Typology of Agricultural Holdings: Characterization and Access to Agricultural Credit in the Groundnut Basin of Senegal

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Abstract

This study aimed to characterize farming systems and assess access to agricultural credit in Senegal's Peanut Basin. A total of 503 producers from Kaffrine and Kaolack were surveyed using a semi-structured questionnaire. Data were analyzed through hierarchical clustering, principal component analysis, and analysis of variance. Five farm types emerged. Type 1 (56.7%) producers sell directly to *Lumas*, lack irrigation, and have no access to credit. Type 2 (14.9%) cultivate the largest areas and invest heavily in inputs, but face repayment constraints and limited credit information. Type 3 (0.06%) sell directly to consumers, do not belong to organizations, yet access the highest agricultural loans, though they struggle to secure inputs; they earn the highest livestock income. Type 4 (16.9%) belong mostly to producer organizations, sell via intermediaries, self-finance or obtain loans from MFIs/PAMECAS, and secure the largest credit amounts, but lack collateral. Type 5 (0.05%) cultivate the smallest plots, rely on equity or bank loans, and obtain the lowest credit due to high interest rates, which also limit access to inputs. Future research will analyze the impact of credit on agricultural productivity among types 3, 4, and 5.

Introduction:

Agriculture in Senegal is predominantly rain-fed and remains highly sensitive to variations in seasonal rainfall (Diaw, 2003). The sector combines both cash crops, such as groundnut and cotton, and staple cereals including millet, sorghum, and maize. In 2020, agriculture employed nearly 69% of the labor force and contributed around 17% to the national gross domestic product (GDP), with about 3.4 million hectares cultivated and export earnings estimated at €700 million (Diouf et al., 2021). This central role is further reflected in the 2021/2022 agricultural budget, which increased by 16% to 70 billion CFA francs, up by 10 billion compared to the previous year (Council of Ministers, 2022).

The agricultural landscape is largely dominated by smallholder family farms, representing close to 90% of holdings. These farms typically combine subsistence production with cash crops and are often complemented by extensive or semi-intensive livestock systems (Guèye et al., 2008). Alongside this traditional structure, new entrepreneurial and commercial farms are emerging, particularly in high-value sectors such as horticulture for export markets and rice, onion, and potato production for domestic consumption (Pene, 2003). According to Diao

(1999), Senegalese agriculture is shaped by two dominant models: capital-intensive agribusinesses concentrated in areas such as the Niayes and the Senegal River Valley, and smallholder family farming. While agribusinesses account for only about 5% of farms (Ministry of Agriculture, 1998), they are characterized by mechanization, irrigation, reliance on wage labor, and weak integration with family-based systems. In contrast, smallholder farms rely primarily on family labor and cultivate small plots mainly devoted to millet, sorghum, maize, and groundnut (Pene, 2003).

Groundnut remains the most widespread crop, especially in the Groundnut Basin, where it constitutes the main source of household income (Bah, 2010). Despite its multifunctional valueas food, fodder, oil, and industrial input—the groundnut sector faces persistent challenges such as declining yields and insufficient supply for processing industries (Guèye *et al.,* 2008). These difficulties reinforce broader concerns regarding food security and rural livelihoods, where access to agricultural finance and inputs emerges as both critical and problematic (Diouf *et al.*, 2021).

More broadly, access to credit in agriculture within the West African Economic and Monetary Union (WAEMU) remains limited, with only 14% of total loans directed to the sector, and most of these being short-term (Lesaffre, 2000). Microfinance institutions (MFIs) further prioritize trade and services (79.18%), with only a modest share (16.4%) allocated to agriculture and livestock (Sossa, 2011). Diaw (2003) highlights the lack of comprehensive information on farming systems including typologies, structural organization, cultivated areas, production constraints, and financing mechanisms which has shaped narratives portraying agribusiness as the engine of development while marginalizing smallholder farmers, sometimes perceived as barriers to progress.

Materials and Methods

Study Area

This research was carried out in the Groundnut Basin of Senegal, focusing on the regions of Kaffrine and Kaolack. Within these two regions, six departments were selected for analysis due to the predominance of agricultural activities (Figure 1).

Kaolack is one of Senegal's 14 administrative regions (Fall, 2006). It is situated at the transition between the southern Sahelian and northern Sudanian ecological zones, spanning approximately 14°30′ to 13°30′ North latitude and 14°30′ to 16°30′ West longitude. The region borders Fatick to the north and west, The Gambia to the south, Diourbel to the northeast, and Kaffrine to the east. The relief is largely flat, and three principal soil types prevail: leached tropical ferruginous soils, hydromorphic soils, and halomorphic soils (Top, Arame, & IFDC, 2025). Ecologically, Kaolack includes a subzone well known as the "old Groundnut Basin," which encompasses nearly three-quarters of the department. This subzone supports about two-thirds of the region's population, and groundnut cultivation is its primary agronomic activity (Assessment of Farmers' Groundnut Varietal Trait Preferences and Production Constraints, 2021).

