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Importance and practices of Egusi crops (*Citrullus lanatus* (Thunb.) Matsum. & Nakai, *Cucumeropsis mannii* Naudin and *Lagenaria siceraria* (Molina) Standl. cv. ‘ Aklamkpa ’) in sociolinguistic areas in Benin

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African traditional vegetables are perceived as potentially useful for income generation and food security insurance. However, Egusi crops (*Citrullus lanatus* subsp. *mucosospermus*, *Cucumeropsis mannii* and *Lagenaria siceraria* cv. ‘ Aklamkpa ’) have been overlooked for relatively long time by research and development organizations while they persist in the farming systems of many regions in West Africa. This paper pinpoints the social importance of Egusi crops and their place in the cropping systems in sociolinguistic groups in Benin. In 2005, a countrywide household survey in Benin on farming systems and cropping practices of Egusi crops across five major sociolinguistic groups show that Egusi is ranked among the top ten crops. This ranking is gender-specific but is not age-specific. Farmers allocated on average 0.74 ha for Egusi production with a significant difference across communities. In the Mahi-fon community in central Benin for instance farm size could reach 5 ha. The most cultivated species is *C. lanatus* subsp. *mucosospermus*. However, in the Adja community the farmers’ preference is for *L. siceraria* cv. ‘ Aklamkpa ’. Egusi species are cultivated in plain field or in home gardens, either in monoculture or in association with other crops. *C. mannii* is mostly intercropped and plays a social and culinary role in Nagot-Yoruba community. Although Egusi is not a specific woman crop, women carry out the post-harvest activities for value adding. Utilizations of Egusi crops are different from one sociolinguistic group to another and could represent a plinth on which a sustainable valuation of Egusi crops could be developed.
Keywords. Benin, cultural practices, Egusi crops, gender, sociolinguistic groups.

Importance et culture de Egusi (*Citrullus lanatus* (Thunb.) Matsum. & Nakai, *Cucumeropsis mannii* Naudin et *Lagenaria siceraria* (Molina) Standl. cv ‘ Aklamkpa ’) dans les régions sociolinguistiques du Bénin. Les légumes traditionnels africains sont considérés comme potentiellement utiles pour contribuer à la sécurité alimentaire et à la génération de revenu au niveau des communautés locales. Cependant, Egusi (*Citrullus lanatus* subsp. *mucosospermus*, *Cucumeropsis mannii* et *Lagenaria siceraria* cv. ‘ Aklamkpa ’) a rarement fait l’objet de recherche et de promotion alors que sa culture persiste dans les systèmes de production de plusieurs pays de l’Afrique de l’Ouest. Cette étude met l’accent sur le rôle social des cultures de Egusi et leur importance dans le système de production des groupes sociolinguistiques au Bénin. En 2005, une investigation des systèmes de production et de culture de cinq régions socioculturelles prédominantes indique que la culture de Egusi est classée parmi les dix premières spéculations, selon la perception des ménages interrogés. Le rang attribué aux cultures de Egusi est relatif au genre mais pas à l’âge. Les agriculteurs allouent en moyenne 0,74 ha pour la production de Egusi, avec une différence significative d’une région sociolinguistique à une autre. Dans la communauté Mahi-Fon du centre Bénin, par exemple, nous avons observé des champs de production de Egusi allant jusqu’à 5 ha. L’espèce la plus cultivée est *C. lanatus* subsp. *mucosospermus*. Cependant, dans la communauté Adja du sud Bénin, la préférence des agriculteurs est pour *L. siceraria* cv. ‘ Aklamkpa ’. Egusi se cultive au champ et en jardin de case, soit en association ou en monoculture. *C. mannii* est généralement cultivée en association et joue un rôle social très important dans les communautés Nagot-Yoruba. Bien que Egusi ne soit pas une culture réservée aux femmes, ces dernières réalisent la plupart des activités post-récolte. Les utilisations associées à la culture de Egusi varient d’un groupe sociolinguistique à un autre et constituent une base essentielle de promotion de la culture.
Mots-clés. Bénin, pratiques culturales, Egusi, genre, groupes sociolinguistiques.

1. INTRODUCTION

The erosion of traditional knowledge jeopardizes local agrobiodiversity (Baco et al., 2007). In a changing economic environment, awareness about the erosion of traditional knowledge linked to local crops is low. According to Shackleton et al. (2002) a persuasive way to draw attention on local crops is to place a value on these resources that emphasizes their contribution to people's livelihood. The private value that farmers assign to crops may then help identify strategies for ensuring the promotion and the sustainable production of crops resources with minimal cost (Brush et al., 1998). The private value of crops in the changing agricultural system of many developing countries is therefore suggested by their persistence in the farming system where alternative cash crops dominate (Mertz, 2005). With the development of cash crops in emerging communities, traditional crops are usually confined to marginal plots with lower soil fertility or are reduced in terms of cultivated area. This situation happens whilst farmers face difficulties in transmitting knowledge to the young generations who are rather oriented towards off-farm activities (Meagher, 1997).

Conserving and sustaining community's knowledge and know-how require thorough documentation and promotion. To date, very few studies focused on the importance of traditional practices related to African vegetables such as Egusi crops. In West Africa where the crops are cultivated (van der Vossen et al., 2004) information lack on the cultural background that contributes to maintain the traditional Egusi farming system. Even, research on farmers' knowledge and their use of different Egusi species are rather scarce in the region (Burkill, 1985; Norman, 1992; Schippers, 2004; Achigan-Dako et al., 2006). Egusi (in Yoruba) or Agushi (in Hausa) is a group of cucurbit species that produce protein and oil rich seeds for which the crop is mainly grown. They consist of species such as *Citrullus lanatus* (Thunb.) Matsum. & Nakai subsp. *mucosospermus* (Fursa, 1972), known as Egusi watermelon (van der Vossen et al., 2004); *Cucumeropsis mannii* Naudin (syn. *Cucumeropsis edulis* (Hook.f.) Cogn.), said to be the true Egusi (Burkill, 1985), and *Lagenaria siceraria* (Molina) Standl., known as the bottle gourd but which encompasses non-hard-coat varieties like ' Aklamkpa ' or ' Accra-kakoun ' also used as Egusi (Achigan-Dako et al., 2006; 2008).

