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Distribution, Diversity and Potential Production of Yams (*Dioscorea* spp.) in Sheko District, Southwest Ethiopia

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Abstract: Yams are the Dioscoreaceae vine plants grown as staple food in tropical and sub-tropical regions that produce underground tubers or aerial bulbs. This researchwas developed with objective of assessing the distribution, diversity and potential production of yams (*Dioscorea* spp.) in sheko district, Bench Maji Zone, Ethiopia. A total of 147 informants were selected from six Kebeles using purposive and random sampling method. Reliable data were collected from households using semi-structured questionnaires, focus group discussions and field observations which were analyzed by using Microsoft excel and descriptive statistics. A total of 3 different types of yam species (*Dioscorea abyssinica, Dioscorea alata* and *Dioscorea bulbifera*) were recorded from Sheko district. Yams were identified as a main staple food for the Sheko people. Four well adopted varieties selected by indigenous farmers of Sheko district were identified; among white yam is most preferred one due to its taste and high yield performance. The findings of the study revealed that most of the farmers (96.8%) highly practicing intercropping whereas few farmers (3.2%) practice monoculture mode of cultivation. Farmers' indigenous experience on production of yam crops in almost all representative kebeles of the District was observed to be tremendous. Therefore, indigenous knowledge of farmers must be valued and supported by research to analyze the productive variety and further improved production and post harvest technology should be introduced.

Keywords: Distribution, Indigenous Knowledge, Production, Yams

1. Introduction

Yams (*Dioscorea* spp.) are the Dioscoreaceae vine plants grown and staple food in tropical and sub-tropical regions that produce underground or aerial tubers [9]. Yams are edible energy-rich tuber crops developed from modified and thickened underground stems storage organs which they are bulky, perishable, and vegetatively propagated by the tuber [21, 5]. Among different type of root and tuber crops, yarms (*Dioscorea* spp.) are the common usable staple food, livestock feed, or as raw materials for the production of different industrial products [22, 3].

Yams are monocot seems to have an African origin [1].The genus *Dioscorea*is the largest of the ten genera of Dioscoreaceae and it contains about 600 varieties species and 95 percent of these crops are grown in Africa [12]. Yams have a relatively narrower range of production, being mainly confined to the tropical region throughout the world from sea level to 1,400 meters. The main production of yam is in the savannah region of West Africa, where more than 90% of the crop is grown. Unlike the other root and tuber crops the white and yellow yam (*Dioscorea rotundata* and *Dioscorea cayenensis [esculenta],* respectively) are thought to be indigenous to West Africa, whereas the water yam (*Dioscorea alata*) is thought to have originated in Southeast Asia [20, 14, 13].Yam is a deeply rooted, climbing, dioecious perennial vine with distinctly veined cordate (heart-shaped) leaves. The tubers are coarse, dry to mealy, tender, crisp, and too mushy and are equivalent in food value to the potato. It is a tropical plant that adapted to 70–80°F and requires high

rainfall but can withstand more drought than cassava and is usually grown on trellises [18]. Yam crop begins when whole seed tubers or tuber portions are planted into mounds or ridges, at the beginning of the rainy season. The crop yield depends on how and where the sets are planted, sizes of mounds, interplant spacing, provision of stakes for the resultant plants, yam species, and tuber sizes desired at harvest [15, 15, 2].

Yam (*Dioscorea* spp.) is widely grown in many parts of Ethiopia particularly in southern and southwest parts of the country and plays a vital role in local subsistence in the region. It serve as a 'life saving' plant group for the marginal farming and forest dwelling communities, during periods of food scarcity [1]. True yams are ubiquitous lowland tropical food plants [10]; and are a staple foodstuff and also important as a secondary (famine) food. Yam is an attractive crop in poor farms with limited resources. Yam is also available all year round making it preferable to other unreliable seasonal crops. These characteristics make yam a preferred food and a culturally important food security crop in some sub-Saharan African countries [12].

