Uluslararası Tarım Araştırmalarında Yenilikçi Yaklaşımlar Dergisi
International Journal of Innovative Approaches in Agricultural Research 2025, Vol. 9 (1), 17-31
https://doi.org/10.29329/ijiaar.2025.1294.2

Original article

Characterisation of Yam Production Systems, Production Constraints, and Factors Impacting Conservation among Farmers in Mbam and Inoubou Division of Cameroon

Antoine Guissana Egouméa [a], Honoré Djonko Beyeguea [a],
Marie Amperes Boat Bedinea [a] & Jean Pierre Mvondo-Awonoa [a,b,*]

[a] University of Dschang, Faculty of Agronomy and Agricultural Sciences, Department of Crop Sciences. P.O. Box 222 Dschang, Cameroon
[b] University of Buea, Faculty of Agriculture and Veterinary Medicine, Department of Agronomy and Applied Molecular Sciences. P.O. Box 63 Buea, Cameroon

Abstract

Yam cultivation is practiced in all agro-ecological zones in Cameroon, but the absence of a gene bank contributes to the low level of yam production. This study aimed to characterise the production systems, highlight production constraints, collect cultivars for characterisation, and determine the factors for conserving genetic diversity in Mbam and Inoubou sub-division. The results show that yam producers in Mbam and Inoubou are gradually moving towards an intensive cropping system using fertilizers and pesticides. However, subsistence yam cultivation without the use of fertilizers and pesticides is still maintained by the majority of producers. The main production constraints for Mbam and Inoubou producers are pests, laborious cultivation, diseases, climatic hazards, lack of seeds, and soil infertility. Six factors significantly ($P < 0.05$) affect the conservation of yam diversity. The cultivation of yams known as yellow loop, sweet white loop, and purple loop positively influences conservation. In addition, producers who stopped their study in secondary school tended to conserve the cultivars. Conversely, pest damage leads producers to reduce the number of cultivars. Similarly, producers who grow yams for food and cultural needs or for food, economic, and cultural needs have cultivar preferences and reduce yam biodiversity. The biodiversity of yams is decreasing as 48% of the producers have reduced the number of cultivars they had at the beginning of the crop. It is therefore urgent to establish a gene bank so that producers are no longer the sole custodians of biodiversity.

Keywords: Yam Production, Production Systems, Production Constraints, Genetic Diversity, Conservation.

Received: 29 August 2024 * **Accepted:** 29 March 2025 * **DOI:** https://doi.org/10.29329/ijiaar.2025.1294.2

*** Corresponding author:**

Jean Pierre Mvondo-Awono is a professor in the Department of Crop Sciences at University of Dschang, Cameroon. His research interests include Crop Production and Genetic. He is also the Dean of the Faculty of Agriculture and Veterinary Medicine at the University of Buea, Cameroon.
Email: jpmvondoa@yahoo.fr

INTRODUCTION

Yam, a tuber crop of the Dioscoreaceae family, is one of West Africa's key staple food crops, providing a substantial supply of nutritional carbohydrate to about 400 million people as well as earning opportunities to farmers (Bhattacharjee *et al*., 2011; Nweke 2016). Its peels can be used as livestock feed (Adegun, 2020) and it is a source of pharmacological chemicals including saponins and sapogenins (Obidiegwu *et al*., 2020). Yam world production is estimated at 75 million tons, with West Africa producing more than 94% of the crop (FAOSTAT, 2023). Nigeria, Ghana, and Ivory Coast together produce about 88% of the world's yam supply. In Cameroon, subsistence yam cultivation is practised in the five agro-ecological zones, mainly in the Adamawa, South-West, Coastal, North-West, Western, Eastern and Central regions (NgueBissa et al., 2007). However, the full production and productivity potential of yams has not been reached, maintaining Cameroon in the sixth place among the six countries of the West African yam zone, with an annual production of 610 136 metric tons (MT) in 2021 (FAOSTAT, 2023). In fact, yam production and productivity have suffered from a range of constraints including high demands of labour, unavailability and high cost of seed yams, pre- and post-harvest pests, inadequate storage facilities, various diseases and institutional research neglect of the crop.

Globally, there are 10 main species of cultivated yams, originating from the tropical regions of Africa, Southeast Asia and South America (Coursey, 1976; Lyonga, 1976; Dansi et al., 2013). Although there were indications of a high diversity of yam species and varieties in Cameroon, farmers have reported biodiversity loss of some potentially significant yam species and varieties as a result of commercial cultivation of a few varieties in response to market demands. Elite species such as *D. rotundata* (White guinea yam), *D. cayenensis* (Yellow guinea yam), *D. dumetorum* (Sweet yam), *D. alata* (Asiatic or water yam), *D. bulbifera* are widely available, but others such as *D. esculenta* (Chinese yam), *D. trifida* (Cush-cush yam), *D. liebrechtsiana* and *D. schimperiana* are scarce and some cultivars have been completely lost through lack of maintenance.

Although yam has been cultivated in Cameroon for at least two centuries, research interest on the crop has generally been scanty compared with the rest of the countries of the African yam zone (Azeteh et al., 2019). However, a good understanding of the determinants affecting yam productivity and production will allow developing effective strategies taking into account the regional differences. Indeed, characterization of yam production systems, production constraints, and factors impacting conservation is important for increasing yam productivity and improving the living standard of the farmers in developing countries.