The major impetus to consider Egusi crops comes from a persistent recognition that these crops play collectively vital roles in the farming systems and in the well-being of West African rural dwellers as recognized by Zoro Bi et al. (2003) in Côte d'Ivoire, Norman (1992) in Ghana and Achigan-Dako et al. (2006) in Benin. People in West Africa consume in many ways the seeds of those crops. " They are prepared for consumption by parching and pounding to free the seed-coat from the kernel which can be eaten either raw or cooked, or more usually when ground to a powder it is added to soups and stews " (Burkill, 1985 p. 577). The importance of Egusi crops has also been raised under various circumstances by other authors like Schippers (2000; 2004) and Vodouhe et al. (2001) as weed control plants.

This study is carried out at country level in Benin and focuses on the diagnostics on traditional practices of Egusi crops across the major sociolinguistic groups dealing with the crops. Sociocultural and ethnobotanical participatory approaches have been used to collect both qualitative and quantitative data to describe farmers' practices of Egusi crops management. We explored also the links between sociolinguistic groups and Egusi cropping systems and the uses that could provide insights towards sustainability.

2. MATERIAL AND METHODS

2.1. Survey area

The study was carried out in five regions of Benin: south-western, south-eastern, central, north-western and north-eastern regions. The agro-ecological characteristics of each zone are presented in **table 1**. After countrywide preliminary discussions with key-informant farmers and extension service workers, criteria such as presence of Egusi production, sociolinguistic group membership and geographical location were used to select seventeen villages from these regions (**Figure 1**). In the south-western region, known as the Adja-Plateau (the dominant sociolinguistic group is Adja), Dogbo, Toviklin and Lalo were selected. In the south-eastern region populated mostly with Nagot-Yoruba community, Saketé, Adjaouèrè and Pobè were selected. In the central region the district of Glazoué and satellite villages (Aklankpa, Assanté) were visited. The population of this region is made up of the Mahi-Fon group. In the north-west, Koko (Tchaourou), Beterou and Copargo were selected. This region is characterized by several sociolinguistic groups dominated by Yom, Lokpa, Bariba and Nagot. In the north-east we visited Ndali, Nikki and villages such as Sirarou, Bori, Ouenou where the major sociolinguistic group is Bariba.

2.2. Respondents sampling and data collection

Based on focus group discussions during the preliminary survey, a sample of 186 respondents were randomly selected from households of the selected regions, with the condition that they should have produced Egusi crops at least once over the last three years.

Table 1. Agro-ecological characteristics of surveyed regions and sociocultural characteristics of informants — *Descriptif des régions d'étude et des ménages interrogés.*

	South-West (n = 13)	South-East (n = 27)	Central region (n = 56)	North-West (n = 39)	Nord-East (n = 51)
Rainfall structure	Two raining seasons with 1,075 mm per year in Dogbo	Two raining seasons with 1,210 mm per year in Pobe	Two raining seasons with 1,040 mm rainfall per year in Glazoue	One raining season with 1,156 mm per year in Copargo	One raining season with 1,100 mm per year in Nikki
Vegetation type	Guinean Savannah	Semi deciduous forest	Transitional savannah	Sudanian savannah	Sudanian savannah
Main staple crops	Maize, cassava, groundnut	Maize, cassava, cowpea, vegetables	Maize, groundnut, yam, rice	Yam, maize, cassava	Maize, yam, sorghum
Main cash crops	Oil palm tree	Oil palm tree	Cotton, cashew nut	Cotton	Cotton
Dominant sociolinguistic groups	Adja, Ewé	Nagot-Yoruba	Mahi-Fon, Nagot	Yom, Lokpa, Dendi,	Bariba, Peulh
Average household size (N = 186)	14.23 (10.21)	7.41 (3.37)	10.79 (7.34)	7.72 (3.17)	14.45 (11.12)
Average informants age (N = 186)	51.00 (20.38)	45.07 (14.36)	47.04 (15.44)	38.31 (10.25)	40.75 (14.39)
Number of women respondents	4	11	20	20	22

Values in brackets represent standard deviation — *Les valeurs entre parenthèses représentent les écarts-types*; N: total number of informants — *nombre total de ménages interrogés*; n: number of informants per region — *nombre de ménages interrogés par région.*

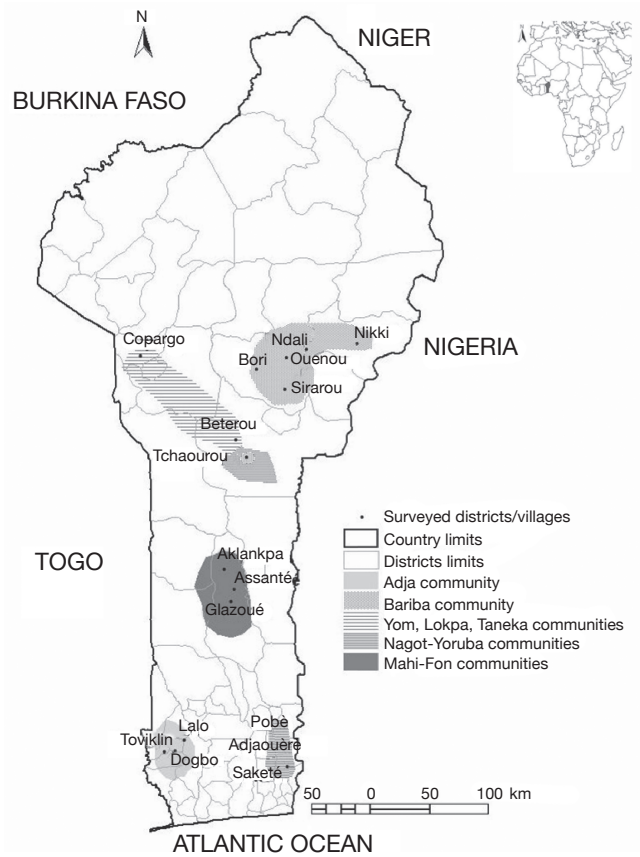

Figure 1. Surveyed sociolinguistic groups in Benin — *Groupes sociolinguistiques interviewés au Bénin.*