Kaffrine, located roughly 250 km from Dakar, covers about 11,492 km², constituting nearly two-thirds of what was formerly the Kaolack administrative region. It is among Senegal's five largest regions. The climate is Sahelian, characterized by a long dry season and a brief rainy season of about three months. The population's livelihoods are based on agriculture, livestock breeding, and trade. Agro-pastoralism supports approximately 75% of the inhabitants, with millet and groundnut being the main crops (Assessment of Farmers' Groundnut Varietal Trait Preferences and Production Constraints, 2021; SCALA Programme, 2025).

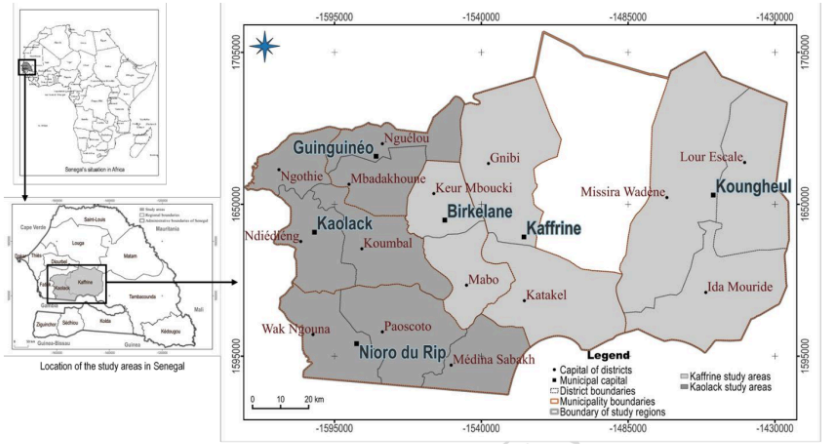


Figure 1: Geographical Location of Surveyed Municipalities

Selection of Study Sites

The selection of villages for this study was primarily guided by criteria related to agricultural practices and the level of awareness regarding the conditions and requirements for accessing agricultural credit and financing. These included knowledge of funding sources, microfinance institutions, groundnut cultivation, and availability of collateral, interest rates, loan repayment conditions, farmers' perceptions of credit amounts, and the mechanisms used by microfinance institutions to recover funds. Additionally, familiarity with agricultural production constraints and the costs associated with accessing inputs were considered (Mbesse et al., in preparation). Supplementary criteria included land availability, year-round accessibility of the area, and the willingness of producers to collaborate with the research team. Based on these parameters, a total of 67 villages were selected across the two regions (see Appendix). Prior to the main field survey, an exploratory study was conducted to provide an overview of the conditions governing access to agricultural credit within the study area (Mbesse et al., in preparation).

Sampling Method

The sample size (N) was determined using the normal approximation of the binomial distribution as proposed by Dagnelie (1998):

$$N = \left[\left(U_{1-\frac{\alpha}{2}}\right)^2 \times p(1-p)\right] / d^2$$

Let:

$U_{1-\alpha/2}$ the value of the standard normal variable corresponding to the probability $1-\alpha/2$, where α represents the margin of error. For $\alpha=5\%$, the probability $1-\alpha/2 = 0{,}975$ yielding $U_{1-\alpha/2} = 1{,}96$. P denotes the proportion of producers with at least 10 years of agricultural experience who meetthe conditions for accessing agricultural credit within the study area.And d ($1\% \leq d \leq 15\%$), is the estimation error margin, set at 5% for this study.

Based on the values of P derived from the exploratory phase of the study, a total of 503 producers were selected from the study area. The distribution was as follows: 45 producers from Birkelane, 30 from Guinguineo, 44 from Kaffrine, 131 from Kaolack, 108 from Koungheul, and 145 from Nioro. The allocation was guided by the relative

importance of total available land and land specifically cultivated with groundnuts. In each locality, respondents were selected using a simple random sampling technique.

Data Collection Methods and Instruments

In each village, producers with a minimum of 10 years of agricultural experience were identified through focus group discussions. However, for the purposes of this study, only those producers who retained knowledge or awareness of agricultural credit systems, had access to agricultural financing, and continued to manage their farms independently were surveyed. Individual interviews were conducted following the methodology described by Bello et al. (2017), involving all 503 selectedproducers (Mbesse et al., in preparation). Data collection in each selected village employed a combination of structured questionnaires, individual and group interviews, and field visits (Kombo *et al.*, 2012; Bello *et al.*, 2017). The data gathered included socio-economic characteristics of the surveyed households (gender, age, education level, farm size, income, access to credit, marital status, and membership in producer organizations), constraints related to agricultural production and credit access, criteria and conditions for accessing credit and markets, input costs, among others. Actual land area figures were adjusted based on discrepancies between self-reported values and GPS measurements taken using a Garmin eTrex 20 device, from a sample of five producers per village (Balogoun *et al.*, 2014).

