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Inventory of african yam bean (*Sphenostylis stenocarpa* (Hochst. ex A. Rich.) Harms) diversity in some Yoruba areas of Benin

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ABSTRACT

The study aimed to document varietal diversity, uses, production constraints, and farmers' selection criteria for the African yam bean (*Sphenostylis stenocarpa*) in Benin, identify production areas, prioritize constraints, evaluate genetic diversity, determine varietal selection criteria, and gather endogenous knowledge on cultivation practices, use, conservation, and seeds. A participatory ethnobotanical survey involving group investigations and individual surveys was conducted in ten villages in the Yoruba cultural zone of southern Benin (Plateau and Collines departments). Surveys used participatory methodologies, including group discussions with the four-square method for variety distribution, comparison matrix for constraints and preferences, and structured questionnaires for individual data from 21 households. Data included socio-demographics, varietal nomenclature, diversity loss, uses, preferences, and constraints, with statistical analysis of traits frequency entered in Excel. Eleven local varieties were identified, differentiated by seed color (41.7%), cooking time (25.0%), and ritual/symbolic functions (20.8%), with 2-7 varieties per village. Main constraints included pod rot (17.24%), lack of trees for intercropping (17.24%), and market outlets (12.06%). Diversity loss showed high erosion (up to 100% in some villages). Uses were domestic consumption (100%) and rituals (50%). Preferences focused on seed availability (61.9%). Production declined in 81% of producers, with solutions proposed as upright varieties (42.9%) and improved practices (37.1%). Local knowledge is crucial for conservation despite erosion; revitalization requires farmer-led selection, adapted varieties, and institutional support, with biochemical/molecular characterization recommended for true diversity assessment.

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INTRODUCTION

Food and nutritional security remain a crucial challenge in many regions of sub-Saharan Africa, where population pressure and climatic hazards compromise the availability and accessibility of food resources. One of the strategies proposed to strengthen the resilience of food systems is the promotion of neglected and underutilized crops, which offer significant genetic and nutritional diversity (Nnamani *et al.*, 2019). Among these crops, *Sphenostylis stenocarpa* (Hochst. ex A. Rich.) Harms, known as the African yam bean (AYB), is a tropical legume native to West and East Africa, characterized by its dual use: protein-rich seeds and nutritious tubers (Palanga *et al.*, 2025). Several studies have documented the high nutritional value of AYB, including protein content comparable to other legumes and a favorable composition of essential amino acids (Ojuederie and Balogun, 2017).

Despite its advantages, AYB remains underexploited and marginalized in African farming systems due to low institutional interest, limited cultural acceptability, lack of consolidated agronomic data, and seed-related issues such as long cooking time and antinutritional factors (Edem *et al.*, 2025). This situation keeps AYB among "orphan crops," i.e., species with high potential but little recognition in agricultural and food policies (*Sphenostylis stenocarpa* conservation review, 2025). At the genetic and agronomic level, recent investigations have revealed significant diversity among AYB accessions, both phenotypically and molecularly (Shitta *et al.*, 2022). For instance, Shitta *et al.* (2022) demonstrated considerable phenotypic variability in a large collection of accessions conserved at IITA, suggesting a rich genetic base that could be exploited for breeding programs. However, despite these advances, the understanding of local varietal diversity cultivated by farmers, as well as the associated indigenous knowledge (nomenclature, uses, selection criteria, constraints), remains fragmentary in many rural African areas, including Benin. In particular, areas with a strong Yoruba cultural identity, where AYB is traditionally grown, have not yet been comprehensively studied to link local diversity with socio-agricultural dynamics.

In this context, the present study aims to identify the production areas of *Sphenostylis stenocarpa* in the Yoruba cultural zone of southern Benin; characterize the varietal diversity as perceived by farmers; analyze the local production and conservation constraints; determine farmers' criteria for varietal selection; and document traditional knowledge related to the cultivation, use, conservation, and seeds of African yam bean.

