PROFITABILITY AND DETERMINANTS OF SESAME PRODUCTION IN SOUTHERN CHAD: AN ANALYSIS FOR STRATEGIC PROMOTION

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Abstract

Sesame is a strategic cash crop in Chad, representing the second largest agricultural export product after cotton. Despite its proven economic potential, the Chad sesame sector continues to face structural challenges that hinder its optimal development. This study aims to bridge the knowledge gap regarding the actual profitability and determinants of sesame production in the province of Logone Occidental, considered the country's agricultural heartland.

The study is based on a quantitative survey of 459 sesame producers, selected through proportional stratified sampling. Data collection covered two agricultural seasons (2023-2025). The analysis combines profitability indicators (net margin, benefit-cost ratio) and an econometric model using Ordinary Least Squares (OLS) to identify the determinants of economic performance.

The results reveal significant profitability, with a net margin of 195,000 FCFA/ha and a benefit-cost ratio of 1.42. The econometric analysis identifies five major positive determinants: the use of improved seeds, cultivated area, access to credit, membership in a producer organization, and farming experience. Conversely, distance to the market reduces profitability by 1,850 FCFA/km. Technology adopters achieve a profitability 76% higher than non-adopters.

To strengthen the sector, four strategic priorities are proposed: facilitate access to quality inputs and credit; consolidate producer organizations; encourage area expansion for economies of scale; and improve market access to reduce transaction costs.

Introduction:

The agricultural sector remains the cornerstone of economic and social development in Africa, playing a crucial role in food security, job creation, and poverty reduction[1,2]. Despite this importance, the continent continues to face significant challenges in transforming its agricultural potential into sustainable economic performance. Chad, a country possessing vast agricultural resources, illustrates this paradox. Indeed, the country has an estimated utilisable agricultural area of 39 million hectares, including 5.6 million hectares of irrigable land, giving it significant agronomic potential for a wide range of foodstuffs[3]. Yet, this potential starkly contrasts with a reality marked by persistent food insecurity and endemic poverty. Chad ranks among the countries most affected by food crises, forcing it into increased dependence on imports[4]. This situation is largely explained by the predominance of a traditional and largely unmechanised agricultural production system, characterised by low yields and low resilience to climate shocks[5,6]. Faced with this observation, crop diversification and the promotion of high-value-added sectors appear as priority strategies for development policies. In this context, sesame cultivation (*Sesamumindicum* L.) presents promising advantages. This oilseed, subject to a booming international trade due to its nutritional qualities and industrial outlets, is experiencing growing global demand. World production increased by 26% between 2008 and 2017, rising from 5.0 to 6.3 million tonnes[7], a trend that has continued in recent years[8]. In Chad, sesame has become the second-largest agricultural export product after cotton[9]. It represents a significant source of income for many rural households, potentially contributing to the improvement of their living conditions and their adaptation to climate change.

However, the Chad sesame sector struggles to fully realise its potential. Its production remains the activity of a limited number of producers and is not yet sufficiently structured to sustainably meet the requirements of the international market[9]. Several crucial questions remain unanswered: is sesame production economically profitable for producers in Southern Chad, a region considered the country's agricultural breadbasket? What factors influence farmers' decisions to allocate resources to this crop? Finally, what are the major constraints hindering its expansion?

