Local Customary Use and Management of Ethiopian Potato (*Plectranthus edulis* (Vatke) Agnew in Sodo Zuria District, South Ethiopia

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Research

Abstract

The Ethiopian potato (*Plectranthus edulis* (Vatke) Agnew, Lamiaceae) is an under-utilized tuber crop. An ethnobotanical study was conducted on the use and management of *P. edulis* in Sodo Zuria district, south Ethiopia. Semi-structured questionnaires were used to interview 63 farmers in three locations. In all locations, farmers reported a decreasing trend in the number of local varieties maintained on their farms. The socio-economic status of the households was found to be an important factor affecting conservation and use of the crop. Most farmers (81%), who did not have enough land, used seed tubers from other sources. The study showed a significant relationship between tuber source and age of farmers (X^2 = 15.81, $P<0.05$). The study also revealed that older farmers were more knowledgeable than younger ones. Based on farmers' descriptors, a total of six distinct local varieties were recorded. Among the six local varieties, **lofuwa**, **unnuka** and **chenkuwa** were widely grown across the study **kebeles**. Shortage of cultivable land, long maturation period, displacement by other crops, and shortage of seed tubers were the main causes for declining interest in cultivation.

Introduction

Farmers have acquired considerable knowledge on ways of conserving and utilizing biodiversity. They use different plant characteristics to identify and select their crop varieties. Agronomic traits, use, and market are the major characteristics that farmers have used in their variety selections (Smolders 2006). This traditional knowledge of useful plant characteristics has enabled them to select varieties that best fit their agricultural systems (IPGRI 1999). Now, however, diversified local food production systems are under threat, including the local knowledge, culture, and skills of farmers (de Boef 2008, FAO 2005). The major factors that have contributed to the loss of indigenous crops include: introduction of exotic species, habitat destruction, land use change, population pressure, selection by farmers and climate change (de Boef 2008, FAO 2010, Smolders 2006). Besides, many traditional crops have been abandoned due to intensification of farming systems (Prescott-Allen & Prescott-Allen 1990, Smolders 2006). As a result, indigenous crops that historically were used for food security are now lost or have become under-utilized. For instance, the Andean root and tuber crops, once important in the region, no longer are found in many areas (Castillo & Hermann 1995). At present, the conservation and utilization of indigenous crop species largely depends on the motivation of farmers (IPGRI 2002).

The conservation and sustainable use of indigenous crops offers an opportunity for addressing the problem of food security. Proper documentation of the available information on distribution, use practices, and traditional knowledge is essential to optimize conservation and further utilization of these crops (Mathenge 1995).

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Plectranthus edulis (Vatke) Agnew, also known as Ethiopian potato, is one of the traditional root crops indigenous to Ethiopia (Asfaw & Woldu 1997, ENBSAP 2005). It has been cultivated for its edible tuber in highly localized areas of south and south west Ethiopia as they are a good source of carbohydrates. The plant is cultivated at altitudes ranging from 1880 to 2200 meters above sea level (m.a.s.l) (Demissie 1988). Despite its local importance, there is limited knowledge of the range of plant traits involved in selection of this traditional crop. Available information on use and traditional management of the crop are also scant. Therefore, the present study focused primarily ethnobotanical use and management with the aim of enhancing conservation and use of this crop.

Methods

Study area and people

The study was conducted in three **kebeles** (neighborhoods, the smallest administrative units in Ethiopia) namely, Delebo-ateware, Delebo-wogene and Koketemarechare of Sodo Zuria district, south Ethiopia (Figure 1). The three study sites were selected based on their distribution, production potential and road accessibility. The study sites range in altitude between 2040 and 2370 m.a.s.l. Within each **kebele** three villagers that have grown the crop for a long time were selected for interviews. The study **kebeles** are inhabited by Wolaita people who belong to the omotic language speaking groups. Subsistence farming is the major economic activity including crops of sweet potato (*Ipomoea batatas* (L.) Lam), Andean (Irish) potato (*Solanum tuberosum* L.), **enset** (*Ensete ventricosum* (Welw.) Cheesman), taro (*Colocasia esculenta* (L.) Schott), yam (*Dioscorea* spp), barley (*Hordeum vulgare* L.), wheats (*Triticum* spp.), and maize (*Zea mays* L.).

