
The Impact of Agricultural

Loan Development on Agricultural Output in Algeria During the Period 2000-2023, An Econometric Study Using the Vector Autoregressive (VAR) Model.

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Received:25/01/2026

Accepted: 27/02/2026

Published:31/05/2026

Abstract:

This scientific study aims to analyze the development of agricultural loans and agricultural output in Algeria over the period 2000–2023, as well as to estimate the statistical relationship between them during this period using the Vector Auto regression (VAR) model. In its theoretical framework, the study highlights the economic importance of agricultural loans. In its applied dimension, it concludes that there is no causal relationship between agricultural loans and agricultural output in either the short or the long run. This finding is supported by the statistical tests employed, namely the Granger causality test and the Johansen cointegration test. Moreover, the results of estimating the VAR(1) model indicate that changes in the volume of agricultural loans did not have a significant effect on agricultural output in Algeria during the period under study.

Keywords: Agricultural Investments; Agricultural loans; Agricultural Production; Causality and Cointegration.

JEL Codification codes: O13 ,Q11 , Q14.

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1. Introduction:

Agricultural loans are considered one of the key factors for the success of agricultural projects, as they contribute to enhancing investment opportunities and providing capital for the acquisition of agricultural machinery, fertilizers, seeds, and the introduction of modern agricultural technologies, among others. They play an important role in increasing agricultural productivity, improving the infrastructure of the agricultural sector, creating employment opportunities, stimulating innovation and development, and increasing output.

On the other hand, the agricultural sector is among the most important sectors in the Algerian national economy, given the role it plays in ensuring food supply for the country and providing employment opportunities, especially in desert regions that have witnessed an expansion in agricultural activity, achieving self-sufficiency and food security, and thereby reducing the import bill, among other contributions. Accordingly, the state has recognized the importance of this sector and the necessity of its development, which has led to increased attention being devoted to it through the creation and expansion of agricultural projects and investments with the aim of increasing agricultural activity and agricultural output, thereby stimulating economic growth and achieving economic development. In addition, the state has adopted a set of fiscal measures and tax exemptions to encourage investment in the agricultural sector, along with the provision of several bank loans whose interest is borne by the state, including the *Rafiq* loan, the *Tahaddi* loan, and other financing instruments.

In this study, we seek, on the one hand, to analyze the evolution of the volume of agricultural loans and agricultural output in Algeria during the period 2000–2023, and, on the other hand, to examine the short- and long-run causal relationship between them over the same period using the Vector Autoregression (VAR) model.

Accordingly, the main research problem of this scientific article is formulated as follows:

What is the impact of the development of agricultural loan volumes on agricultural output in Algeria during the period 2000–2023?

This main problem can be divided into the following subsidiary questions:

- Is there an effect of the development of agricultural loans on agricultural output in Algeria during the period 2000–2023?
- Is there a long-run causal relationship between agricultural loans and agricultural output in Algeria?

Based on this research problem, the following hypotheses are formulated:

- There is a significant effect of the development of the volume of agricultural loans on agricultural output in Algeria during the study period.

- Agricultural loans contribute to increasing agricultural activity and, consequently, agricultural output in Algeria in the long run.

From another perspective, the importance of this scientific study lies in the fact that it addresses a highly relevant contemporary issue, namely the agricultural sector. To address the subject of this study, we relied on the descriptive–analytical approach, as well as the inductive approach, which is based on econometric measurement tools and is well suited to the nature of this empirical analysis.

