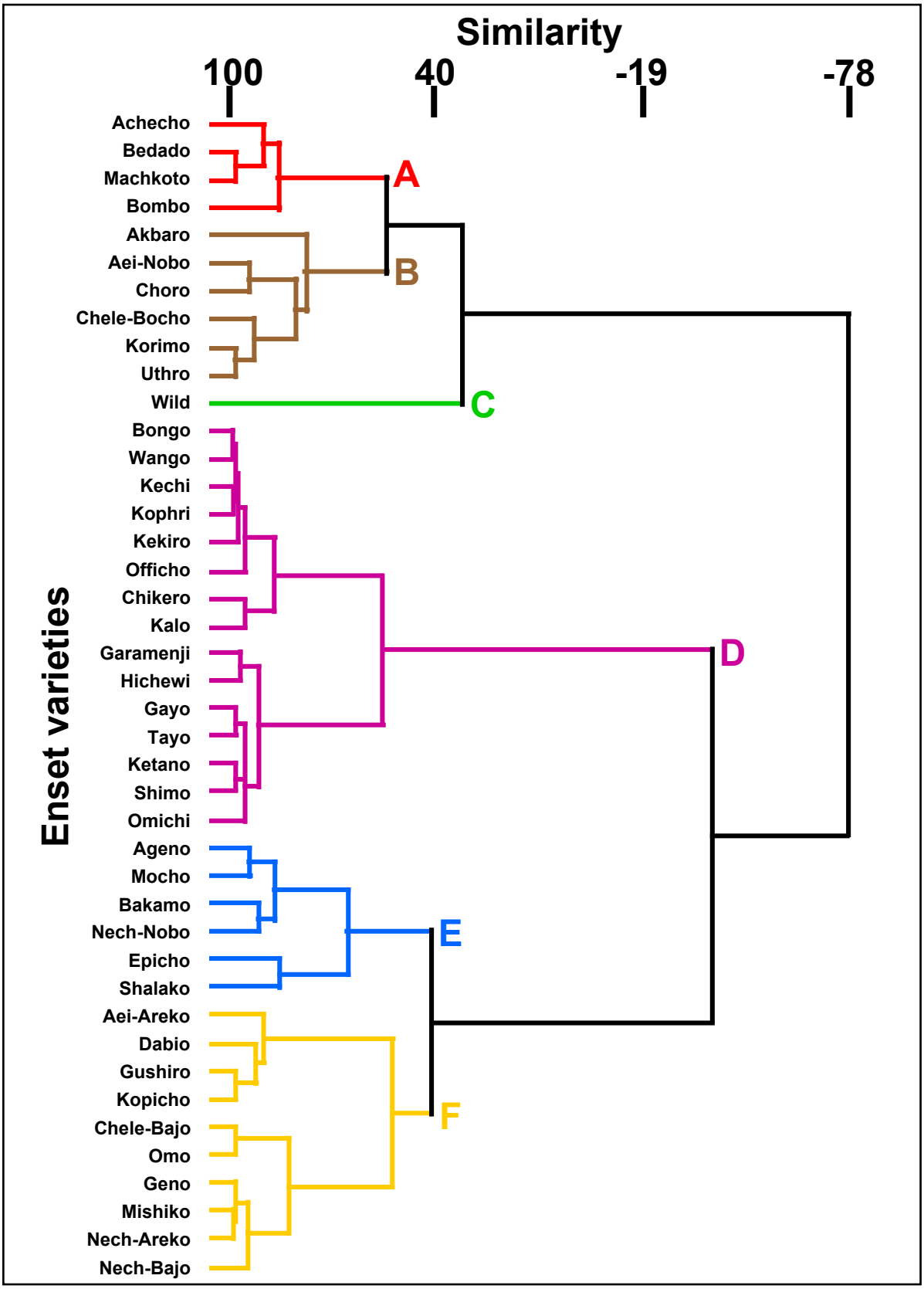

Figure 2. Dendrogram using Ward's method based on a dissimilarity matrix of 42 **Enset** (*Ensete ventricosum* (Welw.) Cheesman) varieties from the Bonga *in situ* conservation site (Decha and Chenna district), Ethiopia.