Data collection

Data were collected from randomly selected informants with different socioeconomic backgrounds (variables inclued age, gender, education, and wealth status). A total of 63 *P. edulis* growing farmers were interviewed using a semi-structured questionnaire that covered topics of: landholdings, cultural practices, the effect of distance on cultivation, movement of planting materials, agricultural inputs, the parts and types of food prepared, traditional use values and crop management. The respondents were also asked about their perception of the production techniques for *P. edulis*, storage practices, and local varieties. Information related to drought tolerance, maturity days, taste, disease resistance, tuber yield, marketability, tuber color, tuber size and shelf life were documented. Out of the total respondents, 81% were men. More than 88% of the respondents have lived in the area and have been involved in farming activities for more than 10 years. Similarly, 70% of the respondents in the study area have grown the crop for more than 10 years. The ages of the respondents ranged from 20 to 80 years. Interviews were facilitated with translators who were conversant in the local language (Wolaitigna). Focus group discussions and key informant interviews were employed as described in Martin (1995) to complement and verify the information obtained from informant farmers.

Living collections of P. edulis varieties reported were collected for conservation. Currently, the collected local varieties are conserved in the field genebank of the Institute of Biodiversity Conservation, Ethiopia.

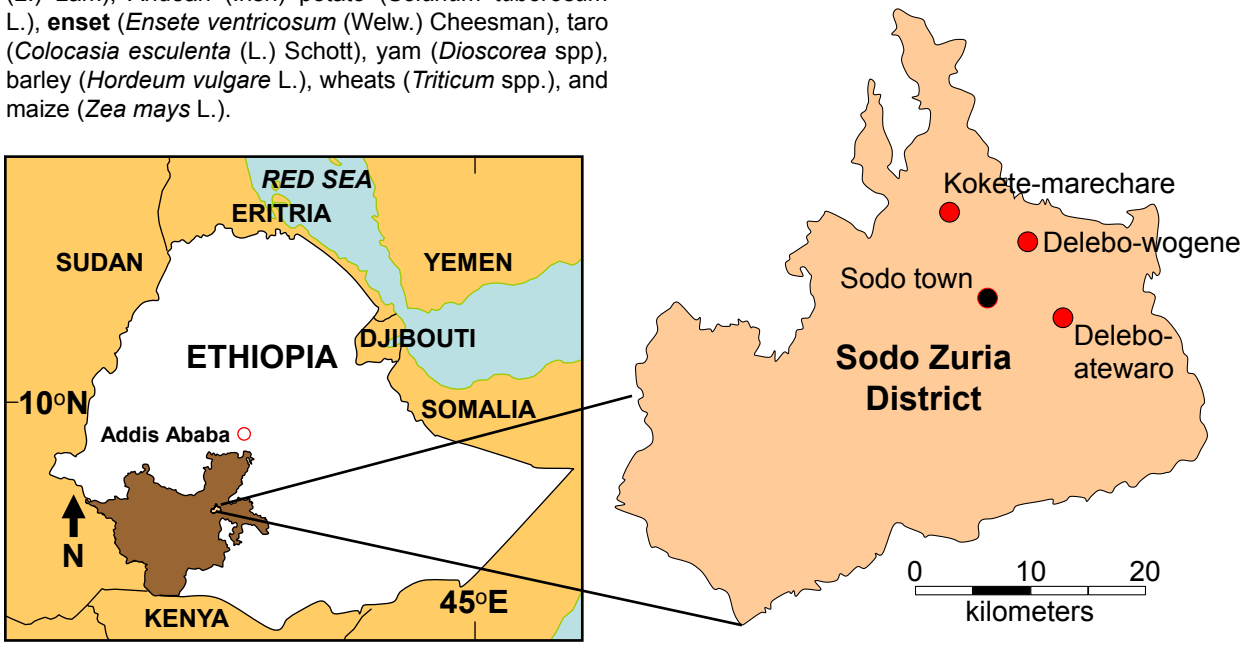

Figure 1. Three **kebeles** of Kokete-marechare, Delebo-wogene and Delebo-ateware in Sodo Zuria district, Southern Nations, Nationalities and Peoples' Region, Ethiopia.