2. Overview of the Development of Agricultural Credit and Support in Algeria during the Period 2000–2024:

Agricultural financing can be defined, its types and sources diagnosed, and its development in Algeria during the period 2000–2023 analyzed as follows:

1.2. Definition of Agricultural Financing, Its Economic Importance, and Its Sources:

Funds and liquidity are among the fundamental elements for creating projects and investments, particularly in the agricultural sector. Various agricultural activities require financial support for purposes such as land reclamation and exploitation, the development of agricultural products, their protection and intensification, among others. In this context, agricultural financing is defined as a necessary economic process for the success of the planned development policy aimed at advancing agriculture ([Hariti, 2020, p. 451](#)). It also refers to providing farmers and cultivators with the necessary funds to ensure the optimal exploitation of their lands, as well as the reclamation of new lands ([Kroush, 2019, p. 529](#)). It is further defined as the mobilization of the funds required for investment in the agricultural sector, whether in the short or long term ([Gandouz, 2022, p. 08](#)).

From another perspective, Murray (1953) defined agricultural finance as the economic study of farmers' borrowing of funds, the organization and operation of agricultural lending agencies, and society's concern with agricultural credit. Tandon and Dondyal (1962) defined it as a branch of agricultural economics that deals with financial resources related to individual agricultural units ([Raghuram & Hymajyoti, 2000, p. 12](#)).

Based on these definitions, agricultural financing can be defined as the provision of the funds and liquidity necessary to establish or expand agricultural investments or projects, or for the purpose of improving the conditions of farmers and cultivators.

On the other hand, agricultural finance is of paramount importance, particularly at the economic level, insofar as it:

- Is considered the primary driver of investment and the establishment of various projects in the agricultural sector;

- Contributes to capital formation, which helps develop infrastructure related to electricity, irrigation equipment, transportation means, seed development, the acquisition of fertilizers and agricultural pesticides, land reclamation, and other related components;
- Contributes to the expansion of agricultural projects and investments in general, which in turn helps create employment opportunities on the one hand, and increase agricultural production—thereby achieving economic growth—on the other;
- Directly facilitates the introduction of technology into the agricultural sector, thereby improving agricultural productivity, and also supports the ability to adapt to changing economic conditions, as technological changes and modern marketing conditions necessitate major adjustments at the farm level (Dahina, 2017, p. 08);
- Contributes to providing liquidity to rural populations and expanding their capital base, which improves their living standards and contributes to revitalizing and expanding agriculture and rural farming;
- Helps confront potential risks, particularly those related to price volatility, climate variability, accidents, natural disasters, drought, and others;
- Contributes to covering cash flow deficits in agricultural activities, which are generally characterized by their seasonal nature and the mismatch between expenditure levels and income (Doligez & Gentil, 2000, p. 13);
- Contributes to capital formation that helps establish linkages between agricultural activity and industrial activity;
- Enables rural populations to invest in agricultural inputs and modern technologies, diversify livelihoods, increase productivity, diversify income sources, and achieve secure and sustainable income, thereby alleviating poverty and economic deterioration in both rural and urban areas (Gbaguidi & Mantsie, 2024, p. 995);
- Almost all countries worldwide are currently working to achieve the Sustainable Development Goals through reliance on sustainable agricultural systems, wherein the importance of financial resources and financing emerges as a key factor in building such systems (Ministry of Agriculture of the Republic of Uzbekistan, 2024, p. 04).

From another perspective, the methods of financing the agricultural sector are numerous and vary from one country to another. They can generally be divided into two types: internal financing (“Ressources Internes”) and external financing (“Ressources Externes”). The first type includes self-financing, while external financing encompasses financing through bank loans, financing through access to government

support (Boutoura & Zaghlami, p. 54), as well as financing through equity participation. The various methods can be identified as follows:

A. Internal Financing (Self-Financing):

This refers to the ability to finance agricultural projects and private farming investments without resorting to borrowing or seeking agricultural support from the competent authorities. It also denotes the undertaking of new agricultural investments and activities, or the expansion of existing ones, based on the farmer's retained earnings or financial reserves. This type of financing is characterized by freedom in decision-making, financial independence, flexibility, low cost, and the absence of any external obligations imposed on farmers (Ben Jawad, 2022, p. 10). Self-financing is also considered a natural, permanent, and reliable financial resource that can be fundamentally depended upon (Mohammad, 2021, p. 20).