Table 3. Mahalanobis's distance between clusters of **Enset** varieties.

Cluster	A	B	C	D	E	F
A	-					
B	5.7	-				
C	68.7**		-			
D	12.9	6.8	70.1**	-		
E	21.7	12.6	82.8**	3.5	-	
F	28.2	19.5*	91.4**	4.2	3.6	-

* =P<0.05, ** =P<0.01

tween the wild and the rest was not unexpected. The wild variety **Kocho seytana** is believed to contain high variability within itself and from the other cultivated ones. Breeding programs on **enset** particularly focusing on the bacterial wilt resistance should seek the possibility of utilizing this variety as a source of reliable resistant genes. The significant distance between varieties of cluster F and both clusters A and B could also be an evidence for the existence of variation between the named cultivated varieties.

Ordination of the enset varieties

The principal components analysis also revealed the distinctiveness of the **enset** varieties. It reduced the 9 variables (quantitative and nutritional characters) into two principal components (PC), with eigenvalues greater than 1 (Table 4). The first two principal components explained 67% of the total variation. The varieties from cluster A, B, and w (Cluster C [the wild]) were located in the negative axis of the first principal component, on the other hand varieties from cluster D, E and F had positive principal component scores (Figure 3). Some varieties from cluster D overlapped to some degree in the positive and negative axis of the first principal component. Apparently the first principal component differentiated **enset** varieties that have a high percentage of crude fiber, fat, protein, nitrogen, mineral ash and low total carbohydrate from those that have high total carbohydrate and comparatively low levels of the other nutritional parameters (Table 4). In Particular the wild variety has high fiber content, about 22% (Table 2). Farmers in the study area do not use this variety as a source of fiber because of its poor quality and stiff nature of the fiber. Most of the varieties in cluster E,