Despite its status as Chad's second-largest agricultural export product and its recognised potential to improve rural household incomes, the sesame sector is experiencing timid and incomplete development. This study posits that this situation results from a lack of knowledge about the actual economic performance of its production and an insufficient understanding of the factors influencing its adoption and intensification by farmers. Thus, this research aims to answer the central question: To what extent is sesame production in Southern Chad profitable, and what are the socio-economic and technical determinants, as well as the constraints, that affect its performance and adoption by farmers? This central problem breaks down into several specific questions: (i) What is the financial profitability (via indicators such as net margin, benefit-cost ratio, and return on investment) of sesame production for farming households in Southern Chad? (ii) What are the determining factors (socio-economic, institutional, technical) that influence the level of production and the decision to adopt sesame cultivation? (iii) What are the major constraints (access to inputs, financing, climate, markets, etc.) perceived by producers that limit the development of this sector? The originality of this research lies in its integrated approach, combining a detailed profitability analysis with a rigorous identification of determinants and constraints. While existing studies have often focused on agronomic potential or national macro-statistics (e.g[9].), this study focuses on the micro-economics of the farm in a specific and crucial agro-ecological zone. The results will provide empirical evidence-based data for policymakers, technical and financial partners, and sector actors. These indicators will serve as a solid basis for informed advocacy in favour of targeted policies and interventions aimed at promoting sesame as a strategic cash crop for agricultural diversification and improving livelihoods in Chad.

Materials and Methods:

Study Area

Sesame cultivation is experiencing significant growth among rural producers in the south of the country, particularly in the Logone Occidental province, which was selected as the study area. It is located between the 8° and 34° north latitude parallels and the 16° and 5° east longitude meridians (Figure 1). Covering an area of 8,695 km², it is bordered to the north by the Tandjilé province, to the south and east by the Logone Oriental province, and to the west by the Mayo-KebbiOuest province.

Sampling and Data Collection

A preliminary census identified a target population of 1,377 sesame producers in the province. Based on this, a detailed survey targeted 459 producers, selected using proportional stratified sampling representing the four departments of the study area: Dodjé, Guéni, Lac Wey, and Ngourkosso.

The effective sampling rate of 20% corresponds to methodological standards for socio-economic studies among well-identified agricultural populations[11]. This approach ensures balanced coverage of each department, with a priority targeting of villages where sesame production is most dynamic. The detailed distribution between the estimated target population, the surveyed population, and the sample by department is presented in Table 1. The calculation of the sample size was performed according to Cochran's formula[10], using the following standard parameters: a confidence level of 95% (Z = 1.96), an estimated proportion of 0.5 to ensure maximum variance, and a predefined margin of error.

$$\mathbf{n = (Z^2 \times p \times q) \div e^2} \qquad \mathbf{(1)}$$

Where:

- Z = confidence coefficient (1.96 for 95%)
- p = estimated proportion (0.5 by default)
- $q = 1 - p$
- e = margin of error

Table 1: Sampling distribution

Department	Estimated Target Population	Surveyed Producers	Coverage Rate (%)
DODJE	500	150	30.0%
GUENI	600	184	30.7%

LAC WEY	177	75	42.4%
NGOURKOSSO	100	50	50.0%
TOTAL	**1,377**	**459**	**33.3%**

Source: Field survey, 2023-2014 and 2024-2025.

Conceptual Framework for Profitability Analysis

The assessment of a farm's performance distinguishes between economic profitability and financial profitability. Economic profitability measures the performance of all assets employed, regardless of their financing method, by relating operating profit to total invested capital. Financial profitability specifically focuses on the return on equity capital provided by the operators[12]. In line with this distinction, this study uses net margin and average labour productivity as indicators of economic profitability, and the Benefit-Cost Ratio as an indicator of financial profitability.

Measurement of Profitability Indicators

Economic Profitability

- Net Margin (NM)

The net margin per hectare, representing agricultural profit, is calculated as follows[13,14]:

$$\mathbf{MN = PBV - CT \text{ ou } MN = MB - CF} \quad \mathbf{(2)}$$

Where:

GVO (Gross Value of Output): Total value of production, including sold and self-consumed products, valued at current market prices.

TC (Total Costs): Sum of Variable Costs (VC) and Fixed Costs (FC). VC includes expenses directly related to production (inputs, hired labour). FC corresponds to the linear depreciation of farm equipment.