Data analysis

Data were coded depending on their nature (qualitative or quantitative). The frequencies of occurrence of each local variety in the three **kebeles** were calculated. Chi-square (X^2) test was run using the SAS GLM-package (SAS 1999) to analyze the relationship between tuber source and age of farmers. Basic statistics were also used to present the results.

Results and discussion

Local variety management

P. edulis is propagated vegetatively by tubers, and the seed tuber for planting was obtained from individually selected tubers of the previous harvest or bought in the market. Preparation of land usually commenced around the month of January and involves a range of cultivation practices. More than 65% of the respondents reported that they plowed the land more than three times before planting. This enabled them to mix farmyard manure with the soil to make it suitable for growing the crop. *P. edulis* needs soils that are rich in organic matter in contrast to other root crop species. Manure is usually distributed on the farm within one to two months before actual plowing begins. The organic manure improves the structure and water holding capacity of the soil. None of the interviewed farmers had used commercial fertilizers or other external agricultural inputs to maintain the productivity of *P. edulis*.

Planting of the seed tubers takes place from March to April and farmers planted the tubers early enough within these months to take advantage of available moisture following the occurrence of brief rains. Farmers indicated that tubers grow in furrows and that they did not follow any planting considerations like spacing or seed rates. *P. edulis* was often grown in home gardens next to other crops that were grown for daily uses. Likewise, farmers preferred to plant tubers in pieces rather than whole tubers. Depending on the size of the tuber, they divided a single tuber into pieces and planted all the tuber pieces in one hill. Using tuber pieces allegedly enables an increase in tuber yield. This observation was in line with the findings of Mulugeta *et al*. (2007).

Most farmers (71%) reported that they carry out weeding activities three times, other farmers weed even more often than this. Weeding is done at all stages of crop development, and hand weeding is the common practice employed. Farmers practiced tipping once or twice shortly after the second cultivation to increase tuber yield and decrease excessive vertical growth of the plant. Farmers cover emerging stolons with soil between one and three times during the growing season to prevent unwanted growth of vegetative shoots, which will reduce tuber yield. Over 92% of farmers responded that cultivating the crop is laborious.

Farmers in the study areas practice crop rotations, and the yields of crops that immediately follow *P. edulis* in the rotation are high. The yield increments could be due to the slowly released nutrients and improved soil structures from the organic matter applied in previous cropping seasons. *P. edulis* is harvested 6 to 8 months after planting depending on the type of local variety. Farmers reported that the harvesting time stretches from September to November. Bulk harvesting can be done but in the study area farmers harvest the crop when needed. The process involves completely pulling up or digging out the plants. The tubers are long, brittle and finger like and are easily broken. Farmers reported that *P. edulis* is rarely attacked by disease and pests compared to other root crop species grown in the study area.

The major share of cultivation activities are performed by male farmers, who were responsible for tuber selection obtaining good quality planting materials, management, and storage. Female farmers in the study area also play important roles in selecting tubers for a range of end-use criteria related to the household food requirements. These include palatability, taste and cooking time. This result supports Friis-Hansen and Sthapit (2000) findings that there is a clear gender difference in management of plant genetic resources at the local scale with respect to conservation and use.

Distribution and characteristics of local varieties

The extent and distribution of local varieties was influenced by each farmer's decisions, and also dependent on the uses of each local variety. The study revealed that the types of local varieties maintained by different farmers in farming communities were quite different. In the past farmers grew a range of local varieties. Now, however, they mainly depended on three local varieties that they think will best meet their needs. This is in line with the findings of Almekinders and Louwaars (2008) that maintenance of local varieties is a dynamic process affected by farmer's selection pressure. Brush (1992) reported that households are the primary management unit for selection of varieties and maintaining diversity.