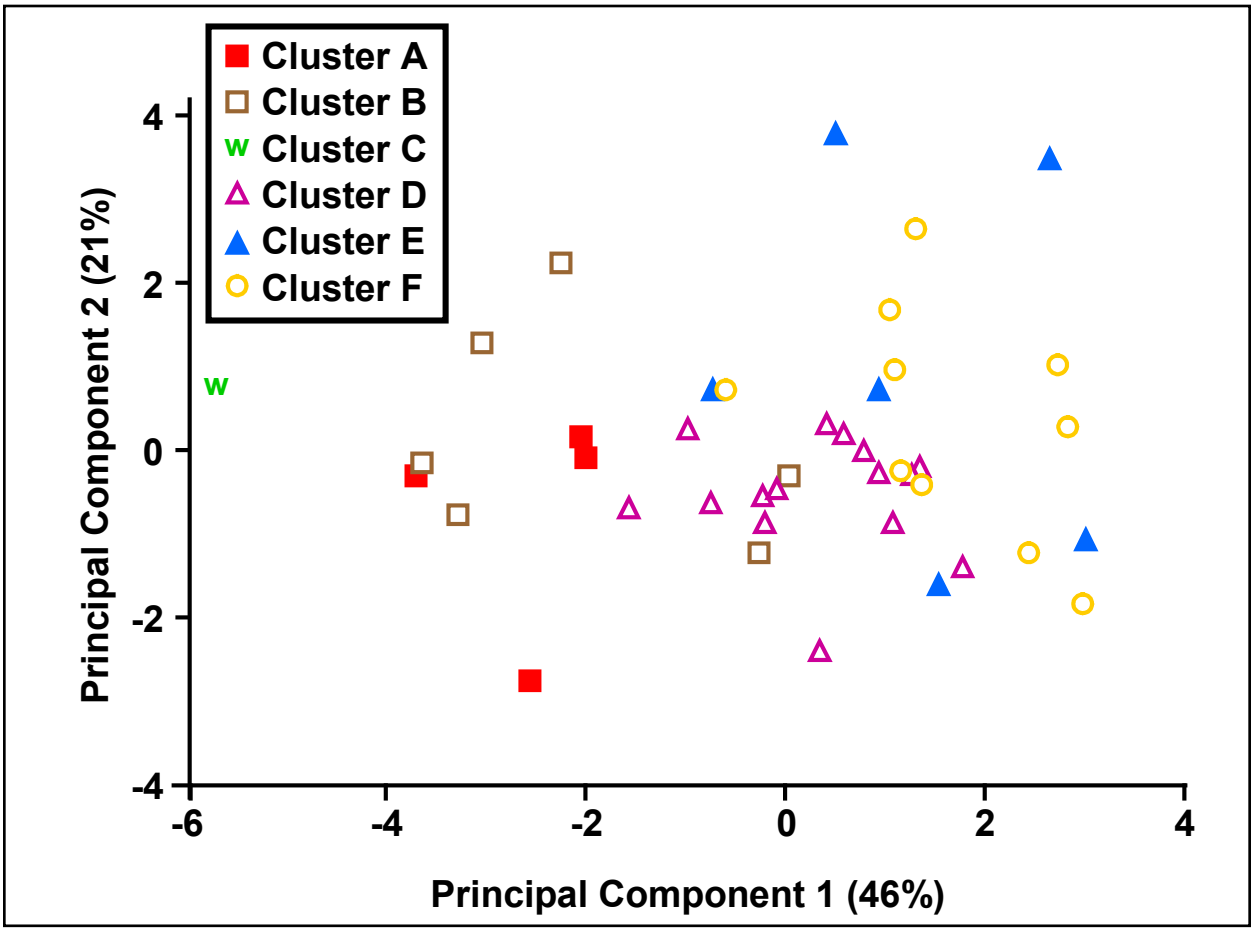

Figure 3. Plot of principal components based on nine quantitative and nutritional parameters.of 42 **Enset** (*Ensete ventricosum* (Welw.) Cheesman) varieties from the Bonga *in situ* conservation site (Decha and Chenna district), Ethiopia.

Table 4. First 2 principal component scores for nine morphological and biochemical parameters with eigenvalues, total variance and cumulative variance for **Enset** varieties.

Characters	Principal Component 1	Principal Component 2
Morphological		
Petiole length	-0.11	0.45
Pseudostem length	-0.06	0.66
Girth circumference	-0.07	0.52
Nutritional		
Fat	-0.24	-0.12
Fiber	-0.39	0.04
Nitrogen	-0.44	-0.18
Protein	-0.44	-0.18
Ash	-0.43	0.09
Total carbohydrate	0.46	-0.02
Eigenvalues	4.2	1.9
Total variance	46%	21%
Cumulative variance	46%	67%

F including the wild had positive scores and members in cluster A and D had negative scores in the second principal component. Members of the cluster B overlapped to some extent in both direction of the second component. This axis differentiated **enset** varieties based on quantitative morphological traits. Varieties in the positive axis of the second axis were those with long pseudostem, long petiole and large girth circumference unlike those located in the negative axis of this component. Both the two principal components revealed that the wild type was highly divergent from the cultivated forms. The forgoing results also revealed the diverse nature of the **enset** varieties studied, which grouped into six clusters, and the names given by the farmers in the area were found to be highly consistent.

Enset varieties

The use of **enset** and its products for different purposes such as food in the form of **amicho** (inner part of the corm eaten boiled), **kocho** (fermented material obtained from a mixture of decorticated leaf sheath and corm), **bulla** (water insoluble starchy product obtained by squeezing the scrapped leaf sheath and corm), medicine, ritual and construction purposes could attributed to the existence of various different **enset** varieties in the Bonga *in situ* conservation site. These are identified, named and categorized by the farmers in the area based on pseudostem, petiole and midrib color, size (width and length), and various end-use and disease resistance characteristics. **Enset**-growers in the study area distinguished more than 65 different types of **enset** varieties with their respective local names (unpublished report) of which only 42 are used in this particular study. Any one farmer usually grows a mix of several different types in a given farm.