MATERIALS AND METHODS

Study area and site selection

The Republic of Benin is located in West Africa, between latitudes 6°10′ N and 12°25′ N and longitudes 0°45′ E and 3°55′ E. It covers an area of 112,622 km² and has a population of over 14 million. A rapid field survey, conducted with decentralized services of the Ministry of Agriculture and in local markets, identified the Yoruba (or Nago) cultural zone as the main production region for African yam beans (AYA) in southern Benin. To cover this area, ten villages were randomly selected. These ten villages are located in two departments in the south of the country: Plateau and Collines. This region belongs to the Guinean agro-ecological zone, characterized by a sub-humid climate, two rainy seasons, annual rainfall between 1100 and 1400 mm, and average temperatures ranging between 25 and 30 °C (Fig. 1).

Data collection

In each village, two types of surveys were conducted according to the participatory methodology described by Dansi *et al.* (2010): Group investigation, including direct observations and field visits Individual survey, based on a structured questionnaire. The data collected within the groups concerned the cultivated varieties (vernacular names, origin, meaning of names, distribution, agronomic characteristics, desired or undesired traits) and production constraints.

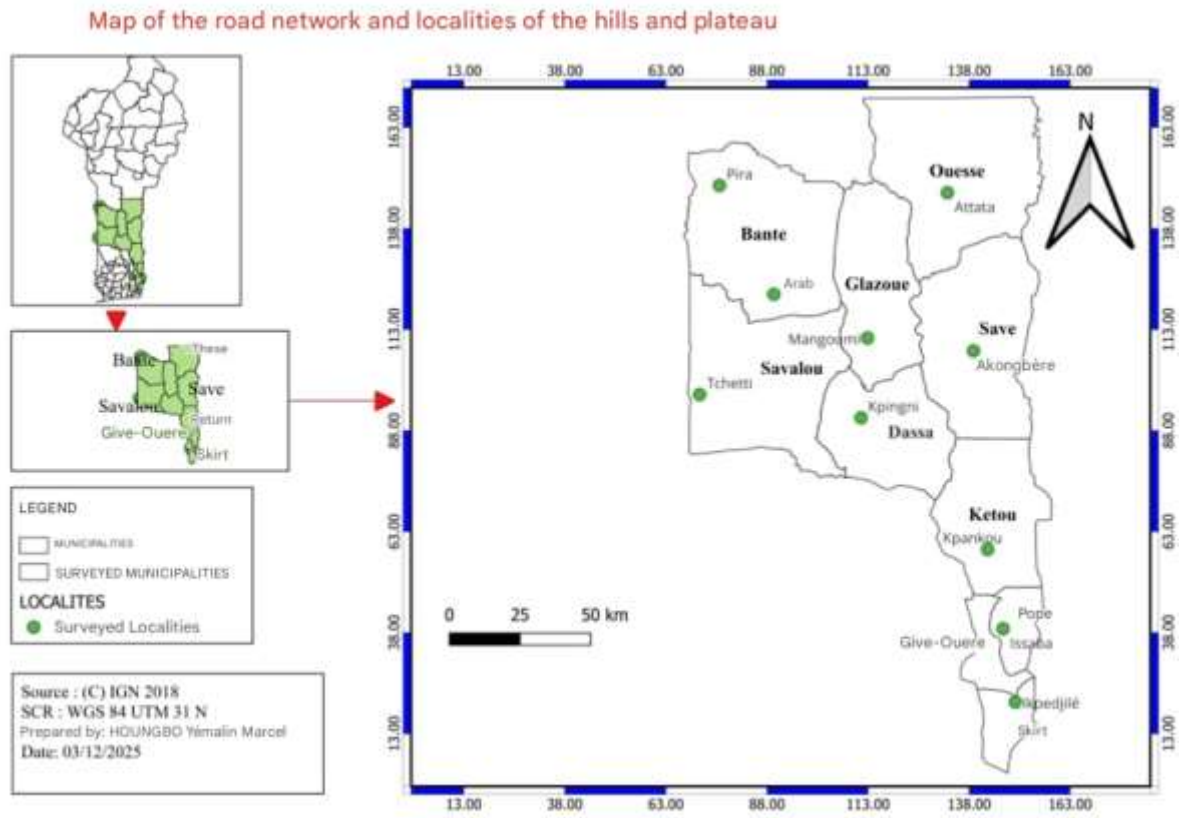

Fig. 1. Map of the study area

The participatory four-square method (Baco *et al.*, 2008; Dansi *et al.*, 2010) was used to assess the distribution of varieties according to two criteria: cultivated area (large or small) and number of farming households (numerous or few). Disappeared varieties and the reasons for their disappearance were also recorded.