The overall objective of this work is to characterization yam production systems, production constraints, and factors impacting conservation of yam among farmers in four sub-divisions in the Mbam and Inoubou who is the one of the main growing area.

MATERIALS and METHODS

Study area

The study has been carried out in four (4) sub-divisions in the Mbam and Inoubou division of Cameroon namely; Ndikinemeki, Noutoukou, Bokito and Ombessa (Figure 1). The Mbam and Inoubou division is characterized by a forest-savannah transition ecosystem located between 4'39 and 4'49 North; then 11'4 and 11'19 East. Altitude varies from 600 to 900 m above sea level. Many types of soils can be found: lateritic soils with pH between 5 and 6, hydromorphic and raw mineral soils. The rainfall gradient is high in the northern part of the region (1500 mm) and goes to 1400 mm in the south and east. The average annual temperature is relatively high and constant (25.5°C) and minima are located between 19.7 and 19.8°C. The maximum relative humidity throughout the year varies between 95 and 98%, with the minimum between 51 and 74%. It is one of the most producing cash crops zone of the country, including cocoa, tuber crops and legumes due to its climatic variability.

Sampling method

The yam producers of Mbam and Inoubou constitute the target population of the study. The normal approximation of the binomial distribution described by the formula described below was used to obtain the sample size.

$$n = \frac{U^2_{1-\alpha/2} \times \mathrm{p}(1-\mathrm{p})}{d^2}$$

Where n is the number of Mbam and Inoubou farmers to be surveyed; $U_{1-\alpha/2} = 1.96$ is the quantile of a standard normal distribution, for a probability value of 0.05; p = 0.10 is the proportion of the population of yam farmers in Mbam and Inoubou (according to the post chiefs, nearly 10% of Mbam and Inoubou farmers grow yams); and d is the expected margin of error of any parameter to be calculated from the survey. For the present study, the expected margin of error (d) is set at 0.06 (this value is close to zero to have an accurate estimate of the parameters). Thus, n is equal to 96 producers to be surveyed for the Mbam and Inoubou and the sample size is set at 100 yam producers.

Data collection

The data were conducted from January to May 2022. A first survey was conducted among delegates and heads of post of the agricultural delegations of the Mbam and Inoubou division in order to target the yam growing area. Subsequently, a second survey was carried out among yam producers through personal interviews previously established according to the objectives of the study. The interview was conducted individually in their homes and on their farms, taking one person per household using structured questionnaire with questions on socio-economic characteristics, farming practices, diversity of cultivars, production constraints, and producer income. The questionnaire was included to

allow for complete examination of the open cultivars, production constraints and methods for yam tuber conservation.