The distinguishing characteristics used by farmers to identify local varieties were growth habit (erect to open), tuber skin color, taste, maturity days, drought tolerance, storage period and marketability (Table 1). In the present study, six local varieties that have been selected by farmers were documented in all the study sites. Among these, three varieties, **chenkuwa**, **lofuwa** and **unnuka** were common and widely distributed. The dominance of these varieties was found to be associated with specific qualities attached to each. For instance, **chenkuwa** was highly valued for its good taste, long shelf life and drought tolerance. Negri (2003) also reported that landraces are maintained because of their peculiar or better taste. On the other hand, **lofuwa** and **unnuka** are early maturing

Table 1. Descriptions of local Ethiopian potato (*Plectranthus edulis* (Vatke) Agnew) varieties by farmers in Sodo Zuria district, South Ethiopia. Poor, Intermediate, Good, Very Good.

Characters	Local varieties		
	Lofuwa	Unnuka	Chenkuwa
Drought tolerant	poor	good	v good
Maturity	early	interm	late
Taste	good	interm	v good
Disease resistant	good	good	good
Tuber yield	good	good	interm
Tuber size	big	interm	small
Tuber color	cream	white	red-purple
Plant height	tall	short	interm
Shelf life	poor	interm	v good
Marketability	seasonal	seasonal	all times

types and give relatively better yield. In addition to other factors mentioned earlier productivity, household requirements (time needed for cooking, good appearance, taste and smell) and market demand were identified as the main selection criteria used by farmers.

Seed system and tuber storage

Farmers in developing countries save their own seed or obtain seed from relatives, neighbors or local markets. This practice is an important traditional practice of farmers that ensures on-farm conservation of local varieties (Sthapit *et al*. 2008). Diffusion of local varieties and seed exchange play important roles in farmers' conservation of agrobiodiversity. Linkage between formal and informal seed systems also contributes to conservation and utilization of local varieties (de Boef 2008). Our own study also revealed that farmers in Sodo Zuria district either save their own planting material or they obtain seed tubers from markets, neighbors, and/or relatives. However, we also found that while farmers reported getting seed tubers free of charge from closely related farmers in the past, today due to the decline in crop production, it was very difficult to get seed tubers from relatives.

Younger farmers mostly depended on the market as a source of seed tubers, whereas older farmers (>51 years) used their own saved seed tubers (Figure 2). A similar result has been reported by Negri (2003) that younger farmers prefer to buy seeds from markets than reproduce them. Middle aged farmers (35 to 51 years) were more or less equally dependent on different seed tuber sources. Age, gender, ethnic group and wealth status of farmers have a direct influence on the diversity of on-farm maintained species (FAO 2010). Chi-square analysis showed that there was a significant relationship between tuber source and age of farmers (X^2 = 15.81, Df =6, P<0.05). Most farmers (81%) who did not have enough land used tubers from other informal seed sources than those that they had saved. Balemie (2011) has also reported similar observations.

It was also observed that a wide knowledge gap existed between young and old respondents about the cultural value of the crop. Mostly, members of the young generation had limited knowledge. This was probably due to lack of documentation of knowledge related to the management of the crop that would then be learned more formally by the young. These knowledge gaps may lead to discontinued cultivation of some of the local varieties.

During the study, farmers reported that seed tuber storage is one of the major challenges of *P. edulis* production. The tuber was maintained *in situ* in the field where it was produced until the predetermined objective was met. In this traditional storage method losses due to excessive heat were significant especially during dry spells. Moreover, in this storage method, the land used for growing the crop remains idle until the next planting season. For poor farmers this was difficult to afford since they derived all of their basic needs from their small plots of land. As a result, they often prefer to consume the produce, and will look for seed tubers from other sources during planting season.