B. External Financing:

This type of financing includes the following forms:

- **Loan-Based Financing:** This involves obtaining agricultural loans from banks or financial institutions for the purpose of implementing agricultural investments and projects or expanding existing ones.
- **Financing through Government Support:** This refers to financial or in-kind assistance provided by the state to farmers or for the purpose of investment in the agricultural sector. It includes financial contributions offered by the state either directly or through its agencies, which may take the form of direct monetary transfers (loans and grants), loan guarantees, tax or customs exemptions, or the provision of services or goods as in-kind support, among others (Ben Jawad, 2022, p. 86). This support aims to promote the agricultural sector and achieve development. According to *Encyclopedia Britannica*, support is defined as a direct or indirect government expenditure, or an economic right or special privilege granted to private enterprises, individuals, or governmental units in order to achieve a public objective (El-Sayed, 2013, p. 2748).
- **Equity Participation Financing:** This refers to the establishment of partnerships among individuals or between individuals and institutions to increase capital for the purpose of investment, establishing projects, or expanding them within the agricultural sector.

2.2. The Main Types of Agricultural Loans in Algeria:

In order to finance agricultural investment and activity, Algeria has activated a partnership between agricultural funds and the Bank of Agriculture and Rural Development. This initiative resulted in the launch of two low-interest loans, namely the *Rafiq* loan (R'FIG) and the investment loan *Tahaddi* (ETTAHADI), in

addition to other forms of financing such as the supplier loan, leasing credit, and rural housing loans, among others. The most important of these loans are presented below.

2.2.1. The Rafiq Loan (R'FIG):

The Rafiq loan is granted by the Bank of Agriculture and Rural Development, with a maturity ranging from 6 to 24 months, and its interest is borne by the state. It is intended for farmers, investors, and livestock breeders, whether operating individually or organized within cooperatives, groups, unions, agricultural units, or as stockpilers of widely consumed agricultural products ([Ministry of Agriculture, Rural Development, and Fisheries \(Algeria\), 2025](#)). This loan includes two main types: the seasonal loan and the federative loan.

a) The Seasonal Loan:

This loan is intended for the acquisition of inputs for agricultural holdings, including seeds, seedlings, fertilizers, pesticides, animal feed, veterinary medicines, irrigation equipment, agricultural products intended for storage within the system for regulating widely consumed agricultural products "SYRPALAC," as well as agricultural operations and harvesting and threshing campaigns ([Ministry of Agriculture, Rural Development, and Fisheries \(Algeria\), 2025](#)).

b) The Federative Loan:

This loan is designed to finance projects and activities related to the production of industrial tomatoes, milk, cereals, potato seeds, table olives and olive oil, honey, and local products (*Produits du terroirs*). It is also directed toward pasta processing units, livestock units, fattening centers, artificial insemination and embryo transfer activities, poultry slaughtering and processing, in addition to activities related to the marketing, storage, packaging, and valorization of agricultural products, as well as the production and distribution of small agricultural equipment, irrigation systems, and plastic greenhouses ([Ministry of Agriculture, Rural Development, and Fisheries \(Algeria\), 2025](#)).