Therefore, this research was carried out looking into those aspects and triesto come up with some solutions and recommendations which could lead to sustained management of these crops, efficient utilization of tuber varieties as well asits products in industries and to identify constraints and opportunities associated with cultural cultivation and utilization of the crops, which may be crucial for future interventions, promotion of the potential utilities and enhancing its adoption in areas with similar environmental settings. The main objective of the study was to explore distribution, diversity and potential production of Yams by the farmers in Sheko district, Bench Maji Zone.

2. Material and Methods

2.1. Description of the Study Area

Sheko district is located at about 583Km in Bench Maji Zone, South Nations Nationalities and Peoples Regional State, Southwest of Ethiopia from Addis Ababa. The study area is mountainous with green vegetation which has high average temperature and receives high amounts of rainfall with an average of 1800–2200 mm annually for more than seven months. The annual temperature of this region was reported to range from 20-25°C. It lies within 07° 00' - 07° 30'N and 035° 15' - 035° 45'E. The topography of the area comprises different land features

2.2. Sampling Procedures

The ethnobotanical data collection of yam crops and its potential production in Sheko district were employed by using two types sampling technique. These were purposive sampling method used to select the representative study sites with respect to the potential of yam crops productions and hence, a total of six kebeles were selected. These were done with the zonal and woreda Agriculture and Rural Development Office guidance. The other method was random sampling which was employed to select the respondent from the selected kebeles and hence, a total of 147 sample size/ households/farmers were selected based on the proportion and applying the formula provided by Yamane [23].

2.3. Data Collection Procedures and Analysis

During the survey, information regarding farmers' knowledge and practices related to Yam production were collected using semi-structured questionnaires that allowed data to gather in the farmers' cultural context. Besides, key-informants who were anticipated to have a particular insight or opinion about the subject under investigation were interviewed. Focus Group Discussions (FGDs) were done by using key informants/elder farmers who had indigenous knowledge for identification and reconcile contradictory information among informants. Accordingly, discussions were taken in groups consisting of eight people in the selected Kebele. Lastly, field observation was performed during the study with the help of field assistances. During field observation, the morphological characters of the crop; size, shape and color of tuber, leaf and stem were observed and captured with photograph. The field observation was used to distinguish yam specious and/ varieties based on morphological characters. In this regard, the sample plants were collected and identified properly. The collected data was analyzed and summarized using Microsoft excels and descriptive statistics were presented in tables and charts.

3. Result and Discussion

3.1. General Characteristics of Respondents

Analyses of information collated from respondents of the district with respect to their age, sex, educational, economy, household size and marital status is indicated in (Table 1). In the present study number of respondents in terms of gender is not proportional. Although efforts were made to account for gender representation, the actual random sampling resulted in only 21 female headed households (14.28%) from the 147 sample producers (Table 1). The age category 41–50 (29.25%) followed by 31-40 (23.81%) and 51-60 (21.09%) had the highest number of respondents that participated in the study. Conversely, the age group > 60 was represented by the lowest number of respondents (Table 1). The result of the present investigation showed that elders were more knowledgeable and possession of traditional knowledge on identifying and selecting good varieties of yams to produce consistence products of the root and tuber crops because of their many years accumulated experiences by trial and error through generation. Regarding the educational background of respondents, majority (34.69%) were first cycle while second cycle primary (31.97%) and illiterate (23.81%). Although most of the participants were first cycle which coincided mainly with age group above 30, they are generally considered as an important repository of traditional

knowledge including the wisdom of cultivating, variety selection and managing root and tuber crops for good product. The family size of most households was 6-8 (51.70%).