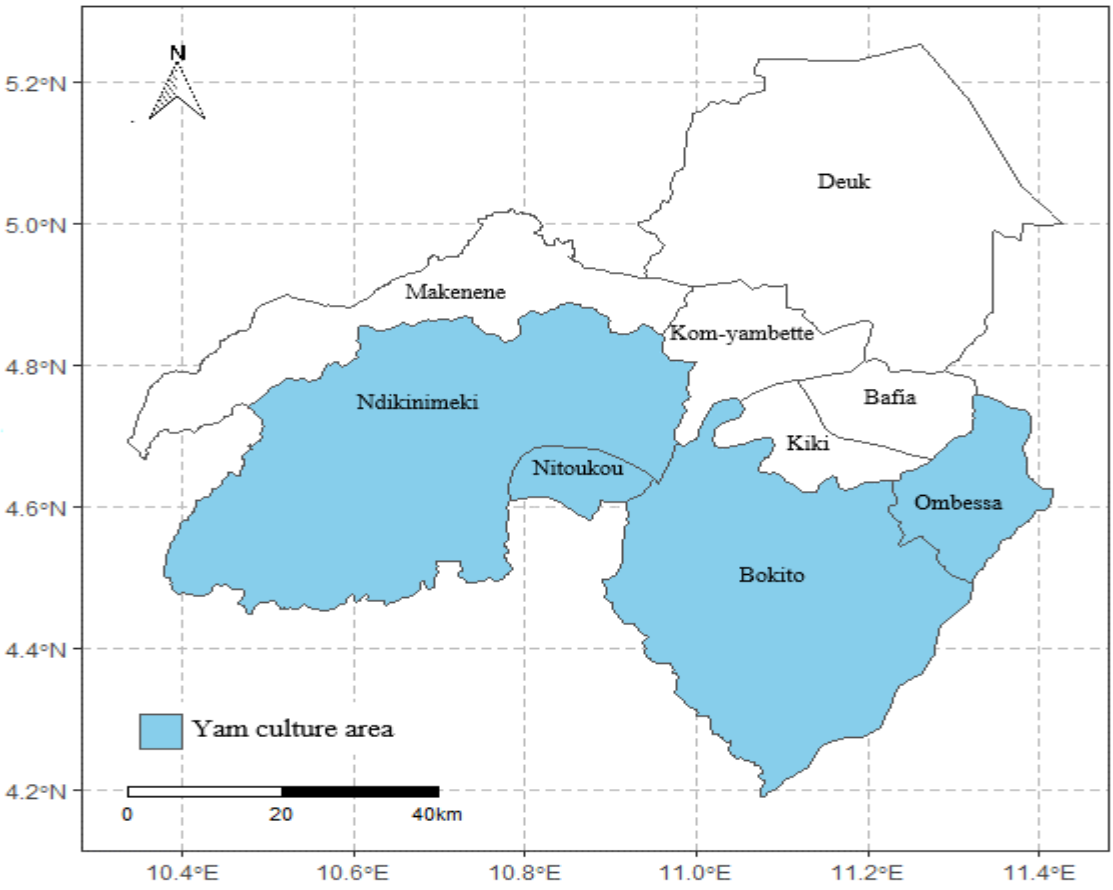

Figure 1. Map of the study site showing the yam-growing sub-divisions selected for investigations. The ggplot2 package of R software version 4.0.3 (http://cran.r-project.org/) was used to create the map.

Data analysis

The data obtained from the surveys were analysed using descriptive and multivariate statistics. Data on the socio-demographic profile of the respondents and the characteristics of the farms were subjected to Pearson's chi-square tests and ANOVA using the finalfit package (Xie, 2020) of the statistical software R version 4.0.3, in order to compare the different districts surveyed. The significance level was set at 0.05 and the means were separated by the SDPP test. To classify the producers in the study area, the analysis of the survey data was carried out in three stages. The first step was a Multiple Correspondence Analysis (MCA) to produce an intermediate representation of the data. Then, a Hierarchical Cluster Analysis (AHC) was performed on the basis of the intermediate representation. The inferential and descriptive statistics of the obtained clusters were the last step.

The function *ktable* of the package knitr of R software version 4.0.3 (Xie, 2020) was used to describe the data matrix. The function *vif* of the package car (Fox and Weisberg, 2019) was used to

examine the multicollinearity of the explanatory variables. The selection of variables and the adjustment of the binomial regression to the data were carried out using the *glm* (generalized linear model) function of the package vgam (Oksanen, 2019). The *drop1* function was used to identify variables with a significant effect in the model.

RESULTS and DISCUSSION

Types of yam production systems

The classification of producers provides the types of production system (Figure 2) and the subsequent static analysis reveals the distinctive and common characteristics of the types of production systems (Table 1, 2 and 3).

This result of this study help to classifying producers into four groups based on their production systems. These groups are:

- Intensive and biodiversity-conserving system: This group represents 11% of producers and is spread throughout the study area (Cluster 1). Most producers in this group stopped their studies at secondary school. They use fertilizers and insecticides, and they grow a variety of yam cultivars.
- Extensive and biodiversity-conserving system: This group represents 27% of producers and is mainly located in Ombéssa and Nitoukou (Cluster 2). Most producers in this group stopped their studies at secondary school. They do not use fertilizers and rarely use insecticides, and they grow a variety of yam cultivars.
- Extensive system that does not conserve biodiversity: This group represents 54% of producers and is mainly located in Bokito and Ndikinéméki (Cluster 3). Most producers in this group stopped studying at primary level. They use a small amount of fertilizers and insecticides, and they grow a limited number of yam cultivars.
- Semi-intensive system that does not conserve biodiversity: This group represents 8% of producers and is mainly located in Ndikinéméki (Cluster 4). Most producers in this group are not in school. They use a high amount of insecticides and a small amount of fertilizers, and they grow a limited number of yam cultivars. Unlike the other groups of producers, the majority of these producers grow "*igname de table*"

The study reveal that the use of fertilizers and insecticides is associated with the loss of biodiversity. Producers who use more fertilizers and insecticides are more likely to grow a limited number of yam cultivars. This is because fertilizers and insecticides can lead to the extinction of yam cultivars that are not resistant to pests and diseases. The study also reveal that the level of education is associated with the conservation of biodiversity. Producers who have a higher level of education are

more likely to grow a variety of yam cultivars. This is because they are more aware of the importance of biodiversity and they have access to information about different yam cultivars. Hence, the conservation of yam biodiversity can be promoted by encouraging producers to use less fertilizers and insecticides, and by increasing the level of education among producers.