The assessment of production constraints was based on the participatory comparison matrix method (Kamara *et al.*, 1996; Defoer *et al.*, 1997; Dansi *et al.*, 2010). Producers first freely listed the constraints, then ranked them in order of importance using a progressive elimination process: the constraint deemed most urgent to resolve was selected, removed from the list, and then the process was repeated until a complete ranking was obtained.

The same approach was used to identify and classify farmers' varietal preference criteria. Regarding local taxonomy, producers were asked to describe the distinctive criteria used to identify each variety. These traits were then statistically analyzed according to their frequency of use. Finally, the producers listed the desired and undesired characteristics for optimal use of the species. The various uses of the seeds and tubers were also documented.

The information obtained in groups was used to construct a structured questionnaire for individual surveys. In each village, all reported AYB farming households were interviewed. The respondent was designated by the host couple, in accordance with the method of Dansi *et al.* (2000). The variables collected included: sex, age, marital status, education level, ethnicity, household size, number of cultivated varieties, planted area, years of experience, and available labor force.

The information obtained was recorded manually and then entered using an Excel spreadsheet. Direct observations in the field (cultivated plots, seed storage facilities, agricultural tools) helped to

corroborate the producers' statements and refine the characterization of local varieties.

RESULTS

Local distribution and nomenclature

Eleven vernacular names for local varieties of African yam bean were recorded in the eight villages surveyed (Table 1). Séssédoudou remains the most widespread, reported in six villages, followed by Séssékpikpa in five localities, and Sésséfoufou in four. The other identified varieties are: EwaEguifoufou, Sésséfoufouolodjoufoufou, Sésséfoufouolodjoudoudou, EwaEguiminrinminrin, EwaEguikpikpa, EwaEguidoudou, Sésséminrinminrin; are mentioned in only one village each, reflecting a restricted geographical distribution or a recent appearance.

Table 1. Vernacular names of AYB varieties and frequency of citation by village

Vernacular name	Number of villages citing the variety
Sessedoudou	6
Séssékpikpa	5
Sésséfoufou	4
EwaEguifoufou	1
Sésséfoufou olodjoufoufou	1
Sésséfoufou olodjoudoudou	1
EwaEguiminrinminrin	1
EwaEguikpikpa	1
EwaEguidoudou	1
Seseminminminrin	1
EwaEguifoufou	1

Table 2. Distribution of names according to their semantic origin

Origin of the vernacular name	Percentage (%)
Seed color	41.7
Cooking characteristics	25.0
Ritual or symbolic uses	20.8
Undetermined / no apparent meaning	12.5

The criteria behind the names vary, reflecting the peasant perception of salient characteristics: 41.7% of the names are based on the color of the seed coat, 25.0% on cooking characteristics (time, texture), 20.8% refer to ritual or symbolic functions, while 12.5% of the names have no explicit meaning according to the respondents (Table 2).

Diversity loss

Assessment of the loss of varietal diversity of African yam beans (AYB) reveals very strong inter-village disparities (Table 3). Two localities show total erosion (PDV= 100%): Ikpédjilè (2 out of 2 varieties abandoned). Kpankou has the highest rate among the villages still retaining some diversity (80%, 4 out of 5 varieties lost), followed by Akongbèré and Issaba (66.67% each), then Attata (60%). The levels of loss are intermediate in Pira / Aroba (33.33%) and lower in Tchetti (25%). Finally, two villages stand out for the complete preservation of their diversity (PDV = 0%): Magoumi and Kpingni (no varieties abandoned out of 2 varieties each).