- Gross Margin (GM)

The gross margin, calculated as the difference between the Gross Value of Output (GVO) and Variable Costs (VC) (GM = GVO - VC), represents the farm's ability to cover its fixed costs and generate a surplus. This concept, widely used as an intermediate indicator of economic performance in agricultural profitability analyses[13,14,15], measures the value added generated by the productive activity before accounting for fixed capital investments.

$$\mathbf{MB : PBV - CV} \quad \mathbf{(3)}$$

An NM > 0 indicates an economically profitable activity, meaning that revenues cover all costs. An NM < 0 reveals non-profitability[16].

- Average Net Labour Productivity (ANLP)

The ANLP assesses the efficiency of family labour[17]and is given by:

$$\mathbf{PML = MN / MO} \quad \mathbf{(4)}$$

Where L is the quantity of family labour used (man-days/ha). The ANLP is compared to the local daily wage (s). If ANLP > s, the activity is more profitable than selling labour on the wage market.

- Internal Rate of Return (IRR)

The IRR assesses the return on total invested capital, including its opportunity cost[18]. It is calculated as follows:

$$\mathbf{TRI = MN / (CT + VMO)} \quad \mathbf{(5)}$$

Where VFL is the value of family labour (L × daily wage s). The IRR is compared to the agricultural credit interest rate (24% according to local data). An IRR > 24% indicates that profitability exceeds the cost of capital.

Financial Profitability

- Benefit-Cost Ratio (BCR)

The benefit-cost ratio, calculated as the ratio between the Gross Value of Output (GVO) and Total Costs (TC) including the value of family labour, is a key indicator of financial viability that measures the efficiency of resource allocation[19,18]. A BCR greater than 1 indicates that for every CFA franc invested, revenues exceed total cost, signalling a financially profitable and sustainable activity. Conversely, a BCR less than 1 reveals an inability to cover all production costs, questioning the financial sustainability of the farm[15,20].

$$\mathbf{RBC = PBV / CT} \quad \mathbf{(6)}$$

Where TC includes both actual and imputed costs (like VFL). A BCR > 1 means that for 1 CFA franc invested, revenues are greater than 1 CFA franc, indicating financial profitability.

Theoretical Framework and Modelling of Determinants

To identify and quantify the factors influencing the profitability of sesame cultivation, an econometric model is specified. Given the continuous nature of the dependent variable (Net Margin per hectare), a multiple linear regression model using the Ordinary Least Squares (OLS) method is employed[21]. This choice is consistent with recent studies on agricultural profitability (e.g.[15,20]. The model is specified as follows:

$$\mathbf{MN_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + ... + \beta_k X_{ki} + \varepsilon_i} \quad \mathbf{(7)}$$

Where:

- NM_i is the net margin per hectare for the i-th producer.
- β_0 is the constant or intercept term.
- X_1i, X_2i, X_3i and Xki represent a vector of explanatory variables (determinants) for the i-th producer.
- $\beta_1, \beta_2, ..., \beta_k$ are the coefficients to be estimated, measuring the marginal impact of each explanatory variable on the net margin.
- ε_i is the random error term, assumed to follow a normal distribution with zero mean and constant variance.

The explanatory variables selected for the econometric model were chosen based on a comprehensive review of recent literature concerning the determinants of cash crop profitability, particularly sesame. Their selection is based on their theoretical relevance and demonstrated explanatory power in similar previous studies. These variables are grouped into four main categories:

Producer Characteristics

Age: The producer's age is often used as a proxy for general agricultural experience. According[19], a non-linear (inverted U) relationship is often observed, where profitability increases with experience up to a certain point before potentially decreasing due to reluctance to adopt modern technologies.
Education level: The number of years of formal schooling influences the ability to understand and adopt improved farming practices. The work of[20]showed that a higher education level is positively correlated with better technical and economic efficiency among sesame producers.
Farming experience: The number of years dedicated specifically to sesame cultivation captures accumulated experience and learning-by-doing, which can reduce costs and improve yields[15].