Table 1. *Household information of Respondents (n=147).*

Variable	Frequency	Percentage
Age (years)		
20 – 30	25	17.01
31 – 40	35	23.81
41- 50	43	29.25
51-60	31	21.09
> 60	13	8.84
Sex		
Male	126	85.71
Female	21	14.29
Educational status		
Illiterate	35	23.81
First cycle (1-4 grade)	51	34.69
Second cycle (5-8 grade)	47	31.97
Secondary high school (9- 10 grade)	12	8.16
Preparatory (11-12 grade)	2	1.36
Degree and above	-	-
Household size		
1-2	17	11.56
3-5	31	21.09
6-8	76	51.70
9 and above	23	15.65

3.2. Distribution and Abundance of Yams

Yams are one of different types of tropical root and tuber crops which comprised covering several genera and species. They are staple foods in many parts of the tropics, being the source of most of the daily carbohydrate intake for large populations [9, 13]. These carbohydrates are mostly starches found in storage organs, which may be enlarged roots, corms, rhizomes, or tubers. Many types of yams are grown as traditional foods or are adapted to unique ecosystems and are of little importance to world food production [13]. The edible yams (*Dioscorea alata, Dioscorea bulbifera* and *Dioscorea abyssinica*) were important to the agriculture and food security of the in the community of the Sheko district even to other woreda of the Bench Maji Zone and many countries of the world that accounted the overall component of the diet for 2.2 billion people in developing countries [7, 8].Among the finding of yams (*Dioscorea* spp.) in the study woreda, Yam (*Dioscorea abyssinica*) is native to Ethiopia whereas the rest two are non-native (exotic) come from elsewhere (i.e. *Dioscorea alata* and *Dioscorea bulbifera*) (Figure 1). This result also was stated by Mekbib and Deressa [16] in similar manner. Development of the tuber crop is important in the study area because they met local food preferences, providing an important part of the diet as they produce more edible energy per hectare per day than any other crop groups which play an important role in food security, nutrition and climate change adaptation. Among these yams was predominantly produced in almost all kebeles of the woreda because most of the local people within household used it for their staple food purposes. Of course, there was slight variation on distribution and abundance of yams (*Dioscorea* spp.) along the kebeles due to the cultivate comparably taro as stable food which was highly distributed and practiced by sheko people.

a. Aerial yam (*Dioscorea bulbifera*) tuber b. Underground yam (*Dioscorea alata)* plant

Figure 1. *Representative type of Dioscorea spp. in the study area.*

3.3. Common Local Varieties of Yam (Dioscorea spp.)

The total numbers of yam species recorded from the Sheko district were three: these were *Dioscorea abyssinica*, *Dioscorea alata* and *Dioscorea bulbifera* common (Figure 1). Based on the cultivation that the yams gives tuber, it can be classified in to; (1) The Underground Yams (locally called Kechi (Bori) which include *Dioscorea abyssinica*, *Dioscorea alata* were abundantly cultivated as main staple food. These yams have two types in terms of varieties include white yams which are most sweet and preferable by farmers for consumption purpose and the other types were black yams which were less tasty. And (2) the Aerial Yams (Wokay or Harekote) meant the tuber is resemble with kidney or heart or foot of horse. On the other hand, these yams were identified based on the existence of variety selected by the community of Sheko district and the main parameter used by farmers' adopted different varieties. These were the resistance to pest and disease, size of tuber, number of tuber per plant, taste of tuber, color of tuber, maturation period and etc.

Hence, prominently four types of varieties were recorded that encompasses like Bori kechi (white kechi), Dissu kechi (black kechi), Body kechi and Torbekechi (Figure 2). There is a distinct difference in between the local varieties of yams that make a variation in cultivation of local people preference with the taste, maturation time, size of tuber and the likes.

Figure 2. *Varieties (landraces) of Dioscorea species production in Sheko district, Boyita kebele.*

3.4. Production of Yams

Yams are grown widely throughout tropical regions around the world and are a staple food for millions people [4, 3, 5]. It is assumed to be the fourth most important tuber crop in the world next to potato, cassava and sweet potato [21, 6]. These crops can be grown at most any time of the year so long as temperature does not freeze. And be very careful about spearing them or breaking them when digging the longer tubers. Store tuber in low light and cool temperatures where they can last up to several months. Despite a growing reliance on distribution and adaptability in the southwest Ethiopia particularly Sheko district of Bench Maji zone,