To facilitate the understanding of the challenge of variability, diversity, and clearly define and develop scientifically acceptable biological classification, Awegechew (1996) argues that both folk botanical and scientific taxonomy should be taken into consideration. Although folk botanical nomenclature is not guided by a set of written rules, there are striking similarities in the way that plants are named by local people around the world (Martin 1995). **Enset** vernacular names are often quite consistent in the study area. Some of these have descriptive meaning while others are just simply names. In most of the villages the common names are shared among the people. In addition to other morphological and end-use characters, midrib color and pseudostem color (both in some varieties or one of them in others) are the most important characters used by the farmers to classify **enset** clones into sub-clones and to differentiate among **enset** clones in the study area. Though, it would seem very difficult to determine which varieties belong to cultivated or wild groups for non-**enset** growing farmers, the **enset** grower farmers easily distinguish between the two on the basis of color, shape, and many other characteristics.

Medicinal and ritual significance

A number of different **enset** varieties were reported to have medicinal and religious (ritual) significance for preventive treatment, healing and other therapeutic purposes, and as protection against evil spirits. These medicinal and ritual varieties are given special care and some examples are given as follows:

Tayo is a variety with a light red pseudostem and midrib and deep green leaf. The boiled corm **amicho** and starchy powder **bulla** are eaten with milk to cure ailments such as broken bones fractures, joint displacement and swelling with pus. It is used to cure similar ailments in domesticated animals, specifically dairy cows when eaten with salt.

Choro is a variety with a deep red pseudostem, midrib and leaf. The corm **amicho** of this **enset** is eaten with cheese specially prepared with butter and milk by women who have just delivered babies and whose discharge of the placenta is delayed. It stimulates the placental discharge during delivery. For dairy cows the **amicho** is given with salt for similar purposes. This variety also has a ritual significance with the people and is found in both Decha and Chenna districts of the study area. Farmers plant **Choro** in front of their **tikuls** as a safe guard against devils' and all evil spirit attacks.

Machedemi is used for the same medicinal purposes as **Choro** when the later is not available or when there is a need to use as an alternative to **Choro**.

Officho is prepared as a dehydrated starch suspension **bulla** together with milk. This is used for a person who has health problems from broken bones, fractures and swelling in order to restore and heal the damaged part of the body.

Myths and Beliefs

Myth is as a society's narratives, expresses and reflects the origins of natural phenomenon, historical events, social institutions and structures, religious and beliefs as well as man himself (Arega 1995). One of the interesting myths about the origin of **enset** in the study area is given below:

During the creation of the world, "**enset** plant was created as a wild and non-wild type. The wild varieties were created along the forests and the non-wild (cultivated) ones were grown in places where man lives. The wild variety was changed into water whereas the non-wild ones changed into food and among the non-wild, the tastiest ones were eaten by man immediately and the other ones were adopted later on". This myth indicates how the local people brought the **enset** plant into cultivation and the empirical method used to differentiate between the cultivated and the wild varieties.

Some of the people in the study area have interesting religious notion about spirits (**adbar**), mainly connected with the **enset** plant. **Enset** in the form of chopped **kocho** is locally called **bachero** is used as a sacrifice in the **enset** agricultural cult. The sacrifices are meant to enhance fertility or production. When **enset** is planted some people perform religious rites to honor the **adbar**. The **kocho** is chopped into pieces and spread over the field during planting a new field and it is believed that a good harvest could be guaranteed by sacrificing the **kocho** to the **adbar**. The elderly men of the village gather, pray and make offering to the **adbar** before they set off on planting as follows; **Yero nokolena none shunebe** (Oh! LORD please reconcile us with our **adbar**). They also further say: **Kolende noch barkon gede** (Oh! our **adbar** please bless our work of hands). Such ceremonies are usually conducted in sacred places and in the forest near to their farms.