Table 3. Diversity loss of AYB in each village

Villages	Municipalities	Ethnicities	NVT	M+S+	M+S-	M-S+	MS-	NVA	POV
Akon gbèré	Savè	Tchabè	3	0	0	0	3	2	66.67
Attata	Ouèssè	Tchabè	5	0	0	0	5	3	60
Issaba	Pobè	Holli	3	0	0	0	3	2	66.67
Ikpédjilè	Sake	Nagot	2	0	0	0	2	2	100
Kpankou	Ketou	Nagot	5	0	0	0	5	4	80
Magoumi	Glazoué	Idatcha	2	0	0	0	2	0	0
Pira	Bantè	Itcha	3	0	1	0	2	1	33.33
Aroba	Bantè	Itcha	3	0	1	0	2	1	33.33
Tchetti	Savalou	Ifè	4	0	1	0	3	1	25
Kpingni	Dassa	Idatcha	2	0	0	0	2	0	0

* M+S+ = Several households with a large cultivated area, * M+S- = Several households with small cultivated areas, * M-S+ = Few households have large cultivated areas, and * MS-= Few households with little cultivated land.

Structurally, the vast majority of sites (8 out of 10 villages: Akongbèré, Attata, Issaba, Ikpédjilè, Kpankou, Magoumi, Kpingni, and the dominant configuration in Pira and Aroba) correspond to the M-S- profile (few households cultivating AYB on small plots), the least favorable configuration for maintaining genetic diversity. Only Tchetti and parts of Pira and Aroba fall under the M+S- profile (several

households, but still on small plots), which offers some support for in situ conservation. These results highlight a very advanced genetic erosion in the majority of the surveyed areas and a generally unfavorable socio-technical context for preserving local varieties, justifying the urgent implementation of targeted participatory conservation actions and the revitalization of AYB cultivation.

Reasons for abandonment

The main reasons given by producers for abandoning certain varieties of heirloom bean are food taboos (35.48%), followed by a lack of market outlets and pod rot due to the need for staking because of the climbing habit, each mentioned by 24.2% of respondents (Fig. 2). Other factors, although less frequently cited, also contribute to this varietal disengagement: post-consumption stomach upset (6.45%) and the long cooking time (9.68%), perceived as a hindrance in home preparation.

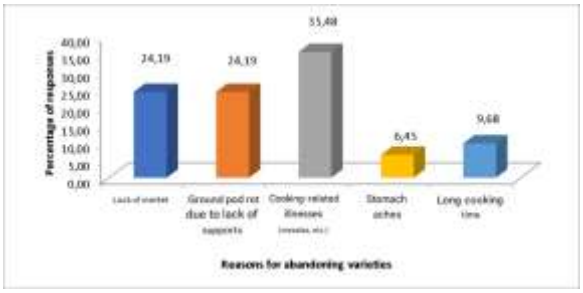

Fig. 2. Reasons for abandoning AYB in households

Liked and disliked traits

The farmers surveyed highlighted several positive traits that motivate the cultivation of African yam beans. Among the most appreciated are the very mild taste of the seeds, high productivity, resistance to storage pests, and the absence of major diseases in the field (Table 4). These qualities make certain varieties particularly interesting for food security and the resilience of agricultural systems. Conversely, several drawbacks hinder wider adoption. The most frequently cited are pod rot, excessive cooking time, and perceived side effects such as constipation, headaches, and post-consumption skin reactions resembling measles. Furthermore, unpleasant odors during cooking are mentioned, affecting the culinary acceptability of some varieties (Table 5).

Number of varieties and cultivated areas

Intra-household diversity. The majority of respondents cultivated 2 varieties (45%), followed by those cultivating 3 (35%). Less extensive or less extensive diversification practices were rare: fewer than 10% cultivated 1, 4, or 5 varieties, respectively (Fig. 3). Regarding cultivated areas, the units reported were often expressed in local fractions called "squares" (1 square = 0.01 ha): 40% of producers cultivated 1 square, 35% 0.5 square, and 25% only a few plants, highlighting the small area allocated to this legume in current production systems.