Yams were remained critically important components of many people's diet, particularly for the large rural populations that still prevails food insecurity. The main source of planting materials that the farmers used to cultivate yams were from previously harvesting crops (36.39%) and followed by obtaining neighbors or friends (30.28%), buy from market (24.29%) and get from agricultural office of the Woreda (9.04%)(Figure 3). As the respondent mentioned, the source of planting material of root and tuber crops were obtained from the agricultural office of Woreda and zone is very less attention had been given for good varieties selective and diseases resistivity and enhance the production. This result was similar with the finding of Mekbib and Deressa [16] depicted in his study conducted on exploration and collection of root and tuber crops in East Wollega and Ilu Ababora Zones: recruiting declining genetic resources.

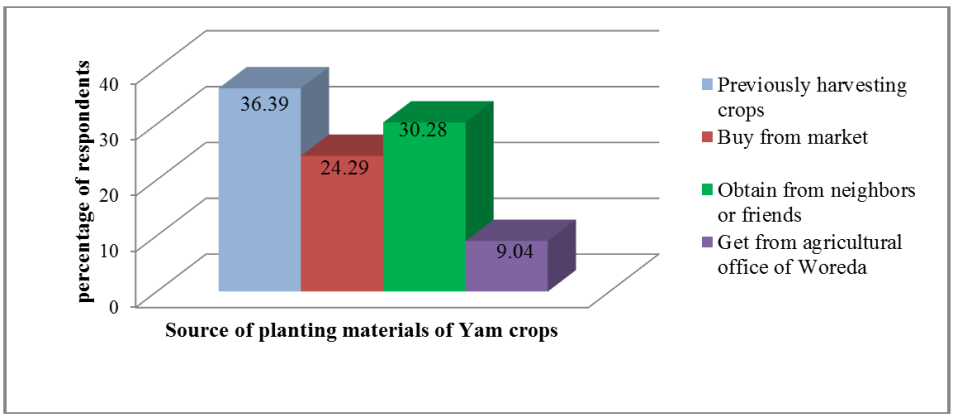

Figure 3. *Source of planting materials of yams in the study area.*

The findings of the study revealed that most of the farmers (96.8%) highly practicing intercropping whereas few farmers (3.2%) practice monoculture mode of cultivation (Figure 4). Farmers practiced intercropping farming system of yam crops with other grains (maize, etc.) or vegetables (like Cabbage) since such crops mature fast especially the space in

between the two plots (lines) where yam planted along the line to enhance the productive of tuber due to the remains of these crops in the farmland or home garden. However, farmers have articulated in the group discussion that, the crop grow better in the absence of shade and if there are other plants around it, it does not give a good yields and its tuber may be affected during harvesting of other nearby crops. During FGD, almost all informants convey that staking is an important practice and without staking no yams production possible practice, because yams are climber plant. Staking is supporting the yams vines so that they can grow upright. However, almost all informants argue that shortage of staking material is constraint of yam production in the area. Based on the season and agro-ecology of the environment, the productivity, maturity and type of cultivation of yams strictly varies accordingly [6, 19, 16].