2.2.2. The Tahaddi Loan (ETTAHADI):

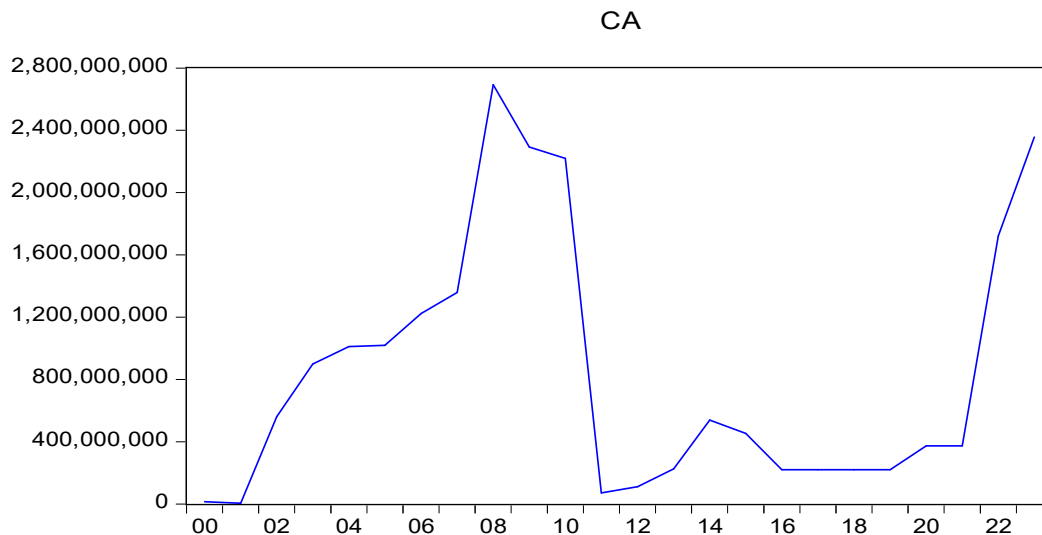
The Tahaddi loan is an agricultural investment loan granted by the Bank of Agriculture and Rural Development. Its duration is determined according to the feasibility study of the project and in agreement with the beneficiary ([Office of the Prime Minister of Algeria, 2024](#)), and its repayment period may extend up to five years. During this period, the Ministry of Agriculture bears the payment of the interest; if this duration is exceeded, the loan becomes subject to a predetermined and increasing interest rate. This loan is intended for farmers, cooperatives, model farms, and economic enterprises within the framework of establishing new agricultural and livestock investments on unused agricultural land belonging to private

operators or to the private property of the state (Ministry of Agriculture, Rural Development, and Fisheries (Algeria), 2025).

2.3. Analysis of the Evolution of the Volume of Agricultural Loans in Algeria during the Period 2000–2023 and the Assessment of Their Risks:

The volume of agricultural loans (CA: *Crédits Agricoles*) in Algeria evolved during the period 2000–2023, as illustrated in the following figure.

Figure (01): Evolution of the volume of agricultural loans in Algeria during the period 2000–2023



Source: Outputs of the *EViews 8* system, based on Appendix No. 1.

The figure above shows that the volume of agricultural credit in Algeria evolved in a fluctuating manner during the period 2000–2023. It amounted to USD 14.49 million in 2000, then declined to USD 5.47 million in 2001. Subsequently, it increased to USD 2.69 billion in 2008, before declining again to USD 71.42 million in 2011. It then rose to USD 538.49 million in 2014, after which it experienced a continuous decline to USD 219.78 million in 2019, and continued in this manner until reaching USD 2.35 billion in 2023. This situation negatively affects, on the one hand, the development of investment volumes and agricultural activity, and on the other hand, the success of agricultural projects in Algeria.

The weakness and volatility characterizing the growth of agricultural credit volumes in Algeria during the period 2000–2023 can be explained by the high level of risk associated with this type of credit and the weakness of agricultural banking insurance in Algeria, on the one hand, as well as the banking financing policy adopted in Algeria, on the other hand.

2.4. Development of the Volume of Government Agricultural Support in Algeria during the Period 2000–2023

At the beginning of the 1990s, Algeria opted to adopt a new development policy in the agricultural sector (within the framework of the 1993 Finance Law), with the aim of improving the social conditions of

farmers and rural areas on the one hand, and achieving self-sufficiency and food security, as well as economic development, on the other hand. Within this policy, a set of measures was adopted, including reducing interest rates on agricultural loans, granting tax and customs exemptions, establishing special funds for agricultural support, and providing financial subsidies to farmers, that is, assistance granted to cultivators in the context of obtaining agricultural inputs, means of production, and incentive grants (Office of the Prime Minister of Algeria, 2024).