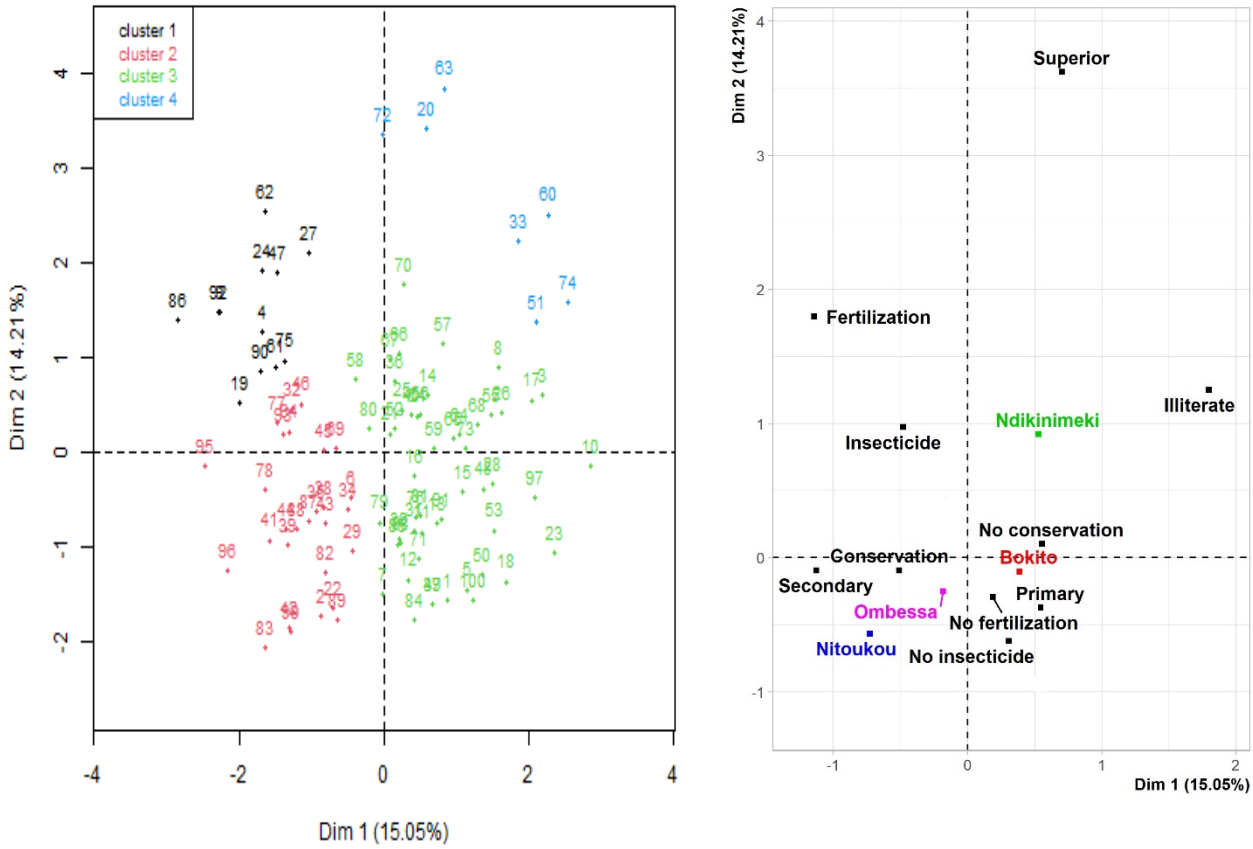

Figure 2. Multiple Correspondence Analysis (MCA) showing distinctive and common characteristics of the types of production systems clustered.

Table 1. Socio-economic characteristics of producers of the four sub-division investigated in the Mbam and Inoubou zone.

Variables	Modalities	Cluster				P value
		C1	C2	C3	C4	
Gender (%)	Woman	90.9	100.0	96.3	100.0	0.391
	Male	9.1	0.0	3.7	0.0	
Sub-division (%)	Bokito	27.3	11.1	33.3	12.5	0.002
	Djikiniméki	27.3	3.7	29.6	62.5	
	Nitoukou	27.3	44.4	16.7	12.5	
	Ombessa	18.2	40.7	20.4	12.5	
Level of education (%)	Illiterate	0.0	0.0	11.1	62.5	<0.001
	Primary	9.1	14.8	74.1	12.5	
	Secondary	90.9	85.2	14.8	0.0	
	Superior	0.0	0.0	0.0	25.0	
Age (year)	Mean	42.5^{b}	38.3^{b}	50.4^{ab}	58.5^{a}	<0.001
	(SD)	(11.5)	(9.5)	(10.3)	(9.2)	
Profession (%)	Farmer	72.7	77.8	96.2	100.0	0.016
	Housekeeper	18.2	18.5	1.9	0.0	
	Other	9.1	3.7	1.9	0.0	

Legend: Cluster 1: Intensive and biodiversity-conserving system (11%); Cluster 2: Extensive and biodiversity-conserving system (27%); Cluster 3: Extensive system that does not conserve biodiversity (54%) and Cluster 3: Semi-intensive system that does not conserve biodiversity (8%).