Characteristics of respondents are presented in **table 1**. According to the importance of Egusi cultivation, the selected households are split in the regions as follows: 13 in the south-western region, 27 in the south-eastern region, 39 in the north-western region, 51 in the north-eastern region and 56 in the central region.

Data were collected by well-trained assistants through observation, semi-structured interviews, a pile sort and attributes approach, and a combination of ranking-rating approach. Observation was done during 30 days by the assistants who lived with farmers (August-September 2005) and benefited from recurrent discussions and observations of the farming activities. This contributed also to develop a mutual trust with farmers and to get accurate data on the relationship between the crop and the sociolinguistic community (Zannou et al., 2004). Semi-structured interviews were realized using a questionnaire with topics such as:

– identification and socio-demographic characteristics of the households,
– cropping system,
– land tenure,
– labor supply and allocation per gender,
– food habit and utilizations of Egusi.

Pile sort and attributes approach (den Hartog et al., 2006) was used to determine the importance of Egusi crop in a given region. Farmers were asked to list every speculation of the households and to rank them according to their values (consumption, market, cultural, etc.) for the household and the priority that each farmer gives to the crop (Zannou et al., 2004). The same procedure was applied to determine which species

of Egusi farmers cultivate the most. Combination of ranking-rating approach (Chiu, 1990) was carried out to appreciate how farmers use Egusi harvest product and how they allocate this harvest to the household needs. This consisted of giving ten grains to a given respondent. First, the respondent lists four major needs of the household and secondly he/she allocates a given number of grains to each need. The ratio of this number to ten corresponds to the proportion of the harvest product allocated to a particular need. This method was quite successful and farmers could easily give their idea of the socioeconomic importance of Egusi crops for the household.

2.3. Data analysis

Frequency distribution curves were performed for every variable to observe the type of distribution. Analysis of variances (ANOVA) to test between groups effects was preceded by a test of homoscedasticity across sociolinguistic groups using the Levene's test for equality of error variances. For the variable allocated areas to Egusi production we observed a positive correlation between the means and the variances from one sociolinguistic group to another. We proceeded then to a logarithmic transformation to make the variance independent of the mean (Sokal et al., 1995). To compare ranks between sociolinguistic regions we computed the Kruskal-Wallis χ^2. The Mann-Whitney U test is used to compare the crop's ranking of men and women. The chi-square (χ^2) test of independence or the Spearman R, the Pearson coefficient of correlation and the Kendall's coefficient of rank correlation τ are used to identify for example association between Egusi ranks and informants' age, ethnic groups and allocated areas for Egusi crops, etc. (Hill et al., 2006). Statistical analyses and graphs were performed using SPSS for Windows (version 12.0, 2003).

3. RESULTS

3.1. Place of Egusi crops in the cropping systems

The cropping systems in Benin include crops such as maize (*Zea mays* L.), yam (*Dioscorea* L. spp.), cotton (*Gossypium hirsutum* L.), cassava (*Manihot esculenta* Crantz) and sorghum (*Sorghum bicolour* (L.) Moench) according to agro-ecological regions (Baco et al., 2007). The Egusi crops are ranked among the top ten speculations. More than 50% informants place Egusi after the fourth rank. This ranking is different from one region to another (Kruskal-Wallis $\chi^2 = 33.69$, df = 4, $p < 0.001$). In the central region dominated by Mahi-Fon, Egusi is considered one of the top crops cultivated from Assanté to Aklankpa villages. Our data show also difference between the ranking of men and women (Mann-Whitney U = 2857.5; p = 0.029). Men generally place Egusi crops above the fourth position while women indicate them below that position. However, Egusi cropping is not age-specific and no association is revealed between farmers' ranking and their age (Spearman R = 0.47; p = 0.52). In fact, more recognition of the importance of the crop could come from the extent of cropping areas devoted to Egusi. In general farmers allocate on average 0.74 ha (standard deviation $\sigma = 0.90$) for Egusi production whilst some rare farmers allocated more than 1 ha. The frequency distribution curve of cropped areas for Egusi production (**Figure 2**) indicated a Poisson distribution pattern (Kolmogorov-Smirnov Z = 3.50, $p < 0.01$) confirming thereby that many farmers grow Egusi on small plots and only few farmers allocated 1 to 5 ha for cropping. From one sociolinguistic group to another, the mean cropped area is different. It ranges from 1.53 ha ($\sigma = 1.22$) in the central region to 0.25 ha ($\sigma = 0.26$) in the south-western region (for logarithmic transformed values the Levene's test of equality of error variances = 1.83, p = 0.12;