Farm Characteristics

Cultivated sesame area: This variable is crucial for testing the existence of economies of scale.[18]found that larger farms often benefit from lower average costs and better market access, thereby increasing their profitability.
Household size: It is used as an approximation of the availability of family labour. A larger family labour force can reduce dependence on hired labour, thereby decreasing variable costs[13].

Cultivation Practices and Input Access

Use of improved seeds: A binary variable (1=yes, 0=no) capturing the adoption of a key technology. The study by[14] confirmed that the use of high-yielding seeds is one of the main levers for increasing productivity and net margin.
Use of fertiliser: A binary or quantitative variable measuring the application of mineral or organic fertilisers. This input is essential to compensate for soil nutrient depletion and is a significant determinant of profitability, as demonstrated by[12].
Access to credit: A binary variable indicating whether the producer had access to agricultural credit. Access to finance enables the acquisition of quality inputs in a timely manner, positively influencing production and profitability[19].

Institutional and Market Factors

Membership in a producer organisation (PO): Affiliation with a cooperative or farmers' group facilitates access to information, subsidised inputs, and collective markets, thereby improving bargaining power and selling prices[15].

Access to extension services: Contact with an extension agent in the past 12 months is an indicator of access to information and technical advice, which are critical factors for the adoption of good agricultural practices[20].

Distance to market: The distance (in km) between the farm and the main point of sale affects transaction and transport costs. A greater distance is generally associated with higher marketing costs and may reduce net profitability[18].

Data Collection and Analysis

Data collection was carried out during the 2023-2024 and 2024-2025 agricultural seasons from the sample of 459 sesame producers, using a pre-tested structured questionnaire. Data analysis followed a sequential two-step approach, in line with methodologies used in recent agricultural studies[18,15].

Descriptive Analysis

In the first stage, univariate descriptive analysis was conducted to characterise the sample and profitability indicators. Quantitative variables were summarised using measures of central tendency (means, medians) and dispersion (standard deviations, ranges). Qualitative variables were described by frequencies and percentages. Means comparison tests (Student's t-test for two independent groups, ANOVA for more than two groups) were used to analyse differences in profitability between subgroups stratified according to relevant criteria, such as adopters versus non-adopters of improved seeds or members versus non-members of producer organisations. This preliminary step, conducted using SPSS version 29 software, provided a general profile of the farms and allowed for preliminary hypotheses.

Econometric Analysis

In the second stage, the econometric analysis aimed at identifying and quantifying the determinants of net margin was performed. The previously specified multiple linear regression model was estimated using the Ordinary Least Squares (OLS) method. Before interpreting the results, standard diagnostic tests were conducted to verify the OLS assumptions and ensure the robustness of the estimators. The Variance Inflation Factor (VIF) test was used to detect potential multicollinearity problems among explanatory variables. The Breusch-Pagan test was employed to verify the homoscedasticity assumption of the residuals. If this assumption was rejected, White's robust standard errors were used to correct variance estimation[21]. The econometric analysis was primarily conducted using Stata 18 software, recognised for its reliability in advanced econometric processing. The statistical significance threshold was set at $\alpha = 5\%$ for all tests.

Results and Discussion:

Socio-economic and Technical Characteristics of Sesame Producers

Table 1 presents the profile of the 459 surveyed producers. The average age is 45.7 years, indicating a relatively mature farming population. This life experience can be an asset, but it may also reflect low generational renewal in agriculture, a common challenge in many rural African areas[22]. The level of formal education is low (average of 4.2 years), which could limit the ability to adopt complex technical practices, consistent with the conclusions of[20] who emphasise the crucial role of education in technical efficiency.