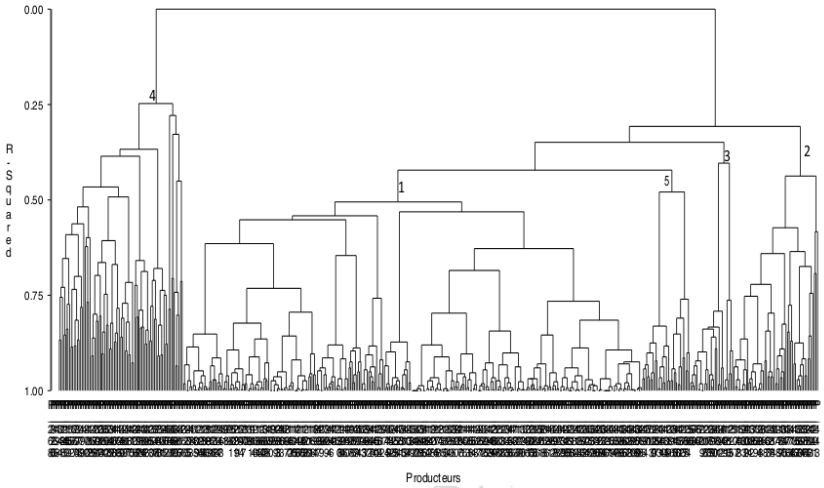
Statistical Analysis Methodology

The collected data were coded, entered, and processed using SPSS (Statistical Package for Social Sciences), version 20.0 (Norusis, 2002), to generate descriptive statistics expressed as percentages.To establish a typology of producers, survey data were subjected to ascending hierarchical classification using the Statistical Analysis System, version 9.2 (SAS v. 9.2), with producer classes defined based on a determination coefficient threshold of $R^2 = 0.50$ (Sossa et al., 2014).Qualitative variables were generally coded as binary indicators: a value of 1 was assigned if the producer confirmed the practice, and 0 otherwise. For example: Marital status: 1 = married, 0 = not married; membership in a producer group: 1 = yes, 0 = no;access to financing: 1 = yes, 0 = no;perception of loan repayment duration: 1 = acceptable, 0 = not acceptable, etc.To analyze the characteristics of each producer group, a Principal Component Analysis (PCA) was performed on the typologies derived from the hierarchical classification using MINITAB 14, following the methodology of Bello et al. (2017). This allowed for a more nuanced description of the groups based on their distinguishing features.For quantitative data, an analysis of variance (ANOVA) was conducted, followed by a multiple comparison test using the Least Significant Difference (LSD) method at a 5% probability level (Dagnelie, 1986), to further characterize the identified producer types.

Results

Typology of Agricultural Holdings in the Groundnut Basin of Senegal

The numerical classification performed on the entire sample of producers in the Groundnut Basin of Senegal resulted in the identification of five distinct producer types. This classification was based on key variables characterizing production systems, including: producer age, cultivated land area, crop marketing methods, production constraints, access to financing, agricultural financing institutions, expenditures on input acquisition (seeds, pesticides, fertilizers), income from livestock, membership in producer organizations, types and modalities of agricultural financing, and the impacts of credit. The classification yielded a determination coefficient of R2 = 0.50, which was deemed sufficient to produce clearly differentiated groups.The dendrogram presented in Figure 2 illustrates the clustering of the 503 surveyed producers.Type 1 represents the largest group, comprising 285 producers, or 56.66% of the total sample;Type 2 includes 75 producers, accounting for 14.91%.;Type 3 consists of 32 producers, representing 6.36%.Type 4 includes 85 producers, or 16.90% of the sample.Type 5, the smallest group, comprises 26 producers, representing 5.17% of all respondents in the Groundnut Basin of Senegal (Figure 2).



Socioeconomic Characteristics Associated with the Five Producer Types in the Groundnut Basin of Senegal

The results of the Principal Component Analysis (PCA) conducted on the five identified producer types indicate that the first two principal axes alone account for 76.50% of the variance related to the socioeconomic characteristics of the different producer groups. The correlations between the canonical axes and the variables describing production systems are presented in Table 1.Variables such as membership in a producer organization and the sale of harvests at local markets (Loumas) without intermediaries are strongly represented on Axis 1, showing positive correlations. In contrast, variables such as marital status, roadside sales (vente bord champ), and perceptions of repayment timelines are negatively correlated with this axis. On Canonical Axis 2, variables such as sales at Loumas through intermediaries and perceptions of the time required to obtain credit exhibit positive correlations, whereas direct sales to consumers are negatively correlated (Table 1).

Table 1. Correlations Between Socioeconomic Variables and Discriminant Axes.

Variables	Axis 1	Axis 2	Axis 3
Marital Status	-0,414*	-0,158ns	-0,121ns
Membership in a Producer Organization	0,346*	0,254ns	0,304*
Roadside Sales (Vente bord champ)	-0,427*	0,171ns	-0,015ns
Direct Sales to Consumers	0,034ns	-0,601*	-0,08ns
Sales at Local Markets (Loumas) with Intermediaries	0,075ns	0,524*	-0,324*
Sales at Local Markets (Loumas) without Intermediaries	0,408*	-0,217ns	0,122ns
Provision of Collateral (DonAppor)	-0,248ns	0,024ns	0,562*
Duration Required to Obtain Credit	-0,216ns	0,325*	0,471*

(duréedemObtCredi)			
Perception of Repayment Period (ApprDelai)	-0,371*	-0,279ns	0,223ns

*ns: not significant; * : significant*

Projection of Socioeconomic Characteristics Across the Axes Defined by the Five Producer Type

The projection of socioeconomic characteristics onto the system of axes defined by the five producer types (Figure 3) reveals distinct patterns. Type 1 producers (56.66%) are predominantly single, widowed, or divorced individuals with no formal education. They tend to sell their agricultural products directly at Loumas without the involvement of intermediaries. In contrast, Type 5 producers exhibit opposing traits: they are mostly married, sell their harvests at roadside locations (bord champ), and consider the loan repayment periods offered by microfinance institutions to be ideal.