Table 2. Cultivation practices amongst farmers in Mbam and Inoubou by cluster

Variables	Modalities	Cluster				P
		C1	C2	C3	C4	
Production objectives (%)	Ali	0.0	11.1	11.1	25.0	0.155
	Ali-cul	18.2	3.7	3.7	12.5	
	Ali-eco	18.2	25.9	27.8	37.5	
	Ali-eco-cul	54.5	59.3	57.4	25.0	
	Eco	9.1	0.0	0.0	0.0	
Association (%)	No	18.2	7.4	18.5	50.0	0.059
	Yes	81.8	92.6	81.5	50.0	
Number of associations	Mean (SD)	2.1[a] (1.4)	2.1[a] (1.3)	2.0[a] (1.3)	1.2[a] (1.6)	0.432
Number of cultivars	Mean (SD)	3.5[a] (1.2)	3.6[a] (1.2)	3.3[a] (1.4)	4.0[a] (1.3)	0.466
Biodiversity conservation (%)	Yes	63.6	74.1	40.7	37.5	0.026
	No	36.4	25.9	59.3	62.5	
Fertility level (%)	Little fertile	81.8	66.7	64.8	87.5	0.502
	Fertile	18.2	33.3	35.2	12.5	
Fertilization (%)	No	18.2	100.0	96.3	62.5	<0.001
	Yes	81.8	0.0	3.7	37.5	
Disease symptoms (%)	No	9.1	0.0	3.7	12.5	0.148
	Yes	90.9	100.0	96.3	87.5	
Disease control (%)	No	45.5	44.4	63.0	50.0	0.379
	Yes	54.5	55.6	37.0	50.0	
Pest damage (%)	No	0.0	18.5	11.1	12.5	0.489
	Yes	100.0	81.5	88.9	87.5	
Insecticide use (%)	No	0.0	66.7	75.9	25.0	<0.001
	Yes	100.0	33.3	24.1	75.0	
Number of weeding operations	Mean (SD)	2.5[a] (0.8)	2.4[a] (0.7)	2.8[a] (1.0)	2.1[a] (0.4)	0.120

Legend: Ali: Alimentary; Cul: Cultural; Eco: Economy. Cluster 1: Intensive and biodiversity-conserving system (11%); Cluster 2: Extensive and biodiversity-conserving system (27%) ; Cluster 3: Extensive system that does not conserve biodiversity (54%) and Cluster 3: Semi-intensive system that does not conserve biodiversity (8%).

Table 3. Cultivar diversity amongst farmers in Mbam and Inoubou by cluster.

Cultivars	Culture	Cluster				P value
		C1	C2	C3	C4	
Boucle jaune	No	54.5	55.6	48.1	50.0	0.928
	Yes	45.5	44.4	51.9	50.0	
Boucle Blanche	No	45.5	22.2	38.9	12.5	0.207
	Yes	54.5	77.8	61.1	87.5	
Boucle violet	No	100.0	85.2	94.4	100.0	0.247
	Yes	0.0	14.8	5.6	0.0	
Violet	No	54.5	77.8	74.1	75.0	0.520
	Yes	45.5	22.2	25.9	25.0	
Igname riz	No	18.2	33.3	44.4	50.0	0.328
	Yes	81.8	66.7	55.6	50.0	
Bamiléké	No	45.5	66.7	68.5	50.0	0.410
	Yes	54.5	33.3	31.5	50.0	
De table/Kalabar	No	81.8	74.1	66.7	25.0	0.044
	Yes	18.2	25.9	33.3	75.0	
Safa	No	81.8	59.3	74.1	87.5	0.288
	Yes	18.2	40.7	25.9	12.5	
Sweet white	No	72.7	70.4	63.0	50.0	0.678
	Yes	27.3	29.6	37.0	50.0	

Legend: Cluster 1: Intensive and biodiversity-conserving system (11%) ; Cluster 2: Extensive and biodiversity-conserving system (27%) ; Cluster 3: Extensive system that does not conserve biodiversity (54%) and Cluster 3: Semi-intensive system that does not conserve biodiversity (8%).

Yam producers in Mbam and Inoubou are gradually moving towards an intensive cultivation system that uses fertilizers and pesticides. However, the majority of producers still maintain subsistence yam cultivation without the use of fertilizers and pesticides (Ngue-Bissa et al., 2007). In fact, the use of fertilizers is considered a shameful practice, and many producers do not publicly state that they use them.

Production constraints

Only 3% of producers have no production constraints, and each producer has an average of two production constraints. Six constraints to yam production were identified in the study area (Table 4). Five constraints are present throughout the study area as soil infertility is not a production constraint in Bokito. The main constraint is the presence of pests (54%). However, the prevalence of these pests is lower (only 24%) in Ombéssa than in the other districts ($P < 0.05$). 36% of producers complained about laborious cultivation practices. Similarly, 34% reported the presence of diseases on their farms. Climatic hazards (19%), lack of seed (16%) and soil infertility (10%) also limit yam production. Soil infertility

is felt more in Ombéssa than in the other districts. Indeed, one quater of the yam producers in Ombéssa consider that their soil is not fertile.

Table 4. Percentage of yam production constraints in Mbam and Inoubou according to the different sub-divisions.

Variables	Modalities	Sub-division				Total	p
		Bokito	Ndjikiniméki	Nitoukou	Ombessa		
Number of difficulties	Mean (SD)	1.9[a] (1.0)	1.8[a] (0.8)	1.8[a] (1.1)	1.7[a] (0.8)	1.8 (0.9)	0.934
No difficulties	Not	96.0	100.0	96.0	96.0	97.0	1.000
	Yes	4.0	0.0	4.0	4.0	3.0	
Pests	Not	40.0	40.0	28.0	76.0	46.0	0.005
	Yes	60.0	60.0	72.0	24.0	54.0	
Hardworking culture	Not	60.0	60.0	68.0	68.0	64.0	0.902
	Yes	40.0	40.0	32.0	32.0	36.0	
Diseases	Not	56.0	80.0	68.0	60.0	66.0	0.282
	Yes	44.0	20.0	32.0	40.0	34.0	
Climatic hazards	Not	76.0	88.0	84.0	76.0	81.0	0.672
	Yes	24.0	12.0	16.0	24.0	19.0	
Insufficient seed	Not	84.0	80.0	84.0	88.0	84.0	0.981
	Yes	16.0	20.0	16.0	12.0	16.0	
Soil fertility	Not	100.0	88.0	96.0	76.0	90.0	0.025
	Yes	0.0	12.0	4.0	24.0	10.0	
Other difficulties	Not	96.0	92.0	96.0	84.0	92.0	0.516
	Yes	4.0	8.0	4.0	16.0	8.0	