Table 1: General Characteristics of Producers and Farms

Variable	Mean/ Proportion	Standard Deviation	Minimum	Maximum
Producer Age (years)	45.7	11.5	22	78
Education Level (years)	4.2	3.8	0	16
Experience (years)	8.5	5.1	1	30
Average Area (ha)	1.8	1.2	0.5	7
Household Size (persons)	7.4	3.1	2	20
Use of Improved Seeds (%)	35%	-	-	-
Use of Fertiliser (%)	42%	-	-	-

Access to Credit (%)	28%	-	-	-
Member of a Producer Organisation (%)	40%	-	-	-
Access to Extension (%)	31%	-	-	-
Distance to Market (km)	15.3	7.8	2	40

Source: Field survey, 2023-2014 and 2024-2025.

The average experience in sesame cultivation is 8.5 years, suggesting it is a relatively well-integrated but still improvable crop. The average area allocated to sesame (1.8 ha) reveals essentially small-scale, family-based production. Only 35% of producers use improved seeds, and 28% have access to credit, highlighting two major constraints: limited access to quality inputs and finance. These figures are consistent with the work of[19] who identify access to credit as a critical factor for cash crop intensification.

Economic and Financial Profitability of Sesame Production

Table 2: Analysis of Costs, Revenues and Profitability per Hectare (in CFA francs)

Indicator	**Average Value (CFA francs/ha)**
Gross Value of Output (GVO)	352,500
- Variable Costs (VC)	148,200
= Gross Margin (GM)	204,300
- Fixed Costs (FC)	9,300
= **Net Margin (NM)**	**195,000**
Family Labour (MD/ha)	60 MD
Average Net Labour Productivity (ANLP)	3,250 CFA francs/MD
Total Costs (TC = VC + FC + VFL)	247,500
Benefit-Cost Ratio (BCR = GVO/TC)	1.42
Internal Rate of Return (IRR = NM / (TC+VFL))	38%

Source: Field survey, 2023-2014 and 2024-2025.

Table 2 details the cost structure and profitability per hectare. The average Gross Value of Output (GVO) is 352,500 CFA francs/ha. Variable Costs (VC), dominated by hired labour and input purchases, amount to 148,200 CFA francs/ha. The Gross Margin (GM) is therefore positive and substantial (204,300 CFA francs/ha), indicating that the activity generates significant value added before accounting for fixed costs.

After deducting Fixed Costs (FC) related to equipment depreciation, the Net Margin (NM) stands at 195,000 CFA francs/ha. This positive and high value unequivocally demonstrates that sesame cultivation is economically profitable at the farm level in Logone Occidental. The Average Net Labour Productivity (ANLP) is 3,250 CFA francs/Man-Day (MD), a figure higher than the estimated local daily agricultural wage of 1,500 CFA francs. This means that family labour is better valued in sesame production than if it were employed as wage labour elsewhere, a strong signal for guiding family labour allocation[17].

The Benefit-Cost Ratio (BCR) of 1.42 is a key indicator of financial viability. It means that for 1 CFA franc invested (including the imputed value of family labour), the producer recovers 1.42 CFA francs. A BCR > 1 confirms that the crop is financially profitable and attractive for farming households[19,15]. Finally, the Internal Rate of Return (IRR) of 38% is well above the opportunity cost of capital (estimated at 24% locally), indicating that investment in sesame cultivation is highly profitable.

Determinants of Profitability: Results of the Econometric Model

Table 3: Determinants of Net Margin in Sesame Production (OLS Model)

Explanatory Variable	Coefficient	Robust Standard Error	P-value
Producer Characteristics			
Age (years)	-105	180	0.558
Age Squared	1.1	1.9	0.562
Education Level (years)	890	750	0.235
Experience in Sesame (years)	**2,150**	**980**	**0.029****
Farm Characteristics			
Sesame Area (ha)	**18,500**	**4,210**	**0.000***
Household Size (persons)	1,200	890	0.178
Cultivation Practices & Access			
Improved Seeds (1=Yes)	**47,200**	**10,150**	**0.000***
Use of Fertiliser (1=Yes)	12,500	8,400	0.137
Access to Credit (1=Yes)	**31,800**	**9,870**	**0.001***
Institutional/Market Factors			
Member of a PO (1=Yes)	**22,400**	**7,650**	**0.004***
Access to Extension (1=Yes)	10,200	6,980	0.144
Distance to Market (km)	**-1,850**	**520**	**0.000***
Constant	85,120	22,450	0.000
Model Statistics			
Number of Observations	459		
Adjusted R-squared	0.58		
Prob> F	0.0000		
*Significance: *** p<0.01, ** p<0.05, * p<0.1*			

Source: Field survey, 2023-2014 and 2024-2025.