The volume of agricultural support in Algeria developed during the period 2000–2020, as shown in the following table:

Table (01): Development of the Volume of Agricultural Support in Algeria during the Period 2000–2020 *Unit: billion DZD*

Year	2000	2001	2002	2003	2004	2005	2006
Agricultural Support	43.53	56.77	75.45	94.21	85.11	96.05	112.9
Year	2007	2008	2009	2010	2011	2012	2013
Agricultural Support	201	308.6	393.8	335.6	392.4	301.3	129.6
Year	2014	2015	2016	2017	2018	2019	2020
Agricultural Support	203.5	316	271.4	151.7	142.4	139.7	132.4

Source: (Ben Jawad, 2022, p. 106).

The figures presented in the table above indicate that the volume of agricultural support in Algeria over the period 2000–2020 evolved in a fluctuating manner. It amounted to 43.53 billion DZD in 2000, then increased to 96.05 billion DZD in 2005, before reaching its highest level at 393.75 billion DZD in 2009. Subsequently, it declined to 129.61 billion DZD in 2013, after which it rose again to 315.96 billion DZD in 2015, and then decreased once more to reach 132.43 billion DZD in 2020. This fluctuation can be explained, on the one hand, by the decline in state revenues from hydrocarbons as a result of falling oil prices in international markets, and, on the other hand, by the austerity policy implemented by the government during the recent period 2016–2020 across all sectors, including the agricultural sector.

3. Analysis of the Evolution of Agricultural Output in Algeria during the Period 2000–2023:

For some time, Algeria has sought to expand its agricultural activity with the aim of increasing the volume of agricultural output. To this end, it has encouraged certain agricultural products that it classified as strategic crops, in addition to diversifying agricultural subsectors. Below is a presentation of the list of these strategic crops and agricultural subsectors, as well as an analysis of the evolution of the volume of Algerian agricultural output over the period 2000–2023.

3.1. List of Strategic Crops in Algeria:

Algeria's agricultural policy and strategy have focused on prioritizing certain agricultural products within the agricultural sector, considering them strategic products due to their contribution to achieving food self-sufficiency and food security on the one hand, and to reducing the food import bill on the other.

These crops include (Ministry of Agriculture, Rural Development, and Fisheries (Algeria), 2025):

- Cereal and fodder cultivation;
- Cultivation of oilseed crops and sugar beet;
- Milk and meat production;
- Cotton production and seed intensification.

Within the same context, the state has attached great importance to the development of these strategic crops by granting land for investment, particularly through Executive Decree No. 24-55 issued on 23 January 2024, which stipulates the modalities for granting agricultural land for reclamation through concession rights in order to implement strategic agricultural projects.

3.2. Distribution of Agricultural Subsector Products by Cultivated Area in Algeria:

Fruits, legumes, olive trees, wheat, pastures, citrus fruits, vegetables, potatoes, fig trees, and date palms are among the most important agricultural production subsectors in Algeria. These subsectors are largely concentrated in certain regions rather than others, and are significantly influenced by rainfall patterns, rising temperatures, and drought affecting agricultural areas in Algeria. They are also affected by the decline in the volume of agricultural projects and investments. Below is the distribution of agricultural subsectors in Algeria according to the size of the cultivated area for the year 2019:

Table (02): Distribution of agricultural subsectors according to the size of the cultivated area for the year 2019 (unit: 1,000 hectares)

Area	Category	Area	Category
330	Vegetables	3322	Wheat
138	Potatoes	263	Fruits
74	Vineyards	65	Citrus
47	Fig Trees	86	Legumes
160	Date Palms	329	Olive Trees
3200	Fallow Land	407	Other Crops
1971	Forests	32798	Rangelands

Source:(Ben Jawad, 2022, p. 141).