Type 3 producers engage in direct sales to consumers and actively contribute to securing agricultural credit from financial institutions. Regarding Type 4 producers (16.90%) and those of Type 5, both groups typically sell their produce at Loumas through intermediaries and are largely affiliated with farmer organizations (Figure 3). Conversely, Type 3 producers (0.06%) are not members of any producer group or cooperative (Figure 3).

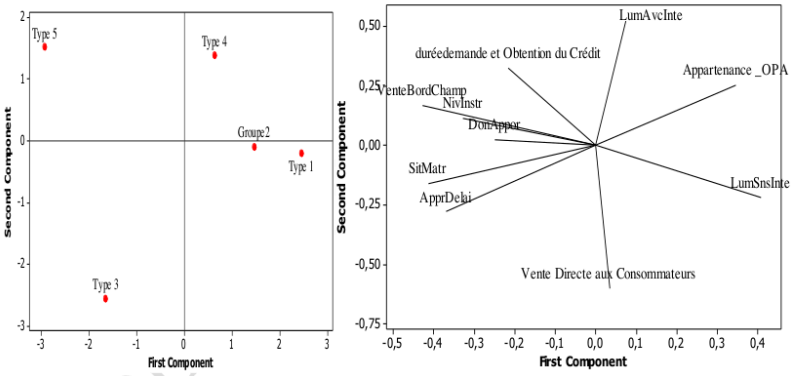


Figure 3: Socioeconomic Characteristics of Each Producer Group in the Groundnut Basin of Senegal

The analysis of variance (ANOVA) and the least significant difference (LSD) test performed on the quantitative data obtained from the classification (Table 2) revealed that the age of producers does not vary significantly ($p > 0.05$) across producer types. However, producers in group 2 cultivate the largest agricultural areas ($p < 0.05$), particularly for groundnut production in the Senegalese Groundnut Basin. They are followed by producers in group 4 (16.90%). Conversely, the analysis of Table 2 shows that producers in group 1 cultivate ($p < 0.05$) the smallest agricultural areas.

Table 2: Cultivated area (Mean ± Standard Error) according to producer types

Producer types	Age (years)	Groundnut area (ha)	Maize area (ha)	Millet area (ha)	Watermelon area (ha)	Sorghum area (ha)	Total area (ha)
Type 1	47,68±0,7	3,24±0,11b	1,35±0,05b	2,73±0,07b	0,69±0,11b	1,14±0,10b	6,81±0,19c

Type 2	51,80±2,05	8,10±1,07a	2,42±0,34a	5,07±0,42a	2,08±0,21a	2,56±0,30a	15,99±1,47a
Type 3	55,25±2,80	2,94±0,57b	1,67±0,33b	2,38±0,46b	-	1,0±0,0b	6,06±1,09c
Type 4	54,25±1,66	5,09±0,40b	2,0±0,3a	4,36±0,35a	1,94±0,49a	2,43±0,74a	11,29±0,86b
Type 5	47,71±5,03	2,50±0,84b	1,10±0,10b	2,30±0,46b	-	-	4,74±1,35c
Fisher's valu	4,52	26,58	7,24	24,96	6,26	8,19	39,48
Probability	0,10	<0,001	<0,001	<0,001	0,005	<0,001	<0,001

Means followed by the same alphabetical letters are not significantly different (P > 0.05) according to the least significant difference (LSD) test

Investment in input acquisition and access to agricultural credit according to producer types

The results of the Principal Component Analysis (PCA) conducted on the five producer types reveal that the first two axes alone account for 76.90% of the information related to the different producer groups regarding credit access modalities. The correlations between the canonical axes and the credit access variables of the production systems are presented in Table 3. Variables such as Own Funds plus IMF, PAMECAS (Partnership for Savings Mobilization and Credit in Senegal), Joint Guarantee, and Equipment plus Agricultural Land are positively correlated with canonical

Table 3: Correlations between credit access variables and discriminant axes

Variables	Component 1	Compoent 2	Component 3
Banks	-0,143ns	-0,356*	-0,173ns
Own Funds + Bank (FonPrBank)	0,03ns	-0,091ns	0,46*
Own Funds (FonProp)	0,248ns	0,088ns	-0,222ns
Own Funds + Family (FonPropFam)	0,158ns	0,058ns	-0,152ns
Own Funds + IMF (FonPropIMF)	-0,213ns	0,303*	-0,041ns
Own Funds + Informal Sources (FonPropInf)	0,232ns	0,135ns	-0,231ns
Microfinance Institution (IMF)	-0,143ns	-0,356*	-0,173ns
Financing (Financmt)	-0,248ns	-0,088ns	0,223ns
No Institution (AucInstitn)	0,248ns	0,088ns	-0,223ns
Alliance de Crédit et d'Épargne pour la Production (ACEP)	-0,273ns	0,079ns	-0,129ns
Agricultural Bank (BanqAgri)	0,012ns	-0,141ns	0,449*
CrediMutuel	-0,273ns	0,068ns	-0,132ns
MutualCredit (CrediMutuel)	-0,143ns	-0,356*	-0,173ns
PAMECAS (Partnership for Savings Mobilization and Credit in Senegal)	-0,191ns	0,339*	-0,015ns
Interest Rate (TauxInte)	-0,175ns	0,132ns	0,349*
InterestPayment (AppInteret)	-0,267ns	0,136ns	-0,11ns
Loan Duration (DurePret)	-0,264ns	-0,126ns	0,133ns
Collateral (Garantie)	-0,272ns	-0,017ns	-0,154ns
No Collateral (Pas de Garantie)	0,267ns	0,066ns	0,164ns
PersonalGuarantee (CautPersnl)	-0,232ns	-0,206ns	-0,182ns
Joint Guarantee (CautSolid)	-0,191ns	0,339*	-0,015ns