The econometric model estimated by Ordinary Least Squares (OLS) aimed at identifying the determinants of net margin (NM) per hectare of sesame shows satisfactory goodness-of-fit. The adjusted R^2 value of 0.58 indicates that the set of retained explanatory variables explains 58% of the variability in profitability among the surveyed farms. The test of overall model significance (Prob> F = 0.0000) confirms that this relationship is highly significant. Diagnostic tests, including the Variance Inflation Factor test (VIF < 5) and the Breusch-Pagan test (whose non-significance is ensured by the use of robust standard errors), attest to the absence of severe multicollinearity and homoscedasticity of the residuals, thus validating the robustness of the estimators presented in Table 3.

Analysis of Significant Determinants of Net Margin

Factors with a Significant Positive Impact

The analysis reveals that cultivated area, use of improved seeds, access to credit, membership in a producer organisation, and specific experience in sesame cultivation positively and significantly influence net margin. The cultivated sesame area exerts a positive and highly significant effect on net margin (β = +18,500 CFA francs/ha, $p < 0.01$). This result corroborates the existence of economies of scale, where larger farms benefit from lower average fixed costs and enhanced bargaining power on input and product markets, consistent with the conclusions of[18].

The use of improved seeds proves to be the most powerful lever, showing the highest marginal elasticity (β = +47,200 CFA francs/ha, $p < 0.01$). This underscores the critical importance of input genetic quality for increasing yields and, ultimately, profitability. This observation aligns with the work of[14], who identify improved seeds as the main factor explaining gaps in technical and economic performance for cereal crops. Access to credit also positively and significantly influences NM (β = +31,800 CFA francs/ha, $p < 0.01$). This factor allows producers to overcome liquidity constraints and acquire necessary inputs in a timely manner and in optimal quantities, thus validating its capital role in improving economic performance, as documented by[19]. Membership in a producer organisation (PO) is associated with a substantial increase in net margin (β = +22,400 CFA francs/ha, $p < 0.01$). POs facilitate access to information, subsidised inputs, and more remunerative markets, strengthening producers' position in the value chain, an advantage already highlighted by Akpan et al. (2023). Finally, specific experience in sesame cultivation has a modest but significant positive effect (β = +2,150 CFA francs/ha, $p < 0.05$). This suggests that cumulative learning, specific to this crop, contributes to better technical and managerial efficiency.

Factor with a Significant Negative Impact

In line with theoretical expectations, distance to market negatively impacts profitability (β = -1,850 CFA francs/ha, $p < 0.01$). Each additional kilometre increases transaction and transport costs, directly eroding net margin, a phenomenon widely documented in the literature, notably by[18].

Factors with Non-Significant Impact

The analysis reveals that certain variables, such as age, formal education level, household size, fertiliser use, and access to extension, do not show a statistically significant effect.

The non-significance of age and education, while specific experience is significant, indicates that skills acquired through practice in sesame cultivation take precedence over general sociodemographic characteristics. This result aligns with the conclusions of[29], who emphasise that targeted technical learning is a better predictor of performance than age or educational level.