Table 4. Agronomic and post-harvest characteristics valued by producers

Valued characteristic	Frequency of citation	Comments
Very mild taste	High	Considered suitable for family consumption
Long-lasting seeds	High	Up to 2-3 years without loss of viability
High productivity	Medium to high	Abundant grains per plant
Resistance to storage pests	Average	Less attacked than other legumes
No major illnesses	Average	No visible signs of fungus or virus

Table 5. Negative characteristics cited by producers

Unpopular character	Frequency of citation	Comments
Pod rot	Frequent	Pods blackened or split open before maturity
Long cooking time	Frequent	Sometimes >3h, requires a lot of fuel
Constipation	Medium to low	This is especially noticeable with certain hard-seeded varieties.
Post-consumption headaches	Weak	Linked to isolated cases, especially in children
Skin reactions (“measles”)	Average	Mentioned in several villages
Unpleasant odors during cooking	Average	Some varieties emit a strong odor

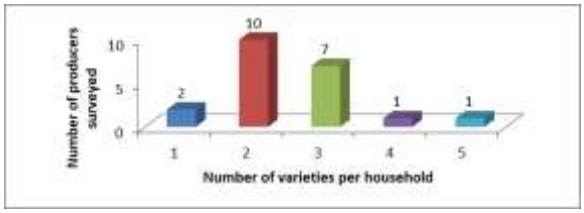

Fig. 3. Number of varieties cultivated per household

Most commonly cultivated varieties

Among the local cultivated varieties, Sésséfoufou clearly dominates with 35.7% of mentions, followed by Sésséfoufou olodjoufoufou (25.0%), Sésséfoufou olodjoudoudou (17.9%) and EwaEguifoufou (7.14%), as detailed in Table 6 and Fig. 4. These results highlight the prevalence of a related group (Sésséfoufou and its derivatives) in current varietal preferences.

Fig. 4. Diversity of cultivated varieties

Table 6. Cultivated varieties

Most widely cultivated variety	Percentage of responses	Villages
Ewaiguifoufou olodjoudoudou	3.57	Tchetti
Ewaiguifoufou olodjoukpikpa	3.57	Tchetti
Sessedoudou	3.57	Kpankou
Sésséfoufou olodjoukpikpa	3.57	Kpankou
EwaEguifoufou	7.14	Tchetti
Sésséfoufou olodjoudoudou	17.86	Attata; Magoumi; Kpankou
Sésséfoufou olodjoufoufou	25	Attata; Magoumi; Kpingni; Kpankou
Sésséfoufou	35.71	Akon gbèré; Attata; Aroba; Pira

Varieties that have disappeared and those that have appeared

Four varieties have been reported as extinct in some villages: Sésséfoufou, EwaEguiminrinminrin, EwaEguikpikpa and EwaEguidoudou. Conversely, two varieties, Séssékpikpa and Sésséminrinminrin, have recently appeared or been rediscovered by the communities (Table 7), suggesting a dynamic of local gene flow.

Table 7. Dynamics of disappearance and appearance of local AYB varieties

Status	Variety name	Village
Missing	Sésséfoufou	Kpankou
Missing	EwaEguiminrinminrin	Tchetti
Missing	EwaEguikpikpa	Tchetti
Missing	EwaEguidoudou	Tchetti
Recently appeared	Séssékpikpa	Kpankou; Attata; Aroba; Pira
Recently appeared	Seseminminminrin	Attata

Seed preparation and storage

Producers select only healthy and visibly disease-free seeds, without resorting to any preventative treatment. The seeds are then stored in airtight bags or containers (Table 8), according to empirical practices passed down orally.