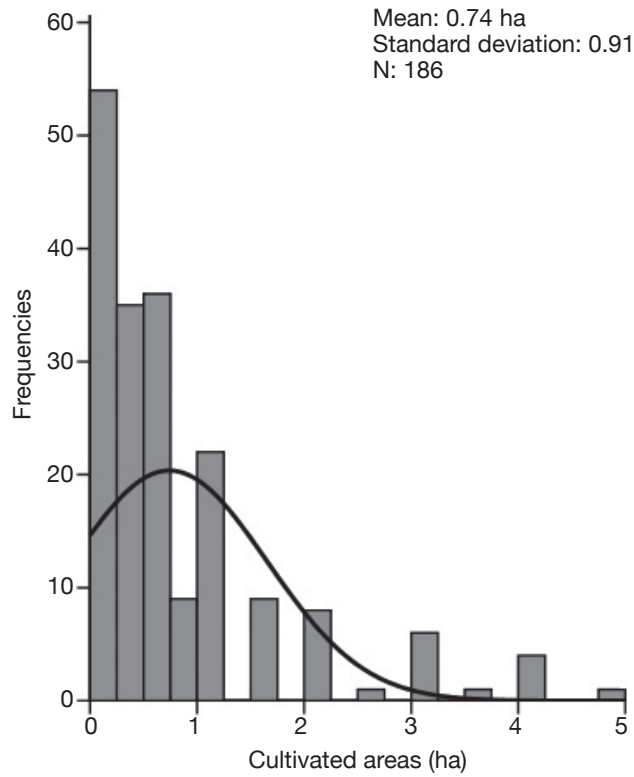

Figure 2. Frequency distribution of allocated areas for Egusi production in five sociolinguistic groups in Benin — *Distribution de fréquence des superficies de production de cultures de Egusi dans cinq régions sociolinguistiques du Bénin* (Kolmogorov-Smirnov Z = 3.50, $p < 0.001$).

F = 21.15, df = 4, p < 0.001). The difference appeared to be region-specific as the Kendall coefficient of rank correlation τ indicated a strong association between the cultivated areas and the sociolinguistic groups (τ = 2.91, p = 0.004). In comparison with other staple crops such as maize and yam, the Egusi crops occupied on average less than 22% of the farmers field and in the north-eastern region dominated by the Bariba sociolinguistic group this ratio could even decrease to less than 15% (**Figure 3**). In the northern region, known as the cotton belt, Egusi crops are left to small farmers. However, this is not the case in the central region where relatively wealthier farmers devoted important part of their field for Egusi production. The allocated area is then more important in this region than in the others as indicated by the pareto chart (**Figure 4**).

In all regions, men allocate for Egusi crops more land (0.94 ha) than women do (0.25 ha) with a significance difference between the two categories (t = 4.95, df = 184, p < 0.001). However, there is no correlation between farmers' age and the allocated areas to Egusi production (Pearson = 0.024, p = 0.74).

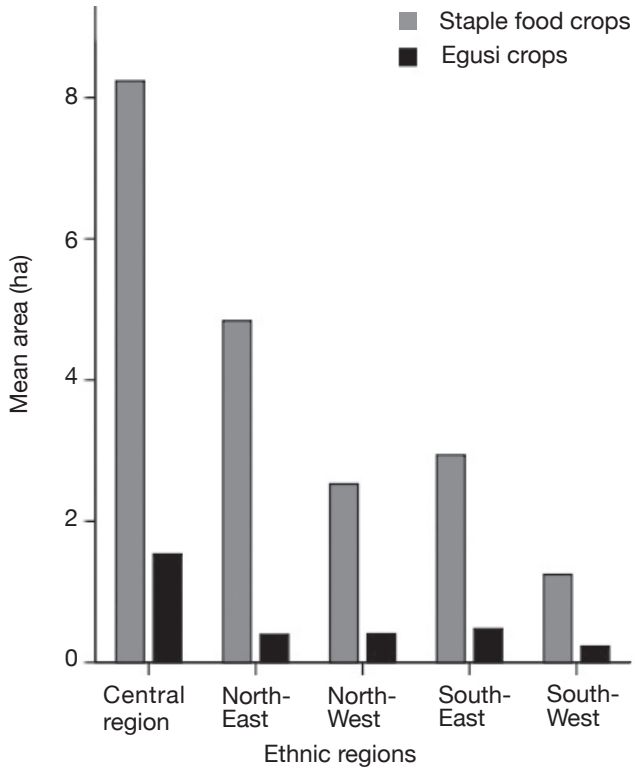

Figure 3. Allocated mean areas for staple crops and for Egusi crops in five ethnic regions of Benin — *Superficies moyennes allouées aux cultures de base et à la culture de Egusi dans cinq régions linguistiques du Bénin.*
The major ethnic groups found in each region are as that follows: Central region: Mahi-Fon, North-East: Bariba, North-West: Yom, Lokpa, Nagot, South-East: Nagot, South-West: Adja — *Les groupes sociolinguistiques dans chaque région sont : Région centrale : Mahi-Fon, Nord-Est : Bariba, Nord-Ouest : Yom, Lokpa, Nagot, Sud-Est : Nagot, Sud-Ouest : Adja.*