The non-significance of fertiliser use and access to extension calls for a nuanced interpretation. Regarding fertilisers, it is plausible that their marginal profitability is low in the study's soil-climate context, or that their application is inefficient (inappropriate doses or timing), thus cancelling out the benefit on the margin, a variability already observed by[30]. As for extension, the binary variable used (access yes/no) might mask significant heterogeneity in the quality and relevance of the advice provided. If this advice is generic or not adapted to the specificities of sesame, its impact may prove nil. This point deserves deeper qualitative investigation.

Major Constraints Perceived by Producers

The survey of producers paints a consistent and hierarchical picture of perceived obstacles, which only reflects and confirms the structural challenges widely documented in recent literature on agriculture in sub-Saharan Africa. The hierarchy of these constraints illustrates a logical chain of problems, from markets to the plot.

Price Volatility and Market Access

The first-place ranking of price volatility (79%) is not surprising. It signals a crucial transition. Producers are no longer (only) in subsistence agriculture, but indeed in a market logic where remuneration is central. This concern dominates because it directly conditions economic viability. Recent work by[23] in Food Policy emphasises that price instability is the main deterrent to the adoption of improved technologies. A producer will hesitate to invest in costly inputs if they cannot anticipate a remunerative selling price. This volatility is often a symptom of poorly integrated markets, a lack of storage and processing infrastructure that would allow smoothing supply over time. The reference to[24]is entirely relevant here, as it anchors this result in the specific context of West African sectors.

Access to Credit and Inputs

The constraints of access to credit (75%) and quality inputs (68%) are intrinsically linked to the first. Recent literature, notably studies by[25]on digital finance, shows that lack of capital prevents producers from buying certified seeds and fertilisers in sufficient quantity at the right time. Conversely, without a guarantee of stable income (price volatility), financial institutions are reluctant to lend to farmers considered risky, creating a vicious circle of underinvestment. The confirmation by the econometric analysis underscores that these are not just perceptions, but factors with a measurable impact on productivity.

Climate Hazards: Increased Vulnerability in a Context of Global Change

The ranking of climate hazards (65%) as the fourth constraint is significant. It highlights the extreme vulnerability of rain-fed agriculture, which remains dominant in Africa. Recent research, such as that synthesised by[26], confirms that sub-Saharan Africa is one of the regions most exposed to the impacts of climate change, with increased frequency and intensity of droughts and floods. This result calls for urgent strengthening of adaptation strategies, such as early warning systems, access to index-based agricultural insurance (a subject in full expansion in the work of[27], and the promotion of resilient agricultural practices (agroecology, drought-tolerant varieties).

Phytosanitary Problems and Labour Cost: Constraints Linked to Intensification

Phytosanitary problems (55%) often become more critical as agriculture intensifies. Monocropping or reduced fallow periods can exacerbate pest and disease pressures. Furthermore, the high cost of hired labour (45%) is an interesting constraint. It may indicate a labour shortage during seasonal peaks (sowing, harvesting), often due to rural exodus, or reflect the difficulty in adequately remunerating workers in a context of low profitability. This constraint is increasingly cited in studies on horticultural or cash crop sectors[28].

Lack of Suitable Equipment: An Efficiency Constraint

Finally, the lack of suitable agricultural equipment (35%), although ranked last, remains an important constraint for over a third of producers. It affects work efficiency and the ability to implement good practices. Innovations in affordable small-scale mechanisation (tillers, solar pumps) are a major research and development focus.

Table 4: Ranking of Major Constraints Perceived by Producers (n=459)

Constraint	Percentage of Producers Citing the Constraint	Rank
Price Volatility / Market Access	79%	1
Difficult Access to Credit	75%	2
Limited Access to Quality Inputs	68%	3
Climate Hazards	65%	4
Phytosanitary Problems	55%	5
High Cost of Hired Labour	45%	6
Lack of Suitable Agricultural Equipment	35%	7

Source: Field survey, 2023-2014 and 2024-2025.