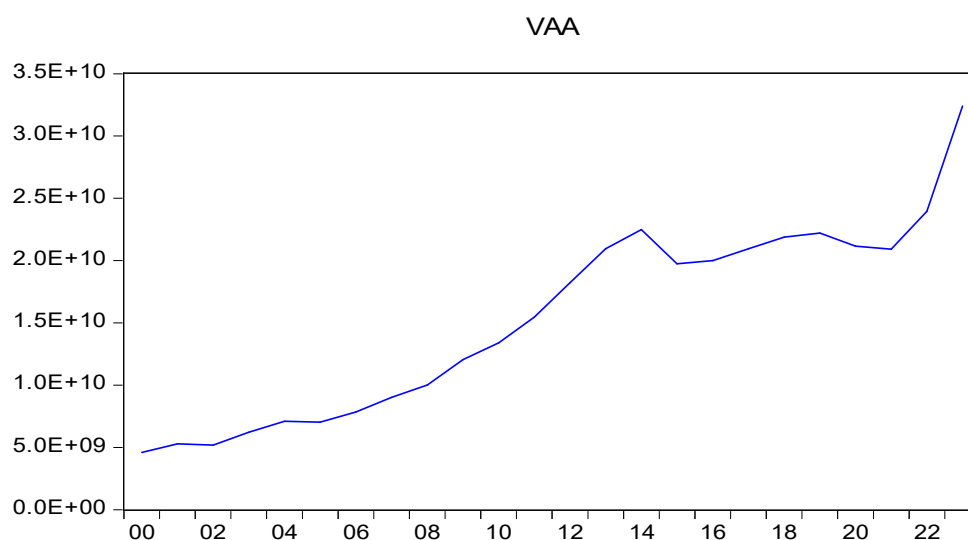
It is evident from the figures in the above table for the year 2019 that the cultivated area devoted to wheat amounted to 3.3 million hectares, while the areas planted with olive trees, citrus fruits, and other fruit trees represented 329 thousand hectares, 65 thousand hectares, and 263 thousand hectares, respectively. The area cultivated with vegetables reached 330 thousand hectares, whereas rangelands were estimated at 32.79 million hectares. Despite these figures, Algeria has not achieved self-sufficiency in meat, cereals, and other products.

On the other hand, forests and idle lands accounted for 1.97 million hectares and 2.3 million hectares, respectively, which constitutes a considerable area reflecting the decline in land reclamation and the impact of obstacles to agricultural investment in Algeria.

3.3. Evolution of Agricultural Output in Algeria during the Period 2000–2023:

The volume of agricultural output in Algeria, that is, the total value added in the agricultural sector (VAA: *Valeur Ajoutée en Agriculture*), evolved during the period 2000–2023, as illustrated in the following figure:

Figure (02): Evolution of agricultural output in Algeria during the period 2000–2023



Source: Outputs of the EViews 8 system, based on Appendix No. 1

The above figure shows that the volume of agricultural output experienced, on the one hand, an overall upward trend and, on the other hand, noticeable fluctuations during the period 2000–2023. It amounted to USD 4.59 billion in 2000, increased to USD 7.09 billion in 2004, then declined slightly to USD 7.02 billion in 2005, before rising to USD 13.39 billion in 2010. Its value reached USD 22.47 billion in 2014, after which it declined again to USD 19.74 billion in 2015. This volume also exhibited fluctuations in recent years, recording USD 22.20 billion in 2019, then decreasing to USD 20.09 billion in 2021, before rising significantly to USD 32.40 billion in 2023.

This increase in the volume of agricultural output can be attributed, on the one hand, to the growing attention paid by the state to agricultural activity and investment over the past decade. On the other hand, the observed fluctuations in its growth during certain periods can be explained by drought conditions and the persistent problem of irrigation water availability, which have affected agriculture and agricultural holdings in Algeria in recent years, particularly since 2016. In addition, the repercussions of the COVID-19 pandemic on agricultural activity, the rising prices of agricultural inputs, and other factors have played a role, alongside the declining interest of young people in working in the agricultural sector in Algeria.