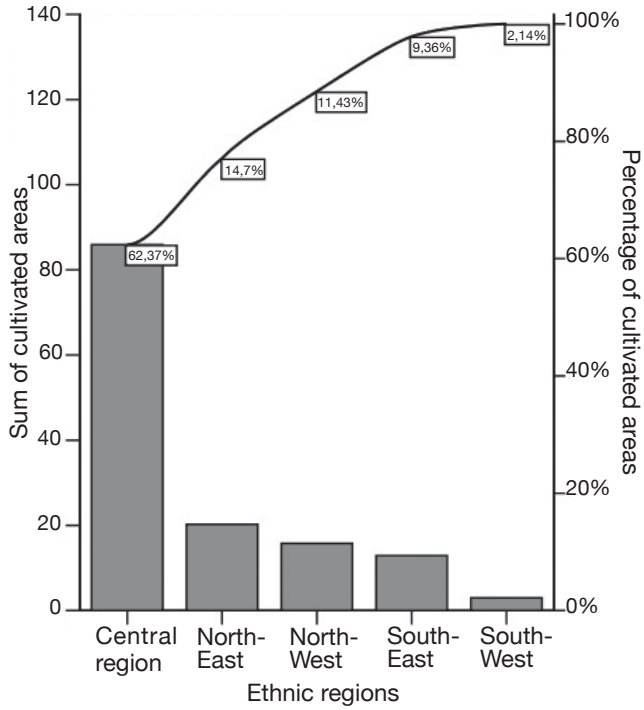

Figure 4. Pareto chart of the cumulative sum of cultivated areas allocated for Egusi crops in five sociolinguistic regions of Benin — *Cumul des superficies moyennes allouées aux cultures de base et à la culture de Egusi dans cinq régions linguistiques du Bénin.*
The major sociolinguistic groups found in each region are as that follows: Central region: Mahi-Fon, North-East: Bariba, North-West: Yom, Lokpa, Nagot, South-East: Nagot, South-West: Adja — *Les groupes sociolinguistiques dans chaque région sont : Région centrale : Mahi-Fon, Nord-Est : Bariba, Nord-Ouest : Yom, Lokpa, Nagot, Sud-Est : Nagot, Sud-Ouest : Adja.*

3.2. Production systems

The analysis of the production systems involving Egusi crops could greatly help better understand the place of this speculation in the farming systems in Benin. In most cases Egusi is cultivated in the house garden (70% of farmers). In the southern regions and in the North-East home gardens dominate (82-100% of respondents) while in the central region farmers grow Egusi crops mostly in plain field (68% farmers). The situation in the north-western region is rather transitional where home garden and fields evolve as well.

Land tenure analysis indicates that farmers acquired plots through inheritance, purchase, donation or location. The dominating land tenure mode is the inheritance from father to son (73% of informants).

Egusi is a low-cost crop and requires very limited inputs for its production. The labor is supplied by

the household and more than 80% of informants use household's labor for Egusi production. However, in the Mahi-Fon community where farmers allocate more land for the crop, 50% of informants used a complementary hired labor.

Within the Egusi crops, *C. lanatus* subsp. *mucosospermus* remains the most cultivated (78% of informants allocate about 100 ha to the crop) followed by *L. siceraria* cv. ' Aklamkpa ' (20% of informants allocate 40 ha to the crop) as depicted in **figure 5**. On the Adja-plateau (south-western region) more than 70% of informant farmers prefer *L. siceraria* cv. ' Aklamkpa ' to *C. lanatus* which is cultivated by relatively few people (29% of informants). *C. mannii* is cultivated by very few farmers and the indication of cultivated areas for this species was difficult for farmers as the crop is usually grown in association. The choice of the Egusi species to cultivate is not gender-specific. Men and women select independently their species ($\chi^2 = 5.75$, df = 3, p = 0.124).

In home garden *C. lanatus* subsp. *mucosospermus* and *L. siceraria* cv. ' Aklamkpa ' are cultivated in monoculture (100% of informants). The two species have a cycle varying from three to four months. In field they are often associated with other crops such as maize, yam, cassava, sorghum or even cotton crop. There are various types of associations developed by farmers themselves. The usual mode is when farmers bring forward the sowing date of associated crops. The two crops could then evolve on the same field. We observed this practice with 37% of informants mostly in the central region.

Another cropping strategy is the sequential crop association where farmers sow Egusi crop first (in most cases *C. lanatus*) and then a second crop at the harvest (19% of informants). This is common in the north-western part of the country where farmers intercrop Egusi with cotton or sorghum. This cropping system is not widespread although farmers recognize that growing *C. lanatus* before a cotton crop has a fertilizing action on the next crop. In home garden or in plain field, *C. mannii* is associated with other crops and is rather scattered on the plot (**Figure 6**). We have not seen any monocropping of this species in surveyed areas.

Although this is not straightforward and clearly established, farmers adopt some rotation practices including *C. lanatus* subsp. *mucosospermus* or *L. siceraria* cv. ' Aklamkpa '. In field the crop is rarely on top of the rotation plan. It appears only after two or three cropping seasons because of needs in weed control and soil fertilization according to most informants. In the northern regions Egusi is rotated with tobacco crop when cultivated in home garden. Whatever the cropping system is, farmers do not use any fertilizers or pesticides for Egusi crops (100% of respondents).

3.3. Post-harvest practices

Post-harvest management is essential for Egusi crops and includes seed extraction, seed drying, storage and conservation or marketing. Women do most of

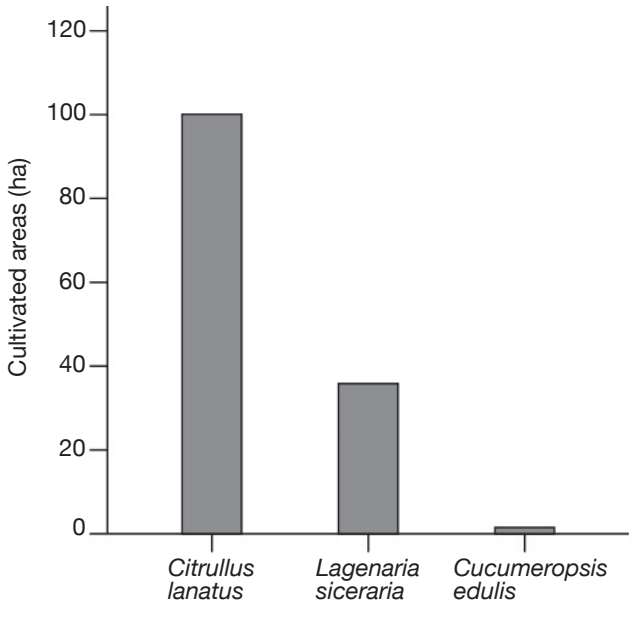

Figure 5. Total cultivated areas allocated to each of the three Egusi species by 186 informants in Benin — *Somme des superficies allouées à chaque espèce de Egusi par les 186 ménages interrogés au Bénin*.