Song's

A new **enset** cycle is set in motion each planting season with two overlapping cycles obtaining at any given time. The seasons of harvesting and planting are practically consecutive. **Enset** is not a delicate and short cycled crop, once established it can tolerate considerable environmental stress, and does not require much labor unlike cereal crops. This is well reflected in some of the traditional songs and sayings of the farmers. For instance one song begins with:
"**Geshe shegetana kocho ebedeshe**
Galeta kuleta bushoa bedeshe
Kocho koda boda-kocho kopa geshe"

This may be translated as: "No matter one sowing **tef** (*Eragrostis tef*) and barley, can never harvest as one can get a harvest from **enset** plant throughout the year".

This is directly related to the fact that **enset** is a main crop of the people that can be utilized throughout the year unlike cereals like **tef**, which have specific seasons and discontinuity in their growing period. This generally expresses the multipurpose nature of the plant and its valuable role in the livelihood of the community.

Use values

To study the informants perceptions on the end uses of the varieties and to assess whether the knowledge is shared or not, 29 varieties which were acknowledged by all of the informants were selected. Multidimensional preference ranking analysis based on the ranking data on uses (Figure 4) separated the varieties locally distinguished as "female" and "male" types into different directions of the axis. The classification of **enset** varieties into "female" and "male" category has no association with the reproductive pattern rather it has an attachment with other attributes as perceived by farmers.

The first axis (dimension) of Figure 4 separated varieties in the "female" category (positive direction) from varieties categorized as "male" (negative direction). Likewise, end-uses such as fermentation quality, amicho quality, fiber quality, bulla quality and earliness contributed more to positive direction of the first axis showing that varieties under the "female" category are best suited for making bulla, amicho, and have better fiber and fermentation quality and they are also early maturing types. On the other hand, yield and tolerance to bacterial wilt, were contributed more to the negative axis of the first dimension where varieties of the "male" category dominated. Varieties under "male" category such as **Neche Nobo** (meaning white **Nobo**), and **Aie-Nobo** (meaning dark **Nobo**), were locally identified as having poor quality **bulla**, **amicho**, fiber, fermentation qualities and are late maturing. However these are reported to be tolerant to bacterial wilt. This could give a clue for the need of undertaking further screening to identify promising tolerant varieties to bacterial wilt disease.

The extreme direction of the negative axis of the second dimension was occupied by the varieties **Choro**, **Akbaro**, **Tayo** and **Officho**. Ritual significance and medicinal value were contributed more to the negative direction of the second axis showing that the aforementioned varieties have a ritual and medicinal significance as perceived by farmers.