In order to protect the tubers from direct sunlight and keep them safe until the next planting seasons farmers covered the fields with available mulching materials. Around March, when the land is ready for planting, the tubers are normally collected from the fields and transferred to the pits

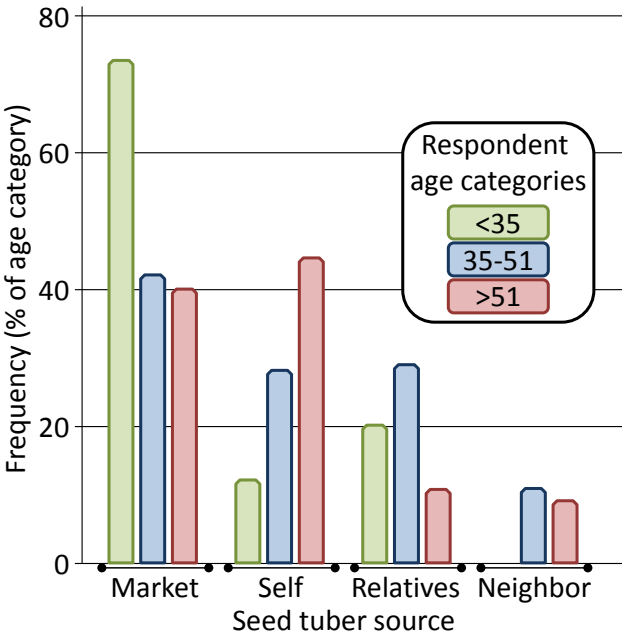

Figure 2. Frequency of Ethiopian potato (*Plectranthus edulis* (Vatke) Agnew) seed tuber sources by 3 age categories in Sodo Zuria district, South Ethiopia.

prepared in cooler places. They maintained the tubers in the pits for a day before actual planting. This was seen as an important step used to facilitate the germination and performance of seedlings in the fields after planting. Key informants also pointed out during group discussions that those farmers who have enough land served as sources of seed tubers during planting. These farmers often produced more than the requirement of their household and saved the surplus to sell during planting. As such, these farmers played greater roles in conserving local varieties.

Use values

P. edulis has a long history of local usage, and is important to the cultural, social and economic life of households (Demissie 1988). It is particularly important in local diets mainly between September and November since other food crops will not be ready for consumption. The primary product of *P. edulis* is the tubers, and these are boiled in their skins and eaten with **dataa**, a traditional stew prepared from a mixture of *Capsicum* spp. and other spices. According to the respondent farmers, *P. edulis* is the most preferred food and often served to esteemed guests. It is traditionally recommended as a special food in the community for people who are recovering from illness, probably owing to its high digestibility. It is also reported that it has no impact on the stomach whatever amount is consumed. A study carried out by EHNRI (1997) (Table 2) on the nutritional content of 100 gm edible portions of both raw and cooked tubers of *P. edulis* showed that it has ample amounts of micro- and macro-nutrients. While it has relatively higher food energy when cooked than *S. tuberosum*, and the fat and calcium contents are almost twice as high as that of *S. tuberosum*. The protein content is similar to that of *S. tuberosum* and is almost twice as high as that of *I. batatas* when cooked. The study also revealed that the cooked tubers have more energy, fiber and carbohydrate compared to the raw tuber.

Brush (1995) reported that farmers maintain local crop populations for cultural uses. The present study also indicated that the *P. edulis* is eaten during Meskel Holiday, a popular religious holiday in Ethiopia, as one component of the diversified dishes prepared for celebration. Farmers also reported that they have local sayings which link the cultivation of *P. edulis* with this popular religious holiday: **Maskala shukkadii**? **Donuwa tokkadii**? Translated as: Have you slaughtered for Meskel Holiday? Have you grown *P. edulis*? This is because, as a tradition, people start to eat *P. edulis* shortly after the end of this religious holiday. The saying is transferred orally from generation to generation.

The dried stems of *P. edulis* are also used as firewood whenever there is shortage. Most farmers reported that *P. edulis* contributes less to household food security as compared to other root crops such as *S. tuberosum* and *I. batatas*. This is mainly attributed to its short shelf life. From the observations made in this study, *P. edulis* is seen to play an important role in filling a gap during times of food shortage.