Figure 6. *Cucumeropsis mannii* in association with dwarf oil palm tree in Pobè (South Benin) — *Culture de* Cucumeropsis mannii *en association avec le palmier nain à Pobè (Sud Bénin)*. Photo: Enoch Achigan Dako.

the Egusi post-harvest activities according to 100% of respondents. Indeed, in every region it has been recognized that only or quite only women have commend of post-harvest management from seeds extraction to bagging. To extract seeds they proceed as follows: after harvest, fruits are bludgeoned to accelerate rotting, and piled together; the fruit pile is covered either with old material or straw for one to two weeks allowing fruits to rot. From the rotted fruits, farmers extract the fleshy content, which encompasses seeds, and wash it with a home made colander. Seed washing (removing extra mucilage) could be generally one to three days delayed. This makes easier the processing to get very clean seeds for market purposes. Farmers in Glazoué reported that the fruits of *L. siceraria* cv. ' Aklamkpa ' could be left three to four months before seed extraction. According to them this process helps manage time as well as seeds cleaning is made easier. To wash seeds they usually carry them to marshlands or rivers to avoid spending additional cost for water. The washed seeds are put in a basket for draining and later spread on a clean carpet and dried under sun. Farmers could then bring their product immediately to the market or store it for a while. For storage (three to nine months or even three years) farmers insure a perfect drying and put seed in Hessian bags. No pesticide is used (100% of respondent). However some farmers insure a regular drying to prevent contamination and insect development.

The conservation of seeds for sowing is still traditional. After a long drying (three to five days under sun), the seeds are mixed with ash in old materials, and put into a plastic bag and hanged at the house roof or in the kitchen. The seed could then be conserved for the next cropping season. Some farmers conserve their seed in recycled pesticide cans or in gourds (40% of respondents). According to farmers, drying before storage is the best conservation method. In the southern regions farmers conserve the whole fruit of *C. mannii* for seeds to be used for the next cropping season. However, conserving the fruit of *C. lanatus* or *L. siceraria* cv. ' Aklamkpa ' is quite difficult. The fruit rot after two or three months giving over seeds to the nature.

3.4. Sociocultural uses of Egusi species

Sociocultural roles played by Egusi crops are important in local communities. According to farmers four main uses are insured by the household: cash income, household food, the gift to relatives and seeds.

Product allocation pattern is depicted in **figure 7**, which indicates that in the southern and central regions farmers sell 50 to 70% of their harvest product for cash income. In central region less than 20% of Egusi product is allocated for households' consumption. Indeed farmers in the region carry their products to Glazoué regional market where prices are considered fair. In opposite the production in the northern region is not primarily devoted to cash income but rather to the household consumption. In the Bariba community for example less than 40% of the harvest product is sold. However, for northern communities (Lokpa, Otammari, Gourmantché, etc.) farmers are getting into cash cropping. It is important to indicate that in the northern regions farmers sell their product at home to women collectors who pass around (100% of respondents).

The gift is relatively important in the south-western region where *C. mannii* plays a strong social role. According to farmers of the region, it is recommended to keep close relationships with neighbors and relatives by giving part of one's harvest to them around the New Year period. In fact *C. mannii*, known as " Egusi

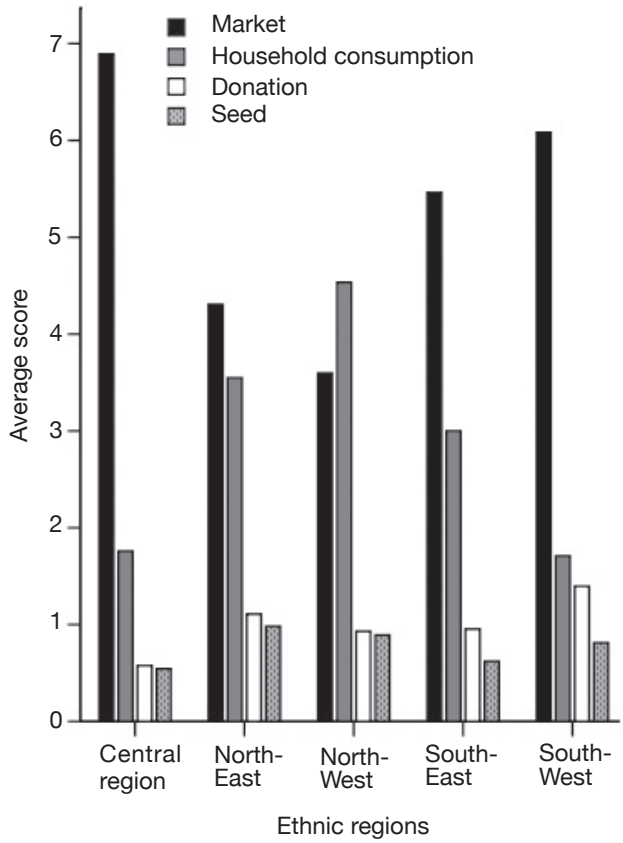

Figure 7. Allocation of Egusi crops harvest to household's needs in five sociolinguistic regions of Benin — *Répartition de la récolte de Egusi suivant les besoins du ménage dans cinq régions sociolinguistiques du Bénin.*
The major sociolinguistic groups found in each region are as that follows: Central region: Mahi-Fon, North-East: Bariba, North-West: Yom, Lokpa, Nagot, South-East: Nagot, South-West: Adja — *Les groupes sociolinguistiques de chaque région sont : Région centrale : Mahi-Fon, Nord-Est : Bariba, Nord-Ouest : Yom, Lokpa, Nagot, Sud-Est : Nagot, Sud-Ouest : Adja.*

tchigan " (the prestigious Egusi) is used as gift in recognition of the social status of the giver. This behavior is related to friendship and is also an indicator of good harvest.