The main production constraints for yam producers in Mbam and Inoubou are pests, laborious cultivation, diseases, climatic hazards, lack of seed, and soil infertility. These findings are consistent with previous studies, which have identified similar constraints to yam production in Cameroon (Lyonga, 1976; Ngeve, 1998; Ngassam et al., 2007). Although the yam cultivar Ombessa is not very affected by pests, pests are still the main production constraint in Mbam and Inoubou. This is because Ombessa has more producers who use insecticides than the other departments. On the other hand, the use of fertilizers does not solve the problem of soil infertility. Studies have shown that yam responds favorably to fertilizer application, but it is difficult to determine the optimum amount of fertilizer to apply (Azeteh et al., 2019). This is because the effects of mineral elements such as N, P, and K vary according to ecological and soil conditions, previous crops, application conditions, and cultivation methods (Adifon et al., 2019).

Profit from yam cultivation

It is noteworthy that yam cultivation is an annual affair, and post-harvest, some producers venture into markets to sell their produce. On average, each producer earns 136,457 FCFA/year. Interestingly, this benefit remained consistent across all districts (p> 0.05).

Table 5. Determination of the average income in FCFA of a producer according to district

	Sub-division				Total	P > F
	Bokito	**Ndikiniméki**	**Nitoukou**	**Ombessa**		
	10 800±2 689	10 846±1 519	11 933±1 831	9 888±1 054	11 000±1 942	0.081
Revenue	102 450±73 541	298 307±259 436	257 333 ±236 451	198,888 ±70 257	224 521±214 141	0.151
Expenses	36 800±25 103	104 615±83 602	61 133±65 813	70 000±25 000	69 680 ±63 066	0.067
Profit	65 650±54 252	193 692±129 868	138 600±116 574	128 888 ±76 883	136 457±104 978	0.197

Yam cultivation offers potential benefits to farmers in Mbam and Inoubou, with an average annual income of 136,457 FCFA. However, the majority of the yam production is consumed by the farmers themselves, limiting its potential as a profitable commercial crop. Despite this, yam cultivation remains an important subsistence activity in the region (Ngue-Bissa et al., 2007).

Conservation determinants of yam biodiversity

The study showed that that 48% of yam farmers reduced the number of cultivars they grow. The detailed results of the binomial regression model (Table 6) showed that multiple factors affect the conservation, or no conservation of yam cultivars. Indeed, the cultivation of certain cultivars, such as "*boucle jaune*", "*blanche sucrée*", and "*boucle violet*", is positively correlated with cultivar conservation. This means that farmers who grow these cultivars are more likely to conserve other cultivars as well Farmers who have a secondary education are also more likely to conserve cultivars. This may be because they have a better understanding of the importance of biodiversity. On the other hand, farmers who experience pest damage are more likely to reduce the number of cultivars they grow. This is because they may be more focused on maximizing their yields, and may not have the resources to maintain a diverse crop portfolio. Finally, farmers who grow yams for food, cultural, or economic reasons are less likely to conserve cultivars. This is because they may have specific preferences for certain cultivars, and may not be interested in maintaining a diverse crop portfolio.

The result of the analysis regarding the identification of significant variables in the model shows that the number of cultivars grown by a farmer does not have a significant impact on whether or not they conserve cultivars (Table 7). This suggests that other factors, such as the ones listed above, are more important determinants of cultivar conservation.

Table 6. Factors affecting cultivar conservation in the study area

Coefficient	Estimate	Std. Error	z value	P (> z)
Intercept	1.8817	1.4574	1.291	0.19668
Boucle jaune_Yes	**1.6583**	**0.6004**	**2.762**	**0.00575**
Blanche sucrée_Yes	**1.1839**	**0.5930**	**1.997**	**0.04587**
Boucle violet_Yes	**3.1346**	**1.3345**	**2.349**	**0.01883**
Number of cultivars	-0.3004	0.2276	-1.320	0.18692
PO_Ali-cul	**-3.8370**	**1.4095**	**-2.722**	**0.00648**
PO_Ali-eco	-1.5394	0.9176	-1.678	0.09341
PO_Ali-eco-cul	**-2.9681**	**0.9549**	**-3.108**	**0.00188**
PO_Eco	-17.5386	1455.3979	-0.012	0.99039
Study_Primary	1.4327	0.9692	1.478	0.13933
Study_Secondary	**2.4452**	**1.0327**	**2.368**	**0.01790**
Study_Superior	0.6628	1.7960	0.369	0.71209
Pests_Yes	**-2.0540**	**0.8235**	**-2.494**	**0.01262**

Legend : Std.Error: Standard Error; P(> z): Probability. Probability values that are significant at 0.05 level are in bold. PO : Production objective.