Equipment (EquipTer)	+ Agricultural Land	-0,191ns	0,339*	-0,015ns

*ns: not significant; * : significant*

The projection of credit sources and access modalities within the system of axes defined by the five producer types (Figure 4) reveals that type 1 producers (56.66%) and type 2 producers (14.91%) are those who, for the most part, have no access at all to agricultural financing from any microfinance institution in the Groundnut Basin of Senegal. They finance their production through personal funds or rely on family members. In contrast, type 3 producers obtain credit from banks and institutions such as MFIs and IMCEC, whereas group 4 producers (16.90%) finance their production through personal funds or loans obtained from MFIs and PAMECAS. The latter provide a joint guarantee or pledge agricultural equipment and land as collateral to access agricultural credit from these microfinance institutions. As for type 5 producers, they finance their agricultural production through personal funds, commercial banks, or agricultural banks. However, this category of producers considers access to financing to be difficult due to the high interest rate (13%); axis 2, whereas variables such as Bank, IMF, and IMCEC are negatively correlated, with correlation coefficients ranging between 30% and 45%.

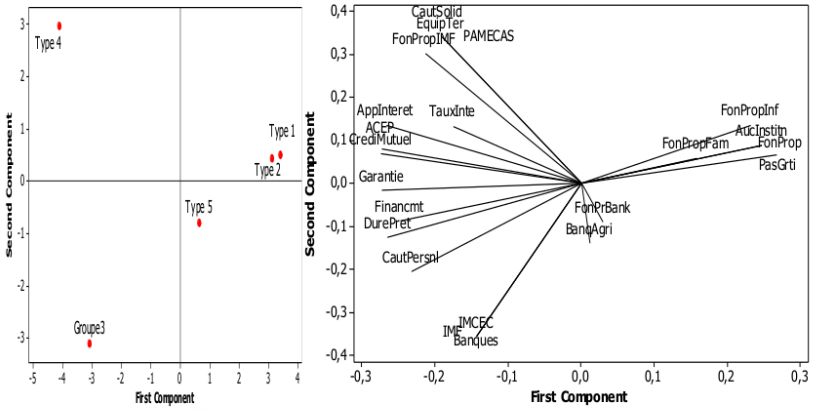


Figure 4: Sources and modalities of credit access according to the five producer types in the Groundnut Basin of Senegal

The analysis of variance (ANOVA) and the least significant difference (LSD) test performed on quantitative data related to credit access and financing in the Groundnut Basin of Senegal, obtained through numerical classification (Table 4), revealed that type 1 and type 2 producerswho constitute the majority do not have access to credit or financing ($p > 0.05$). However, these producers, particularly those of type 2, are the ones who invest most in the acquisition of inputs (seeds, fertilizers, and pesticides) due to the size of their cultivated areas. With respect to credit access, producers in groups 3 and 4 (16.90%) obtain the highest loan amounts ($p < 0.05$) from microfinance institutions, accompanied by substantial personal contributions, whereas those in group 5 receive the lowest credit amounts according to the LSD test. Similarly, type 3 producers derive the highest income from livestock production, in contrast to small-scale producers (type 1), who generate the lowest income (Table 4).

Table 4: Credit access and input expenditures by producer type

Producer types	Fertilizerexpenditure (FCFA)	Pesticide expenditure (FCFA)	Seedexpenditure (FCFA)	Livestockincome (FCFA)	Personal contribution (FCFA)	Creditsreceived (FCFA)
Type 1	96 623,92± 5799,46b	11248,73± 1081,34b	115912,93± 6759,93ab	176441,86± 12932,22b	-	-
Type 2	297 537,74± 67556,16 a	42409,38± 9432,15a	320044,44± 39521,02a	279280,0± 35482,88ab	-	-
Type 3	104642,86± 25818,67b	8500,0± 3271,09b	192 000,0± 58855,76ab	375000,0± 125000,0a	34666,67± 5577,73a	235000,0± 64355,78a
Type 4	137 421,21± 15747,98ab	16 011,63± 2438,90b	185734,09± 22542,06ab	215925,93± 39721,28ab	44031,75± 5742,82a	337 535,21± 50707,36a
Type 5	179 666,67± 124967,11 ab	46 666,67± 21666,67a	33500,00± 6500,0b	-	10000±0,0 b	161 250,00± 11250,0b
Fisher value	11,62	12,99	19,53	3,91	0,69	0,36
Probability	<0,0001	<0,0001	<0,0001	0,01	0,04	0,021

Constraints faced by the five producer types in the Groundnut Basin of Senegal

The results of the Principal Component Analysis (PCA) conducted on the five producer types reveal that the first two axes alone explain 80.60% of the information related to the different producer groups concerning production constraints and access to credit. The correlations between the canonical axes and the credit access variables of the production systems are presented in Table 5. On discriminant axis 1, variables such as credit access constraints, constraints on agricultural product storage, and water scarcity are positively correlated with the axis, whereas difficulties in accessing inputs are negatively correlated with axis 1. This indicates that producer types with access to agricultural credit struggle to obtain inputs, while those with access to inputs in the Groundnut Basin do not always have access to financing (Table 5).