Farmers keep part of the harvest for seed. Almost all respondents (80%) indicated that they keep some seeds (less than 10%) from the previous harvest that serve during the cropping season. A share of 17% of informants, including 52% women, do purchase seed while few others get them as gift. The access to seed is significantly different across sociolinguistic groups ($\chi^2 = 54.61$, $df = 8$, $p < 0.01$). In the Nagot communities the seed gift still prevails according to 30% of informants of the region. In the north-eastern region many Egusi farmers (30%) purchase the seed while in the central region only 7% of informants indicated purchasing seed for cropping.

In addition to the use of the seeds, young leaves of *C. mannii* are used as leafy vegetable. This has been reported in South-West in Adja community and in Bariba community as well. Few farmers also reported the medicinal role of some Egusi species such as *C. lanatus* subsp. *mucosospermus*. The sliced young fruit of this species is said to heal stomach aches while the seed coat in decoction with *Eucalyptus* (*Eucalyptus camaldulensis* Dehnh.) roots is a sedative for epilepsy. The roasted seed, ground with salt is taken with warm water or porridge to prevent vomiting.

4. DISCUSSION

4.1. Place of Egusi crops in the cropping systems

The placement of Egusi crops in the cropping systems in Benin varies from one region to another. In the central region for instance Egusi crops ranked in the top crops (see also Zannou et al., 2004). The ranking of Egusi crop is gender specific. Women give better rank to Egusi crops. However, our results show that they allocate few lands to Egusi production in comparison to men. This is understandable in a system where the land tenure gives privilege to men only (Lastarria-Cornhiel, 1997). In fact according to traditional believes in all sociolinguistic groups women do not inherit land. Most of the time they receive it from the household chief who decides on the portion of land that the family relatives should manage. This condition impedes certainly women's ability to plough bigger areas. The main land acquisition being the inheritance and in recognition that women are not allowed to inherit land, it is clear that although they attributed good rank to Egusi crop, women could not unfortunately expand their production as a result of land tenure practices. Among the Egusi crops, *C. lanatus* subsp. *mucosospermus* is the most cultivated species. More land is allocated to its production. The importance of *C. lanatus* among Egusi species is certainly related to its cropping cycle. The crop cycle covers three months (Vodouhe et al., 2001; Achigan-Dako et al., 2006) and is rapidly marketable and provide fresh cash to farmers after the long dry season.

4.2. Production system and post-harvest practices

The description of the production system of Egusi crops in Benin is scarce. As many other crops they have been overlooked by research and development organizations until recently. It is important to distinguish Egusi watermelon (*C. lanatus* subsp. *mucosospermus*) from watermelon (*C. lanatus* subsp. *vulgaris*), which is cultivated worldwide and for which statistics are available. The same remark applies for *L. siceraria* (bottle gourd), which is worldwide cultivated but which has a variety used as Egusi in West Africa (Zoro Bi et al., 2003; Schippers, 2004; Achigan-Dako et al., 2006).

Our results indicate that in some regions Egusi crops are cultivated in association with other major crops such as cotton. The logic behind associating *C. lanatus* or *L. siceraria* cv. ' Aklamkpa ' is many-sided. First of all, farmers want to prevent the production uncertainty and to meet resources constraints for the household. Hence they diversify the income sources (Mertz et al., 2005). Second, land accessibility is a key constraint in many areas and led to various optimal space management options. Third, *C. lanatus* and *L. siceraria* cv. ' Aklamkpa ' have a creeping habit, produce abundant biomass and are said to control weeds as well as they enrich the soil (Saidou et al., 2004; Schippers, 2004).

The association of Egusi and cotton crops in the cropping system is particularly interesting as West Africa is the second world exporter of cotton (Berti et al., 2006). According to farmers, the purpose of associating cotton and Egusi crop is mainly to reduce to fertilizer dependency. The issues of the environmental impact of highly extractive crops such as cotton have been raised by many authors (Gray, 2005; Moseley, 2005). Cotton cultivation in Mali for instance better explains agricultural soil degradation in Siwaa and Djitoumou (Moseley, 2005) given its heavy nutrient demands and associated use of inorganic fertilizers and pesticides. Moreover, the decreasing returns to cotton in Benin in recent years (Berti et al., 2006) has been stimulating interest for crops like Egusi, particularly in the north-western region where more land are progressively being allocated to the crop. In that region, we observed various scenarios of farming strategies in which an interaction exists between Egusi (as subsistence crop) and cotton (as cash crop) through shared cropping practices and soil fertility management. Doing so, farmers reduce the chemical fertilizer input

as well as they develop a potential pathway by which non-food cash crops may have an indirect incentive for the productivity of food crops. Goreveh et al. (2003) reported a similar situation in Zimbabwe. Although farmers indicate that no direct fertilization is applied in Egusi production *C. lanatus* for instance is said to respond well to fertilizers (van der Vossen et al., 2004). In these conditions, cultivation practices that combine Egusi and cotton crops for mutual benefit are to be promoted.

The production of *C. mannii* is strongly declining (Egunjobi et al., 2004). Our results indicate similar situation where farmers allocate lesser land to its production in comparison with other Egusi species. *C. mannii* is used to be an important vegetable in West and Central Africa at a time when there was plenty of forest to practice shifting cultivation. In Benin nowadays, *C. mannii* is rarely cultivated in monoculture. Many reasons could explain this choice of farmers. First, *C. mannii* is a climbing species and need stake for growing. Farmers grow it in association with yam, which needs also a stake. Both crops could then benefit from the support of the same stake and the farmer could save resources and time for stakes searching. However, the farmer sows also *Cucumeropsis* near the dead trees at the edge of garden. Second, the cropping cycle of this species covers seven to eight months (Egunjobi et al., 2004; Achigan-Dako et al., 2006) and in some regions mainly in northern Benin farmers do complementary watering if necessary. The crop is then preferably cultivated in garden close to home for monitoring.