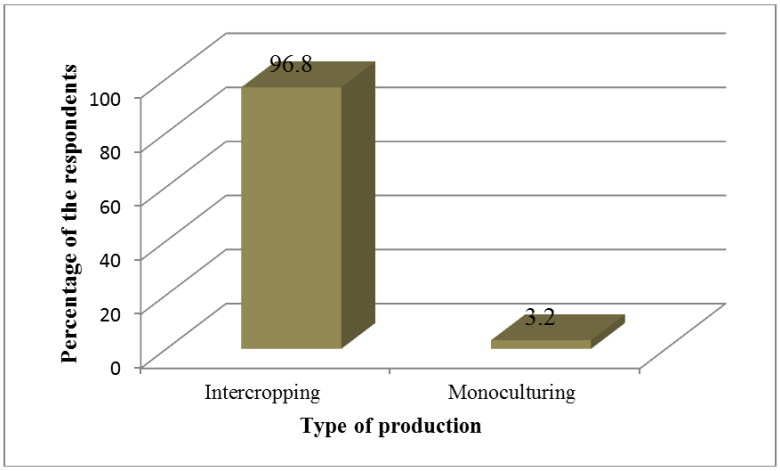

Figure 4. *Type of yam crop cultivations in the study area.*

The use of indigenous knowledge in propagation, transplanting, intercropping, harvesting/ processing, protection from pests and diseases are valuable. Farmers cannot travel long distances and buy expensive exotic technologies for their small patches of farms. It is worthy to note that the yam crops occupy a strategic position among cultivated crops and the positions they occupy vary in the different agro-ecological zones in the study area. The crop is the leading the staple food that solves the problem of food insecurity in Sheko district. Based on the local farmers' indigenous experience on production of yam crops, it was tremendous in almost all representative kebeles of the District though they lost wise management system and surplus production of the crops. Yam spp. was propagated in different manner among the farmers of the representative kebeles. Farmers in Sheko cultivated this crop in their farmland reserving a few of the mature tubers, using small whole tuber or commonly by cutting/setts, curried for about two days. The greater the weight of the setts used to establish a yam plant the greater the weight of the yam to be produced by the plant, however farmers in Sheko generally cut tuber in to four sets to economize planting material. The other ways of propagation in case of *Dioscorea bulbifera*, the whole bulbils are used as planting material. Then the sets planted in well prepared ridge in 0.6 m between plant and 1.5-2m between row intervals. In Sheko rain lasts more than eight months which is ideal environment for yam production where planting normally take place in November/December.

3.5. Harvesting and Post Harvest Practices of Yams

The farmers use different indicators to check whether each variety of yams is matured or not [17]. The maturity, harvesting time and storage place were different from place to place and various types of root and tuber crops in the study area that cultivated by local farmers. As yams matured, it produces flowers. The color of leaves also changes from green to yellow color. The farmers must wait more than seven months to get the first products or tuber. Farmers also dig the soil around the plant and check whether the tuber matured or not. A matured tuber produce hair like structures and its size is also bigger and become large. After the tuber matured, the farmer harvest immediately that used for planting materials and food. Most of the harvesting time was June after seven months of planting. The local farmers of the study area used their indigenous knowledge to harvest and store the tuber crops. Yams mature between six and nine months after sowing, though some yams need more time to be ready. But in the case of aerial yam reach for harvesting within 3 to 4 months after planting. The leaves age, turn yellow and die five to six months after planning. This is followed by the drying and death of vines. Most of the farmers use ground or field storage, meaning left in the ground to grow, for varying lengths of time until they are needed for eating or/and propagation purposes as planting material for the next propagation seasons or for sale purposes as deterioration is usually not rapid.

Two general practises exist in yam production in Sheko district; each plant in the field can be harvested twice. This practice is called double harvesting, in this case the tuber is carefully cut below the head and removed, leaving the top to grow again and produce another tuber, or tubers. The other is plant in field is harvested only once, this practice is called single harvesting.When field storage is not practicable, there

are some traditional methods of storage mechanism that can be used to extend the shelf life of tuber crops [9]. Although different ways of storing methods are pertained throughout the world, the most commonly applied method in the study area by the local farmers were: leave it in the soil until the next planting season reach accounts (30.74%) and followed by the method storing in sack at home (27.14%) and shelf in the house (22.35%) (Figure 5). These methods that the locale farmers practiced for a century were determined by the types and agro-ecological condition of the environment.