Table 5: Correlations between constraint-related variables and discriminant axes

Variables	Component 1	Component 2	Component 3
Input accessconstraints (Contr_AccesIntra)	-0,347*	-0,206ns	0,146ns
Credit constraints (Contr_Crédit)	0,367*	0,141ns	-0,101ns
Land accessconstraints (Contr_AcceTer)	-0,317*	-0,302*	-0,148ns
Agricultural productstorageconstraints (Contr_ConsevPA)	0,30*	0,17ns	-0,135ns
Water scarcity (Contr_manqEau)	0,338*	0,219ns	-0,141ns
Delayed financing of needs (FinaRepBesoi)	-0,277ns	-0,051ns	-0,51ns
Short repayment duration (ApprDurRemb)	-0,302*	0,349*	0,111ns
Penalty for late repayment (PenalRetaRem)	-0,265ns	0,419*	-0,085ns
Non-compliance with credit by guarantor (RsNCrd_psgrti)	0,045ns	0,499*	-0,32ns
Non-compliance with credit due to repayment delay (RsNCrd_delRembcou)	-0,275ns	-0,022ns	-0,518*
High interest rate on credit	-0,211ns	0,28ns	0,502*

(RsNCrd_Tauxintérét _élevé)			
Lack of information on credit (RsNCrd_ManqInfo)	0,30*	-0,376*	-0,086ns

*ns: not significant; * : significant*

The projection of socioeconomic characteristics within the system of axes defined by the five producer types (Figure 5) reveals that group 1 producers (56.66%), who constitute the majority, face constraints related to access to credit and agricultural financing, problems with agricultural product storage, and water management limitations. In contrast, type 3 and type 5 producers have over 90% access to credit but encounter significant difficulties in obtaining agricultural inputs. Regarding type 4 producers, they appreciate the repayment period granted for loans, but their main constraint is the absence or insufficiency of collateral to access agricultural credit. Type 2 producers (14.91%), on the other hand, experience real difficulties in accessing credit and financing due to very short repayment periods and, above all, a lack of reliable information on credit access (Figure 5).

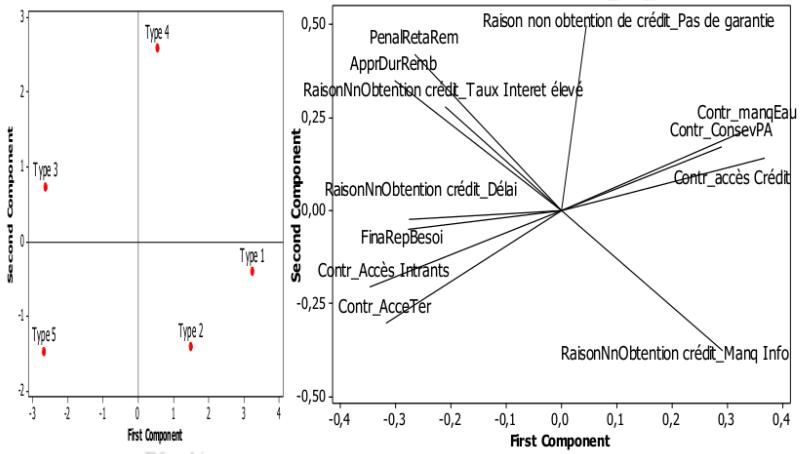


Figure 5: Production and credit access constraints according to the five producer types in the Groundnut Basin of Senegal. The variables prefixed with "Contr" represent constraints

Discussion

Characterization of Agricultural Holdings

The rural sector in developing countries in general, and in Senegal in particular, is composed of a diversity of agricultural holdings, which differ from each other in terms of their structural and functional characteristics (Henintsoa, 2008). These holdings are predominantly small family farms, playing a significant economic and social role through the supply of food to urban areas, the provision of export products, and the maintenance of family solidarity networks, among other contributions (Mbaye, 2010). The typology conducted on the holdings of the