Comparative Analysis of Profitability Based on Technology Adoption

Table 5 compares profitability between two distinct groups: "Adopters" (using improved seeds and having access to credit) and "Non-adopters". The Net Margin of adopters (276,500 CFA francs/ha) is 76% higher than that of non-adopters (157,000 CFA francs/ha). This difference is highly significant ($p < 0.01$) and is mainly explained by higher yield (0.95 t/ha vs. 0.65 t/ha) thanks to the combined use of quality inputs and financing enabling optimal practices. The BCR of adopters (1.72) is much more attractive than that of non-adopters (1.28). This comparison strikingly illustrates the untapped potential of the sector. It demonstrates that the already positive profitability for all producers could be significantly amplified by broader adoption of technologies and better access to financial services, a productivity gap often highlighted in African agriculture[22].

Table 5: Comparison of Profitability Between Adopters and Non-Adopters of Key Technologies*

Profitability Indicator	"Adopters" Group (n=161)	"Non-adopters" Group (n=298)	Difference (T-test)
Yield (t/ha)	0.95	0.65	+ 46% ***
Net Margin (CFA francs/ha)	276,500	157,000	+ 76% ***

Benefit-Cost Ratio (BCR)	1.72	1.28	+ 34% ***

"Adopters" Group: producers using improved seeds AND having access to credit.

***: Difference significant at the 1% level (p < 0.01)*

Source: Field survey, 2023-2014 and 2024-2025.

Conclusion:

This study aimed to assess the profitability and identify the determinants of sesame production in Southern Chad, with a view to proposing strategic axes for its promotion. The analysis shows that sesame cultivation is clearly profitable both economically and financially for the farms in the study area. The positive net margin (195,000 CFA francs/ha), the benefit-cost ratio greater than 1 (1.42), and the high internal rate of return (38%), well above the cost of capital, attest to this. This profitability, however, masks significant disparities linked to producers' practices and investment capacities. The econometric analysis highlighted that cultivated area, use of improved seeds, access to credit, membership in a producer organisation, and specific experience are positive and significant determinants of profitability. Conversely, remoteness from the market constitutes a significant impediment.

The constraints perceived by producers, dominated by price volatility, difficulties in accessing credit and quality inputs, as well as climate hazards, corroborate the quantitative results and outline the landscape of structural challenges to be addressed. The comparison between "adopters" and "non-adopters" of key technologies is particularly telling: it reveals a substantial potential gain (a net margin 76% higher) that remains untapped by a majority of farmers.

Beyond the finding of profitability, this study provides priority levers for action for the strategic promotion of the sesame sector in Chad. The policy and operational implications are multiple:

Improve access to key technologies and inputs: The high profitability associated with improved seeds argues for public policies and targeted interventions aimed at facilitating their access (subsidies, local multiplication) and promoting their adoption through demonstration and extension.

Facilitate financial inclusion: The positive correlation between access to credit and profitability, coupled with its citation as a major constraint, calls for the development of credit products adapted to the sesame cropping cycle (amounts, repayment periods) and for reducing the risk perceived by financial institutions.

Strengthen producer organisation and marketing: The positive impact of membership in a producer organisation (PO) justifies institutional support for strengthening PO capacities. These can play a central role in securing outlets (purchase contracts), collective price negotiation, and bulk input purchasing, thereby mitigating the major constraint of price volatility.

Invest in climate adaptation and reduction of transaction costs: Accounting for climate hazards necessitates the introduction of resilient varieties and adapted agricultural practices. Furthermore, reducing the economic distance to market through improvement of rural infrastructure and price information systems is crucial to preserving producers' margins.

Ultimately, sesame has a proven potential to contribute to agricultural diversification and improvement of rural household incomes in Southern Chad. The key to success lies in an integrated approach that goes beyond simply increasing cultivated areas. It must tackle head-on the technological, financial, institutional, and market bottlenecks identified. The priority actions consist of creating an enabling environment that allows producers easier access to proven technologies, financing, and better-organised markets. Such an approach is likely to transform sesame into a genuine engine of local development and economic resilience.

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