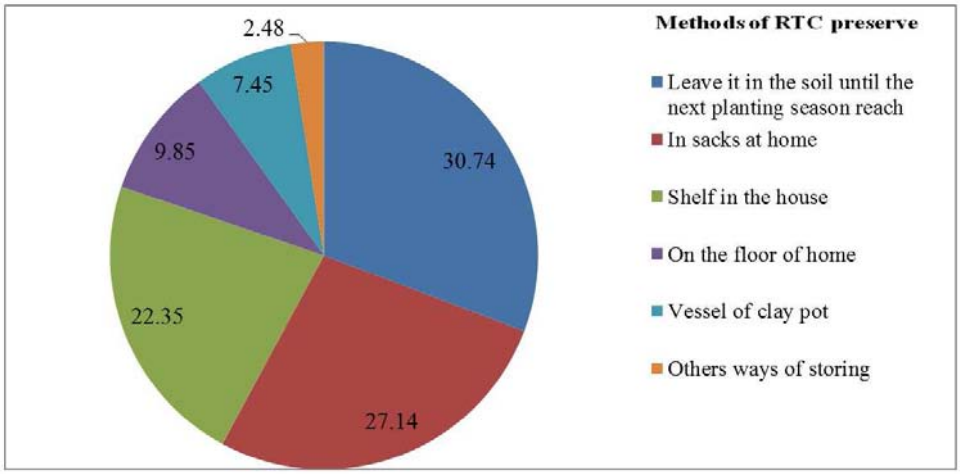

Figure 5. *Farmers store the product of yam tuber for extending shelf life.*

Yams are grown for their modified, thickened root or stem which generally develop underground and few are above ground (aerial tubers for example *Dioscorea bulbifera*). These organs are rich in carbohydrate and are commonly used as staple food, livestock feed, or as raw materials for the production of industrial products. Farmers were stored the yams for the task of staple food and planting materials for the next season. Although the shelf-life of yam varied accordingly, the products lost frequently observed [11]: (1) Physical losses of the dried commodity (tubers) as the extended it beyond the shelf-life of it; (2) There are financial losses when handling older fresh roots and tuber, as there is price discounting in anticipation of physical losses. Discounts can be as high percentage for the tuber crops. (3) Losses due to change in use. For example if harvest fresh roots and tuber crops could not be marketed within three days of harvest or few exceed they may be processed into dried products of lower value. (4) Lost potential because of failure to harvest at the optimum time. The harvesting time of each root and tuber crop was fixed as it matured. If it is flexible, there was a loss in potential earnings if the timing is not optimal. (5) The value of dried tuber was related to its quality, so poor qualities represent a loss of income.

Yams (*Dioscorea* spp.) are an important root crop in the study area. White yams, in particular, are considered a prestigious food and are preferred to other foods by urban populations. However, the harvested crop is easily bruised during storage and transportation, which reduces yields and income. Careful handling using appropriate tools for lifting the tubers is advocated and partially damaged tubers may be chipped and dried or used immediately. Traditional storage structures include pits, trench silos, and heaps in the field but these are difficult to manage i.e. to prevent pest attack and provide regular inspection of tubers [7]. Beetles (insect) have been revealed to be the predominant cause of storage damage with further spoilage occurring from moisture in the study area. A raised hut with storage shelves made of locally available materials provides good ventilation and good access for inspecting tubers. During long storage, yam tubers loose moisture and shrivel but covering the tubers with yam vines, straw or other similar plant material may reduce this.

4. Conclusion and Recommendation

This study was significant to assess the distribution, diversity and potential production in Sheko district, Benchi Maji Zone. Based on the finding obtained, there was three different type of yam species (*Dioscorea abyssinica, Dioscorea alata* and *Dioscorea bulbifera*) were recorded with four varieties (dissu kechi, beri kechi, torbe kechi and boddy kechi) that the farmer adopted for a number of generations using their indigenous knowledge. The farmers produce white yam varieties abundantly which has good taste and productive and with better market value. The most commonly applied method of storage method to extend shelf life of the tuber practiced by the local farmers in the study area were leaving the tuber in the soil and in the sack and on floor. And also farmers used different mechanisms to protect the tuber from damaging by different constraints. Therefore, indigenous knowledge of farmers must be valued and supported by research to analyze the productive variety and further improved production and post harvest technology should be introduced.

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