Post-harvest practices are similar in all investigated regions. Basically the post-harvest activities are handled by women. No particular difference has been reported for the processing of the species of Egusi. However, processing the seed of *C. mannii* is time consuming and labor intensive (Egunjobi et al., 2004; Schippers, 2004).

4.3. Socioeconomic role of Egusi crops

Farming in sub-Saharan Africa is characterized by semi-subsistence, low-input, low-productivity farming systems (Govereh et al., 2003; Gray, 2005). Egusi farming systems reflect similar overview with objectives such as income generation, diversification, household food security, social relationships and seed provision for the next cropping season. However, these objectives are differently prioritized from one sociocultural region to another. Basically, in most regions the crop is primarily cultivated to provide food for the households. However, in the central region the crop is primarily cultivated to insure cash income.

C. mannii, listed as potential vegetable crops in mild climate region (Prohens et al., 2003), is indigenous to West Africa (Burkill, 1985). The species plays a key social role in addition to interesting culinary characteristics. Many constraints have been raised about its production. In addition to constraints raised above, the species is a low-yield crop in comparison with *C. lanatus* and *L. siceraria* (Achigan-Dako et al., 2006). Because the requirement of additional land and labor is not compensated by the return yield of *C. mannii*, farmers have developed cropping systems through home gardens and crops association. Yield purposes and stake requirement might jeopardize the long-term production of *C. mannii*. However, the maintenance of this species in the cropping system, despite constraints, demonstrates very well how human can integrate ethical values into decisions and action. Here, farmers manage the resources in an altruistic fashion and not merely to economic ends (Alhamidi et al., 2003) and it makes *C. mannii* valuable and sustainable. However, for how long will traditional knowledge still sustain agrobiodiversity conservation in evolving agricultural systems? (Baco et al., 2007). Probably, *C. mannii* has a better price at market and its harvest overlaps with the higher prices period, providing thereby more income to producers who manage cropping and harvesting accordingly. Farmers' willingness to produce for cash has also been reported by Zannou et al. (2004) for yam varieties production in Dani, central Benin.

Utilizations of Egusi crops are different from one sociolinguistic group to another and could represent a plinth on which a sustainable valuation of Egusi crops could be developed. This was recognized and reported by Burkill (1985) who wrote about the traditional uses of *C. lanatus* in Yoruba community: " A Yoruba food or flavored called " oguiri " is made from the fermented kernels; " igbalo " is another food made from the seeds roasted, pounded, wrapped in a leaf and then boiled ". In Adja community the preference goes for *L. siceraria* cv. ' Aklamkpa '. Farmers' choice is based on yield, weed control and soil fertility management. In central region with the Fon-Mahi community, farmers claim to have a perfect commend of Egusi production and have oriented their production towards market. Moreover, the medicinal uses of these species, although not clearly perceptible, are additional reasons that reinforce Egusi practices in Benin rural communities. It has also been reported that the seed in association with the leaves of *Rhynchosia nyasica* Baker treat hypogalacty (Adjanohoun et al., 1989). Burkill (1985) reported also that the seed of *C. lanatus* are used as vermifuge in Senegal while the juice squeezed from pulp roasted in fire-ash is drunk in South Nigeria as a worm-medicine. According to the same author, the juice from *C. mannii* fruit, mixed with other ingredients is applied in Ghana to the navel of a newborn baby for five days till the cord-relic drops off.

4.4. Research policies and development implication

These diagnostics clearly indicate that Egusi as semi-subsistence crops persist in the farming system of Benin and is variously used in the overall production system as well as it insures food security and income generation. The absence of clear policies of promotion of these resources jeopardizes the agrobiodiversity of the country (Baco et al., 2007). The strong decline of the production of indigenous species such as *C. mannii* calls for actions. According to Egunjobi et al. (2004), unless the seed yield of *C. mannii* can be increased and its crop management and seed processing be simplified, it seems likely that its replacement by other Egusi species will continue. Primarily, research and development plan should seek wide evaluation of genetic resources of *C. mannii* and the elaboration of breeding program. In-depth diagnostics on *C. mannii* will help identify factors that would boost its production. It is worthy to raise awareness at communities level through participatory selection of varieties that correspond to communities needs.

Cotton is the major cash crop in Benin and heavily depends on fertilizers. Soil fertility management to improve production has become a major concern of policy makers and research organizations in Benin. In conditions of limited resources farmers have adapted their cropping systems to the local environment by developing traditional and new strategies and activities that could contribute to maintain and enhance crops productivity. These strategies include for instance the integration of Egusi crops in the rotation system (Saidou et al., 2004). However, the potential role of Egusi crops in soil fertility improvement is not well understood yet and is rarely investigated. We advocate that the contribution of Egusi crop to soil fertility regeneration in cotton cropping system need further investigation and research policies development should take into account farmers' best practices of soil fertility management.

5. CONCLUSION

The outlook for the continued cultivation of traditional species in the face of changing policies is difficult to determine (Brush et al., 1998). However the farming systems of Egusi crops in five sociolinguistic regions in Benin showed a promising future where farmers manage various objectives to address constraints and meet income and food demand under scarce resources endowments. The Mahi-Fon community has demonstrated a particular interest for Egusi production, which could be listed as cash-food crop for this community. In consequence it would be interesting to go on comparative study on Egusi crop influence on households and/or communities livelihood. This could suggest rationales in addition to the sociocultural importance, for launching a true promotion of these species, recognized as neglected (William et al., 2002). Women play an important role in Egusi production through their active and total involvement in post-harvest activities, it is not rather true that Egusi is a woman-only crop. Men plough more land than women. Young and elder are equally involved in its production. The decline of *C. mannii* production is a major concern and should be addressed through further investigation on the promotion strategies of the species. The use of Egusi crops in soil fertility management is a plinth on which sustainable management of the genetic resources of Egusi species could be built on.

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