Table 7. Marginal effect analysis on determinants of cultivars conservation

Variables	Df	Deviance	AIC	LRT	P(> Chi)
<none>	/	104.20	130.20	/	/
Boucle jaune	1	112.75	136.75	8.5502	0.003455
Blanche sucrée	1	108.38	132.38	4.1880	0.040711
Boucle violet	1	111.98	135.98	7.7801	0.005282
NCC	**1**	**106.01**	**130.01**	**1.8098**	**0.178535**
OP	4	120.11	138.10	15.9090	0.003144
NE	3	112.47	132.47	8.2752	0.040653
Pests	1	111.23	135.23	7.0379	0.007980

Legend: AIC: Akaike Information Criterion ; LRT: Likelihood Ratio Tests ; P(> Chi): Probability values. Probability values that are not significant at 0.05 level are in bold. NCC: Number of cultivars cultivate; PO: Production target; NE: Education level.

Despite the cultural importance of yam in Mbam and Inoubou, yam producers are reducing the number of their cultivars. However, those with a high level of education (secondary) tend to conserve diversity. This is in contrast to the findings of Egah et al. (2012), who found that biodiversity is conserved by illiterate producers in Benin. This difference may be due to the different cultural contexts of the two regions.

Growers who cultivate Dioscorea dumetorum cultivars, such as yellow and purple loop, tend to conserve these cultivars. These cultivars have a problem with post-harvest hardening, are not highly valued, and are not widely grown. Similar observations have been made in Benin, where less appreciated varieties or those of low organoleptic quality are grown to maintain their seeds (Egah et al., 2012). This is also the case for sorghum in North Cameroon, where varieties with poor agronomic or taste qualities are maintained and transplanted on small areas.

In Mbam and Inoubou, producers select yam cultivars based on their production goals. This practice, which has also been observed in northern Benin, puts the biodiversity of yam (Dioscorea sp.) at risk of losing less valuable varieties (Egah et al., 2013). The varietal diversity of yam is therefore threatened and could soon resemble that of sweet potato and sorghum, which have seen their diversity decline by 20 varieties in 50 years in the northern Philippines (Campilan and Prain, 2005) and by 8 varieties in one year in Mali (Bazile and Soumare, 2004).

Climatic hazards are a major threat to yam cultivation, and high temperatures create more favorable conditions for pests. This leads producers in Mbam and Inoubou to select yam varieties based on pest pressure. Indeed, favorable conditions provide an extensive area for yam pests (Villeneuve, 2005), and climate change can lead to genetic erosion of yam (Zoundjihékpon, 1997).

CONCLUSION

This study aimed to characterise the production systems, highlight production constraints, collect cultivars for characterisation, and determine the factors for conserving genetic diversity in Mbam and Inoubou. The Multiple Correspondence Analysis (MCA) showed the existence of four production systems. Eleven percent of producers use the intensive system that conserves biodiversity, 27% of producers use the extensive system that conserves biodiversity, 54% of producers use the extensive system that does not conserve biodiversity, and 8% of producers use the semi-intensive system that does not conserve biodiversity. Pests, laborious cultivation, diseases, climatic hazards, lack of seeds, and soil infertility are the main production constraints for producers in Mbam and Inoubou. Climatic hazards are also responsible for the susceptibility of cultivars to pests, leading to a reduction in the number of cultivars. In addition to pests, the production objective negatively affects the genetic conservation of yam. On the other hand, producers who grow yellow yam, sweet yam, and purple yam tend to conserve cultivars, and producers with secondary education conserve genetic diversity more than producers with other education levels.

Acknowledgements

Our sincere gratitude goes to the departmental delegate for agriculture and the heads of post who helped us identify the yam production areas and provided the data that we used to reach the farmers. We

would also like to express our appreciation to NKAMA ADALA Anais Cybelle and AYIBISSE Agnès Carine for their invaluable contribution in collecting the data

REFERENCES

Adegun, M.K. 2020, Comparison of the growth and economic values of maize and yam peel based supplement fed to West African dwarf rams. Journal of. Animal. Science and. Livestook. *Prod. 4*, 2.

Adifon FH, Yabi I, Vissoh P, Balogoun I, Dossou J, Saïdou A. 2019. Écologie, systèmes de culture et utilisations alimentaires des ignames en Afrique tropicale : synthèse bibliographique. Cah. Agric. 28: 22.

Atieno V., Gatheri G. W., Kamau J. W. and Muthini M. 2020. Morphological and molecular characterization of cultivated yam (Dioscorea species) in selected counties in Kenya. African Journal of Plant Science 14(7):270-279.

Azeteh N. I., Hanna R., Nekongo S. P., Achiangia P. N., and Lava K. P. 2019. Yam (*Dioscorea* spp.) production trends in Cameroon: A review. African Journal of Agricultural Research. Vol. 14 (26), pp. 1097-1110.

Bazile D. et Soumare. M. 2004. Gestion spatiale de la diversité variétale en réponse à la diversité écosystémique : le cas du sorgho (*Sorghum bicolor* (L.) Moench) au Mali. Évolution des pratiques et dynamique des territoires 13 : 480 - 487.