Threats and conservation status

The study conducted by Kassa and Manig (2004) indicated that reduction in average land holding per household is

Table 2. Nutritional content (per 100gm of edible portion) of *Plectranthus edulis* (Vatke) Agnew, *Solanum tuberosum* L. and *Ipomoea batatas* (L.) Lam tubers in Ethiopia. (Source EHNRI 1997)

Composition	*Plectranthus edulis*		*Solanum tuberosum*		*Ipomoea batatas*	
	Raw	Cooked	Raw	Cooked	Raw	Cooked
Food energy (calories)	69.00	100.60	103.7	89.70	136.00	134.20
Moisture (%)	81.90	73.80	73.10	76.80	67.40	65.60
Nitrogen (grams)	0.30	0.24	0.30	0.26	0.30	0.13
Protein (grams)	1.50	1.00	1.30	1.10	1.30	0.50
Fat (grams)	0.20	0.20	0.10	0.10	2.00	0.20
Carbohydrate (incl. fiber) (grams)	15.30	23.70	24.40	21.10	28.20	32.60
Fiber (grams)	0.70	1.00	1.40	0.90	1.10	1.50
Ash (grams)	1.10	1.30	1.10	0.90	1.10	1.10
Calcium (milligrams)	29.00	19.00	14.00	9.00	52.00	35.00
Phosphorous (milligrams)	90.00	62.00	57.00	49.00	34.00	54.00
Iron (milligrams)	9.30	1.10	2.30	1.50	3.40	0.90
Thiamin (milligrams)	-	0.11	0.08	0.05	0.08	0.06
Riboflavin (milligrams)	-	0.32	0.08	0.09	0.05	0.01
Niacin (milligrams)	0.70	0.30	1.00	0.80	0.90	0.40

the result of increased farm population. The present study has supported this observation. Increasing population has resulted in redistribution of land among new household members. As a result of decreasing size of land holdings, farmers have chosen to cultivate crop species that generate better income in short periods of time. Further, the number of local varieties cultivated has decreased significantly. Long maturation periods, shortages of seed tubers, short storage periods, laborious production techniques, and prolonged drought have all contributed to the loss and/or local extinction of some varieties including **keytaria** and **merchia** (Table 3).

Table 3. Reasons given for loss of local Ethiopian potato (*Plectranthus edulis* (Vatke) Agnew) varieties by farmers in Sodo Zuria district, South Ethiopia. Rank indicates the relative contribution of reason for the loss of local varieties.

Reasons for the loss of local varieties	Informant responses		
	Number	Percent	Rank
Land scarcity	39	20.2	1
Late maturity	39	20.2	
Displacement by other species	31	16.1	2
Shortage of seed tuber	29	15.0	3
Short shelf life	24	12.4	4
Laborious production techniques	20	10.4	5
Drought	11	5.7	6
Total	193	100	

Conclusions

P. edulis is important in local diets, and cultural, and socioeconomic life of the people in the study area. Farmers maintain different local varieties on small plots of land as an adaptation strategy for meeting various needs. Maintaining the knowledge of the available diversity is, therefore, essential for effective management and use of the crop. Further assessments of the conservation status and vulnerability of local varieties of the crop, and indeed their within cultivar diversity, need to be conducted. Therefore, action is required now to conserve local varieties both *in situ* and *ex situ*. Selection and breeding efforts should focus on local varieties with preferred traits important for growers.

The traditional seed supply system is the only means of seed supply in the study area. Like other crops, to maintain the diversity of the crop, alternative sources for seed tuber supply need to be explored. Socioeconomic research should be carried out in all *P. edulis* growing areas of the country to study different aspects, uses and management of the crop by different ethnic groups. This will also enrich the understanding of production and use trends, and other major constraints associated with the crop. Documentation links indigenous practices with modern knowledge that will enable development of useful strategies to conserve local varieties.

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