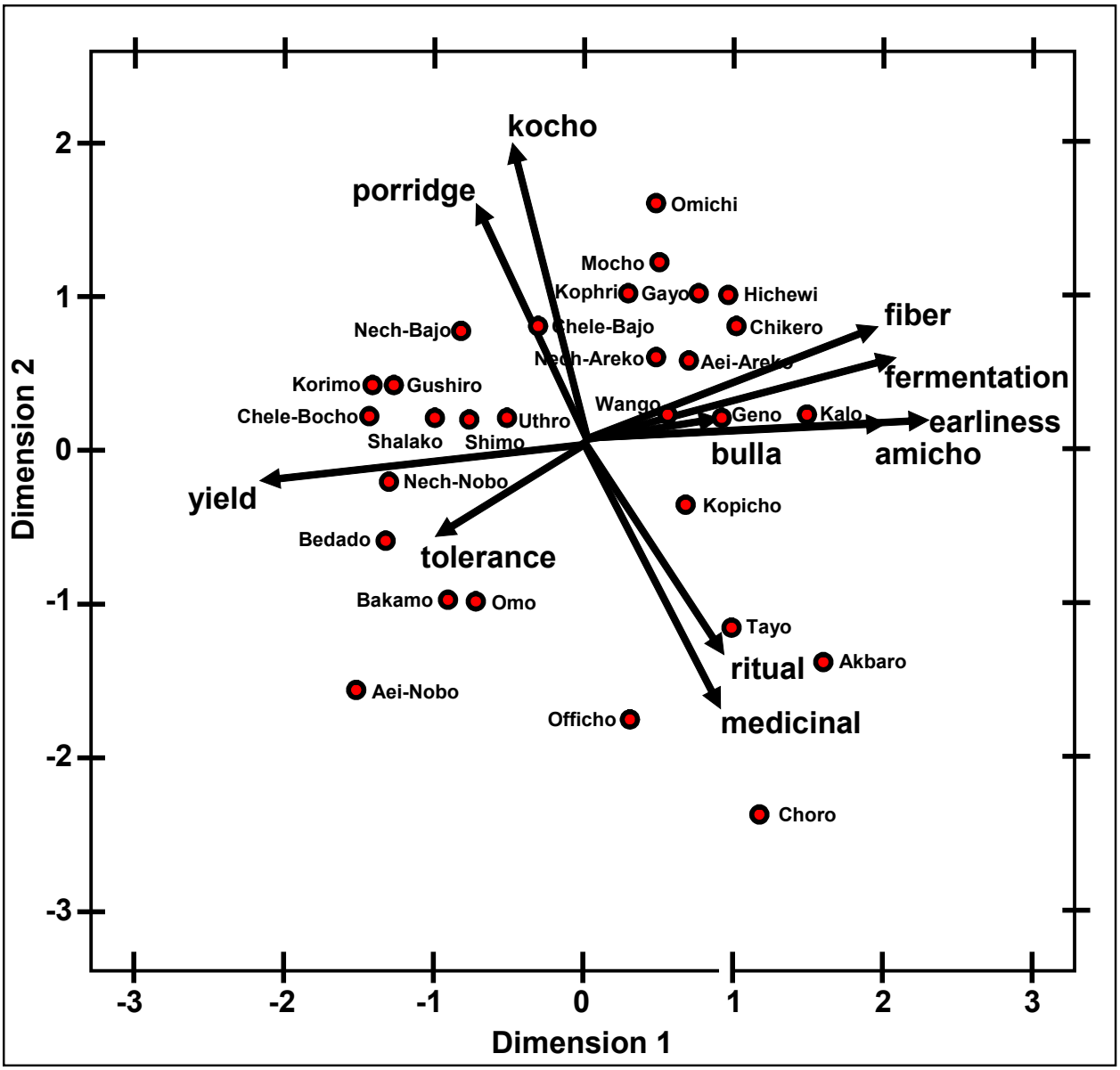

Figure 4. Ordination of 29 **Enset** varieties based on the end uses obtained from multidimensional preference ranking analysis. Preferences were based on selection for: **bulla** quality, **amicho** quality, **kocho** quality, fiber quality, fermentation quality, earliness, yield, porridge quality, medicinal value, ritual significance and tolerance (resistance) to the destructive bacterial wilt (*Xanthomonas musacearum*) disease.

The end uses, **kocho** and porridge qualities were located in the center, which indicates that they have no significance in discriminating varieties in to “female” and “male” categories. Almost all **enset** varieties can be utilized for making **kocho** and porridge.

Discussion

Farmers in many parts of the country (including the study area) are confronted with complex and heterogeneous environments. They are also faced with many sources of production risks and uncertainty, e.g., rainfall variability, insect and disease outbreaks. In such situations, on-farm diversification i.e. maintenance of a diverse form of crops and livestock production that interlock with each other deserves attention as a complementary or alternative livelihood strategy. The **enset** farming in the Bonga area (Kaffa zone) is of complex nature and highly dependent on animal manure as a source of nutrient. Farmers managed complex gardens containing a number of plant species including cabbage, taro and crops other than **enset**. These systems represent a strategy to promote diversity of diet

(improve nutritional aspects of the households), increased income sources and stability of production. Small areas around the house commonly contained on average 10-20 **enset** varieties planted in one plot. Such practice confers at least partial resistance to diseases specific to particular strains of the crop (particularly in the absence of pesticides and fungicides). This allows farmers to exploit different microclimates and also enhances harvest security. Moreover, such practices can also enable farmers to schedule farm operations such as planting, weeding and harvesting in such a way as to distribute labor and avoid or minimize labor bottlenecks.