Senegalese Groundnut Basin allowed for the categorization of all producers into five types, each characterized by specific attributes, with an average age that does not vary significantly across types. Similarly, Sossou et al. (2017) found no significant differences in the ages of producer categories in Benin. Type 1 producers (56.66%) cultivate average areas of 6.81 ± 0.19 ha and sell their production directly to Lumas without any intermediaries. They face water scarcity. Type 2 producers (14.91%) cultivate larger areas, averaging 15.99 ± 1.47 ha, and invest the most in input acquisition. Type 3 producers (0.06%) cultivate on average 6.06 ± 1.09 ha, sell directly to consumers, and do not belong to any producer organization; they experience difficulties accessing agricultural inputs. Type 4 producers (16.90%) cultivate an average of 11.29 ± 0.86 ha, sell their production to Lumas through intermediaries, and most belong to a farmers' organization. Type 5 producers (0.05%) are predominantly married, cultivate 4.74 ± 1.35 ha, and sell their harvests at the field edge. Similar findings were reported by Sossa et al. (2014) for pineapple producers in the Allada plateau in Benin. According to these authors, the large number of producer groups identified reflects the diversity of agricultural practices in tropical environments. However, our results, compared to those of Ayena & Yabi (2013), reveal a higher number of groups. According to these authors, cotton producers in northern Benin can be categorized into three homogeneous groups of holdings. Nevertheless, all studies agree on the presence of three categories of actors: large producers, medium producers, and small producers. Accordingly, our results suggest that the most numerous groups, 1 and 3, are medium-scale producers (total cultivated area between 5 ha and 10 ha); groups 2 and 4 represent large producers (total area greater than 10 ha); and group 5 comprises small producers (total area under 5 ha) (Sossou et al., 2017).Contrary to Ayena & Yabi (2013), who found that small producers were the most affiliated with farmers' organizations (FOs), our results indicate that large producers, particularly group 4, are more likely to belong to FOs. This significant difference among producer types may be explained by the need to secure increasingly demanding markets. Moreover, according to Sossou et al. (2017), this situation can be attributed to the regular contact of these producers with extension services. Producers seeking information and market opportunities to improve their production systems tend to rely more on the actors providing this information, such as NGOs, projects, state research centers, or other extension structures. Therefore, their degree of group membership and contact with support services are strongly correlated.Similarly, small producers in group 5 prefer to sell their production directly at the field edge, unlike other producer categories who prefer to sell at Lumas, with or without intermediaries. This result may be explained by the limited resources often observed among small producers (Touré, 2013) and their desire to quickly repay contracted loans.

Access to Agricultural Credit and Inputs by Farm Holdings

The improvement of agriculture requires financial resources, which farmers often do not have at the appropriate time. Consequently, access to credit is fundamental for agricultural diversification. Despite this, agricultural populations either have no access or face significant difficulties accessing financial services. Credit demand is generally scattered and concerns relatively small amounts. Based on the level of access to agricultural credit, farm holdings in the Senegalese Groundnut Basin were categorized into five distinct producer types. Sossou et al. (2017) identified four producer types in Benin according to income and access to financing. However, our results, compared with those of Sossou et al. (2017), also suggest that producers can be classified as poor and vulnerable, moderately prosperous, and wealthy and prosperous. Type 1 producers (56.66%), who constitute the majority, have no access to agricultural financing. Type 2 producers (14.91%) invest the most in input acquisition but face difficulties accessing credit due to very short repayment periods and a lack of information. Type 3 producers (0.06%) obtain agricultural credit (235,000 ± 64,355.78 FCFA) and earn the highest income from livestock (375,000 ± 125,000 FCFA). Type 4 producers (16.90%) finance their production through personal funds or loans obtained from microfinance institutions (MFIs) by providing a sole guarantee. They also receive the highest loan amounts (337,535.21 ± 50,707.36 FCFA) with the largest personal contributions (44,031.75 ± 5,742.82 FCFA). The loan repayment period is generally suitable, although they sometimes lack sufficient collateral to access credit. Type 5 producers (0.05%) finance their production through personal funds, commercial banks, or agricultural banks. They generally receive the lowest loan amounts (161,250 ± 11,250 FCFA) and perceive access to financing as difficult due to the high interest rate (13%). Thus, group 1 producers, who are the most numerous and cultivate on average