Table 8. Preparation and storage of AYB seeds

Part used as seeds	Criteria for seed selection	Treatments before seed storage	Storage containers
Seeds	Healthy plants, healthy pods, and healthy seeds	None	Bags and jerrycans

DISCUSSION

Vernacular names and classification criteria

The study revealed an inventory of eleven vernacular names for local varieties, confirming the cultural and taxonomic richness associated with AYB in the surveyed communities. The fact that names are primarily based on seed color (41.7%) and culinary characteristics (25%) indicates that farmers classify varieties according to criteria directly linked to their use. This type of nomenclature based on visible and functional traits has also been documented in African yam bean vernacular studies (Nnamani *et al.*, 2019). The presence of names

based on ritual or symbolic functions (20.8%) reflects the socio-cultural role of the African yam bean in local identities.

Extent and causes of varietal erosion

The results show very marked varietal erosion, with losses reaching 80-100% in several localities such as Ikpédjilè and Kpankou. This rapid disappearance aligns with previous observations that under-utilized legumes like AYB face challenges due to limited farmer interest, small cultivation areas, and socio-economic factors (Shitta *et al.*, 2022; PMC review on neglected legumes, 2021). The massive dominance of the M-S-configuration (few households, small plots) exacerbates the problem: small plots and a limited number of producers do not allow continuous reproduction of varieties or sufficient gene flow to maintain diversity. This phenomenon is common in orphan crops, where the absence of structured value chains accelerates genetic erosion (Shitta *et al.*, 2022).

Guardian communities and abandonment reasons

In contrast, the villages of Magoumi and Kpingni, which maintain their entire diversity, illustrate the importance of guardian communities in in situ conservation. Their example shows that even small communities can sustainably preserve local varieties when there is stable culinary or cultural demand. The main reasons for abandonment food taboos (35.48%), lack of market outlets, pod rot, staking constraints corroborate obstacles reported in studies on AYB utilization and adoption (Shitta *et al.*, 2022; AGRIS, 2022). The very long cooking time, often exceeding three hours, has been consistently identified in the literature as a major constraint limiting AYB consumption (Shitta *et al.*, 2022; AGRIS, 2022).

Cultural taboos and valued traits

Food taboos related to certain seed colors or "hot" or "heavy" varieties reflect a traditional system of beliefs still influencing cultivation decisions. Farmers value key traits: mild taste, acceptable productivity, resistance to storage pests, and notably seed longevity (2-3 years). These characteristics confirm results reported for AYB germplasm collections, which showed good post-harvest performance and high agronomic potential (Shitta *et al.*, 2022). Conversely, constraints mentioned pod rot, long cooking time, constipation, unpleasant odors indicate that local varieties require participatory selection to combine desirable culinary traits with agronomic robustness.

Cultivation scale and genetic risks

Most farmers cultivate only 0.01 ha or less, and 25% are limited to a few isolated plants. This low land investment greatly reduces the probability of maintaining intra-plot diversity, as noted in studies on under-utilized legumes in West Africa (Shitta *et al.*, 2022). Moreover, the preference for a small number of varieties particularly Sésséfoufou, which largely dominates current cultivation could lead to genetic homogenization, making the system more vulnerable to diseases or climatic changes. The disappearance of varieties such as EwaEguiminrinminrin or EwaEguidoudou, especially observed in Tchetti, likely reflects a decline in intergenerational seed transmission. Conversely, the recent appearance of Séssékpikpa and Sésséminrinminrin suggests seed exchange between villages, local revalorization or reintroduction through lineage-based networks. This dynamic deserves exploration in participatory diversity restoration programs.

Traditional conservation methods and limitations

Finally, the absence of pre-storage treatment and exclusive use of bags or jerrycans indicate that conservation relies on traditional but limited methods. While AYB is relatively resistant to post-harvest pests, the lack of preventive treatments could exacerbate losses under humidity fluctuations or severe infestations (Shitta *et al.*, 2022).

CONCLUSION

This study highlights that Sphenostylis stenocarpa (African yam bean) holds significant agrobiodiversity, nutritional, and cultural value in the Yoruba zones of southern Benin. However, the crop is severely threatened by genetic erosion, low cultivation intensity,

socio-cultural constraints, and a lack of institutional support. To ensure its sustainable use and conservation, targeted in situ strategies, participatory selection programs, and culinary and institutional valorization are urgently needed to reintegrate AYB into local farming systems and safeguard its genetic resources for future generations.

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