Farmers in the Bonga *in situ* conservation site are maintaining **enset** varieties for different purposes based on their household constraints and choices. Some of the varieties are maintained for household consumption, others for sale as an income source, and still others for various purposes including medicinal value. Variation, as it is expressed by morphological and nutritional analysis was enormous among the **enset** varieties and "perceptual distinctiveness" of **enset** varieties, of which farmers were minutely cognizant, is significant in their recognition of variation and therefore plays a role in their selection and maintenance of the overall variability. Moreover, Almaz (2001) found a reasonable amount of variability with a certain level of duplication (about 29%) using AFLP technique (molecular analysis) on 65 **enset** varieties (the 42 varieties of the present study are included in the study) sampled from the same area. The result of the molecular analysis revealed that more than 70% of the varieties maintained by farmers in the study area are distinct from one another. This is an indication that the farmers' practices in maintaining, characterizing and selecting **enset** varieties based on their own criteria's are still valid and need to be documented. However, the informal exchange systems of eneset varieties among farmers of the same area and/or different areas needs further study.

Even though the **enset** plant is believed to be nutritionally poor particularly in protein and vitamin, farmers are maintaining/selecting **enset** varieties that contain relatively higher content of protein, fat and fiber (Table 2). Almost all of the varieties in all the cluster groups were also found to contain better amounts of total carbohydrate than the wild variety. This was because of the selection exercise undertaken by farmers in the areas for a number of parameters including nutritional quality. In addition to the morphological traits, farmers can also distinguish the varieties based on the end uses as "female" and "male" category. The categorization into "female" and "male" has nothing to do with the biological reproductive parts of the plant, but rather with a set of qualities and characteristics in terms of desirability for harvesting, time of harvesting, fiber and food content, softness and hardness, palatability when immature, length of fermentation period required, size, growth rates, and resistance to disease and pests. These distinctions are made from within the culture and linked by the men and women farmers to cultural conceptions of 'maleness' and 'femaleness'. The multidimensional preference ranking analysis also revealed that varieties identified as "female" are having the best qualities for making **bulla**, **amicho**, and also have best fiber and fermentation quality. They are also early maturation types unlike the "male" category, which are high yielder and of a late maturing type. The use or consumption patterns of **enset** varieties in the study area also contributed a great deal to increase the diversity of the **enset** varieties.

To sustain the **enset** farming and the conservation practices it is useful to improve the market imperfections in the area. Markets may exit, but they are 'thin' markets with few buyers and farmers have poor access to market information. This can be exacerbated in the area economies where all households harvest at the same time. A large harvest for everyone will decrease the opportunities to sell when the need to sell is greatest. If diversity can be more valued in the marketplaces through the creation of consumer demand for certain products (e.g. quality of produce from each variety of **enset**), and farmers can access those markets, their incentives to maintain diversity may be increased. Policy support is needed to increase consumer demand for diverse **enset** resources and to improve processing, packaging, storage and marketing of **enset** products. To enhance the on-farm conservation of **enset** in the *in situ* conservation site requires interventions to increase benefits to farmers through processing and sensitization of entrepreneurs to use more local products.

Support for the traditional inefficient mode of propagation through the use of *in vitro* propagation is of paramount importance to conserve of the existing diversity of **enset** germplasm in the Bonga *in situ* conservation site. Moreover, *in vitro* propagation may help to produce healthy (bacteria or virus free) plantlets.

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