6 ha without any access to credit, can be classified as poor. This situation may reflect their persistence in a state of critical vulnerability. According to Abalo (2007), microfinance is often considered one of the major public policy tools for poverty alleviation. Better access for this social group could improve their living conditions. However, considering observed parameters such as water scarcity and direct field sales, the qualitative impact of credit for the poorest farmers may be limited. Their inability to repay loans generally restricts their future access (Henintsoa, 2008). Furthermore, the limited capacity of poor farmers to approach financing sources reflects their precarious access to MFIs. They face substantial barriers due to the absence of MFIs in their villages. According to Pecqueur and Zimmerman (2004), the most effective investments should be designed and implemented at the village and local level. However, MFIs, savings and credit cooperatives, NGOs, and other structures offering microfinance services are not always established close to rural beneficiaries (Touré, 2013). Consequently, poor farmers are strongly limited in establishing any social or professional relationships with these institutions. Information on credit opportunities for agricultural activities rarely reaches them, thereby hindering financing. According to Sohinto (2008), for most developing countries where GDP depends heavily on agricultural production, operating credit constitutes the primary tool for improving agricultural productivity. With credit, each poor farmer could potentially become a micro-entrepreneur and initiate a process of economic accumulation and success (Adégbola et al., 2010). It is therefore urgent to address credit access for the poorest by reforming the financial system in Senegal. Although lacking access to financing, type 2 producers can be considered moderately prosperous despite their large cultivated areas. These producers, who do not belong to any farmers' organization (FO), consider membership in an FO or group as non-essential for obtaining credit. According to Dufumier (2012), in reality, obtaining microcredit requires strict rules, freely accepted by borrowers (e.g., belonging to solidarity groups, providing guarantees, etc.). Consequently, producers with limited resources are often unable to meet these conditions and are restricted from accessing any type of credit (cash or in-kind) for crops. Ideally, such producers should finance their investments themselves (Mbaye, 2010), which is what the majority of type 2 producers do by investing their own funds in acquiring inputs (seeds, fertilizers, pesticides). They also have the greatest access to inputs because they do not wait for MFI credits, which often arrive late, to fund their production. In contrast, type 3, 4, and 5 producers can be considered wealthy and prosperous (Sossou et al., 2017). These producers have very easy access to financial services from microcredit institutions. Moreover, their membership in FOs demonstrates a strong interrelationship with extension services, from which they receive valuable information for accessing agricultural credit. Their easy access to credit is explained by the fact that the requirements for obtaining loans are not considered restrictive, even if collateral is sometimes lacking (Touré, 2013). They generally perceive the conditions for granting credit as fair and interest rates as low, except for group 5, which experiences the highest rate (13%). Yunus (2013) asserts that borrowers must join a solidarity group to obtain a loan. Members of this category thus improve their living conditions through diversification and increased income sources. Diversification becomes possible due to obtained credits and the self-financing capacity of these producers (Ouedraogo & Gentil, 2008), as evidenced by livestock income among type 3 producers. However, type 5 producers mostly obtain credit from commercial or agricultural banks, highlighting the mismatch between the supply and demand of MFI financing (Niyongabo, 2011). These producers report long delays in the availability of MFI credit, with short repayment periods, which hampers repayment. The annual interest rate applied (13%) at banks remains the highest according to producers' perceptions. Current Senegalese legislation sets a maximum annual rate at 27%, and transparency is regulated according to a conventional banking approach, slightly adapted for microfinance (Mbaye, 2010; Touré, 2013). According to a survey by Touré (2013), over half of Senegalese clients (55%) are unaware of interest rates, and some MFIs charge rates exceeding 27%. Consequently, producers' statements regarding applied interest rates may be inaccurate or indicate a lack of understanding of the rates charged. Finally, the dynamism and ease with which wealthy and prosperous farmers access credit are partly explained by their higher education levels, which likely influence their decisions to join groups and acquire new knowledge (Niyongabo, 2011). Regarding clientele, type 3 producers obtain credit from MFIs and IMCEC, while type 4

producers (16.90%) access credit from PAMECAS with a sole guarantee. This suggests that MFIs and IMCEC serve medium-scale producers (5–10 ha), whereas PAMECAS favors large producers (total area >10 ha). Banks generally prefer lending to smallholders (total area <5 ha) due to small loan amounts and uncertain repayment prospects caused by climatic hazards, low yields, and socio-economic instability (Ouedraogo & Gentil, 2008). According to the typology of MFIs by the Senegalese General Directorate of Microfinance, PAMECAS is a mature, large-scale, nationally recognized institution with extensive microfinance experience, and one of the pioneers of microfinance in Senegal (Touré, 2013). Our findings on loan amounts contrast with those of Touré (2013) for rural women, whose loans rarely exceeded 100,000 FCFA. However, both studies agree that the amounts received are insufficient and inadequate for farmers' needs, further illustrating the mismatch between credit supply and demand. These low loan amounts may also result from the absence of MFI subsidization policies (Wyssen, 2007). Analysis of MFI objectives reveals two converging approaches: a social approach, where microfinance should be accessible to the poor, aiming to increase social capital and autonomy (Iserte & Lapenu, 2013); and an approach focused on financial viability and institutional sustainability (Sossou *et al.*, 2020). Microfinance services and products support this dual objective, though critics argue that it may favor the less poor among the poor. These implicit goals drive differentiated modes of intervention (Wyssen, 2007).

Conclusion

This study enabled the categorization of different types of producers in the Senegalese Groundnut Basin. Overall, producers in the area can be grouped into five distinct types. Type 1 represents the vast majority of producers. These producers are predominantly single, face water scarcity, and have no access to agricultural financing. Type 2 producers cultivate the largest agricultural areas and invest the most in input acquisition but encounter difficulties accessing credit and financing due to very short repayment periods and a lack of information. Type 3 producers do not belong to any producer organization but obtain the highest agricultural credit amounts from institutions such as MFIs and IMCEC, with the largest personal contributions. They face challenges in accessing inputs but derive the highest income from livestock. Type 4 producers mostly belong to a farmers' organization and also cultivate large areas. They finance their production through personal funds or loans obtained from MFIs and PAMECAS by providing a sole guarantee. They receive the highest loan amounts along with the largest personal contributions. Although the loan repayment period is generally suitable, they sometimes lack sufficient collateral to access agricultural credit.Type 5 producers cultivate the smallest areas, mostly belong to a farmers' organization, and finance their production through personal funds, commercial banks, or agricultural banks. However, they receive the lowest loan amounts due to high interest rates and face considerable difficulties in accessing agricultural inputs.Future research is planned to investigate the impact of credit obtained by prosperous producers on agricultural productivity in the Senegalese Groundnut Basin.

Acknowledgments

None

Conflict of Interest

The authors declare thatproducers onconflict of interest.

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