Bhattacharjee, R., M. Gedil, A. Sartie, E. Otoo, D. Dumet, H. Kikuno, P.L. Kumar, and R. Asiedu. 2011. "Dioscorea." In *Wild Crop Relatives: Genomic and Breeding Resources*, edited by C. Kole, 71–96. Industrial Crops, Springer, Berlin Heidelberg. https://doi.org/10.1007/978-3-642-21102-7_4.

Campilan D. et Prain. G. 2005. Utilisation des connaissances locales pour conserver la diversité de la patate douce aux Philippines. *In* Conservation et utilisation durable de la biodiversité agricole. Guide de référence 1: 83 - 88 .

Coursey DG. 1976. The origins and domestication of yams in Africa. In: Harlan JR, de Wet JMJ, Stemler ABL. (Eds.), Origins of African plant domestication. Monton, Hague pp. 383-403.

Dansi A, Dantsey-Barry H, Dosou-Aminon I, N'kpenu EK, Agre A P, Sunu YD, Kombate K, Loko YL, Dansi M, Assogba P, Vodouhe R. 2013. Varietal diversity and genetic erosion of cultivated yams (*Dioscorea cayenensis* Poir – D. rotundata Lam complex and D. alata L.) in Togo. International Journal of Biodiversity Conservation 5(4):223-239.

Egah J., Baco M. N., Moumouni I. M. et Nouatin G. S. 2013. Les paysans maintiennent-ils la biodiversité dans un contexte de changement climatique ? une étude de cas de l'igname au nord-bénin. Agronomie Africaine 25 (3) : 285 – 297.

Egah J., Baco N., M. et Moumouni I. 2012. Dynamique de gestion de la biodiversité d'igname face au développement du vivrier marchand au nord-Bénin. *VertigO*, *12*(3).

FAOSTAT. 2019. Available at http://www.fao.org/faostat/fr/#data. On 14 June 2024

Food and Agriculture Organization of the United Nations (FAOSTAT). Statistics, Rome, Italy. Available online: www.fao.org/statistics/en (accessed on 19 January 2023)

Fox, J. & Weisberg, S. 2019. An R Companion to Applied Regression, Third edition Sage, Thousand Oaks CA. https://s ocia lscie nces.mcmas ter. ca/ jfox/ Books/ Compa nion

Lyonga SN (1976). Production investigation on edible yams (Dioscorea spp.) in the Western and Northwestern highland savannah zone of the United Republic of Cameroon. PhD Thesis, University of Ibadan 298 p.

Lyonga SN. 1976. Production investigation on edible yams (*Dioscorea* spp.) in the Western and Northwestern highland savannah zone of the United Republic of Cameroon. PhD Thesis, University of Ibadan 298 p.

Ngassam SB, Malaa DK, Ngome TP, Aighewi A.B. 2007. Analyse diagnostique des circuits de commercialisation de l'igname au Cameroun : atouts et contraintes. In : Nkamleu B, Annang Bacco D. N.M. 2009. Securing livelihoods through yams (SLTY); Proceedings of a Technical Workshop on the Progress in Yam Research for Development in West and Central Africa held in Accra Ghana, 11-13th September 2007. IFAD TAG 704, IITA, Nigeria, pp. 79-94.

Ngeve JM. 1998. L'igname au Cameroun : contraintes de production, acquis de la recherche et perspective pour l'avenir. In : Berthaud N, Bricas N, Marchand JL. (Eds.), L'igname, plante séculaire et culture d'avenir. Acte du Séminaire International Cirad-Inra-Orstrom-Coraf. Azeteh et al. 11093-6 Juin 1997, Montpellier, France pp. 401-407.

Ngue-Bissa T, Mbairanodji A, Njualem DK. 2007. Technical guide for the production and conservation of yams (Dioscorea spp.). PNDRT, Yaoundé, Cameroon 33 p.

Nweke, F. I. 2016. *Yam in West Africa: Food, Money and More*. East Lansing, Michigan: Michigan State University Press

Obidiegwu, J.E.; Lyons, J.B.; Chilaka, A.C. 2020. The *Dioscorea Genus* (Yam)—An appraisal of nutritional and therapeutic potentials. *Foods*, *9*, 1304.

Oksanen, J. 2019. Vegan : Community Ecology Package R package version 25-6. https:// cran.r- proje ct. org/ package= vegan.

Perrot N., Gonne S. et Mathieu B. *sd* : Biodiversité et usages alimentaires des sorghos *muskuwaari* au nord-Cameroun. 15 p.

Villeneuve C. 2005. Vivre les changements climatiques. Conférence au CEGEP de Ste-Foy du 20 octobre 2005. Université du Québec à Chicoutimi, Département des sciences fondamentales. 42 p.

Xie, Y. 2020. knitr: A General-Purpose Package for Dynamic Report Generation in R. R package version 129.

Zoundjihékpon J., Dansi A., Mignouna J. H., Kouakou A. M., zongo J., N'Kpènou K. E., Camara F., Kourouma S., Sanou H., Bélem J. Oossou R., Vernier P., Dumont R.Y., Hamon P. et TioTouré B.Y. 1997. Gestion des ressources génétiques des ignames africaines et conservation in situ. Aménagement et nature 135 : 85-93.