3.4. Major Problems and Challenges Facing Agricultural Activity and the Agricultural Sector in Algeria:

Agricultural activity in Algeria faces a set of challenges and obstacles that hinder the achievement of the desired level of performance. Among the most important problems and challenges affecting agricultural activity in Algeria are the following:

- The decline in irrigated agricultural land areas as a result of the drought experienced by Algeria, as well as rising temperatures, which has made the performance of the agricultural sector dependent on prevailing climatic conditions (Boufleh & Boufleh, 2013, p. 43);
- The weakness of agro-food industries, which have become unable to absorb surpluses of certain seasonal agricultural products; the development of agro-food industries ensures the sustainability and advancement of the agricultural sector;
- The high cost of investment in infrastructure and the reluctance of young people to invest in the agricultural sector;
- The high cost of loans and banking finance for the agricultural sector, coupled with increased risks in the sector, which places farmers and cultivators in a situation of inability to repay and meet their obligations, thereby limiting their capacity to invest in agricultural activities;
- The reliance of agricultural activities on self-financing based on managerial autonomy, as well as dependence on traditional methods characterized by limited productivity;
- The decline in water levels in certain dams and the high cost of drilling wells, among other factors;
- The spread of agricultural diseases and the inability to provide agricultural medicines and pesticides, in addition to their high prices;
- The rise in prices of raw materials due to speculation and their occasional unavailability;
- The weakness, obsolescence, and deterioration of agricultural machinery fleets, including tractors, trucks, transport vehicles, and others;

- The weakness of foreign direct investment, that is, foreign partnerships in the agricultural sector in Algeria;
- The decline in groundwater reserves in Algeria as a result of drought;
- The shortage of qualified labor in the agricultural sector due to reliance on child labor. In this regard, Arab data indicate a decline in the share of the agricultural population relative to the rural population and total employment in the agricultural sector, from an average of 2.2% annually during the period 2010–2019 to 1.5% annually during the years 2018 and 2019 (Gandouz et al., 2022, p. 09).

4. Estimating the Statistical Relationship between Agricultural Credit and Agricultural Output in Algeria during the Period 2000–2023:

To examine the relationship of influence between the agricultural credit variable CA (Crédits Agricoles) and the agricultural output variable VAA (Valeur Ajoutée en Agriculture) in Algeria over the period 2000–2023, the Vector Autoregressive (VAR) model will be employed. This model was developed by the economist Sims (1980) (Bourbonnais, 2015, p. 277). The analysis proceeds by first examining the stationarity of the time series variables, then testing for causality between the variables, followed by determining the optimal lag length of the model, and finally estimating the model.

4.1. Examining the Stationarity of the Time Series Variables and Their Cointegration:

The stationarity of time series variables is a fundamental prerequisite for estimating regression models, as the use of non-stationary variables may lead to spurious results that deviate from reality. To test the stationarity of the time series variables, the Augmented Dickey–Fuller (ADF) test (1981) is employed, as it accounts for the problem of autocorrelation among the random error terms (Mestoui, 2019, p. 140). The results of the test indicate the following:

Table (03): Results of the Augmented Dickey–Fuller (ADF) stationarity test for the time series variables

Series	Original Series			After First Difference		
	ADF _c (Calculated)	ADF _t (Critical)	Result	ADF _c (Calculated)	ADF _t (Critical)	Result
CA	-2.798	-2.998	Non-stationary	-1.957	-49.11	Stationary
VAA	-2.06	-19.57	Non-stationary	-2.678	-2.642	Stationary

Source: Outputs of the EViews 8 system, based on Appendix No. 1

We state that a time series is stationary if the calculated value of ADF_c is less than the tabulated value ADF_t. From the table above, it is evident that the time series of the agricultural credit variable (CA) is non-

stationary and becomes stationary after taking the first difference (DCA). Likewise, the time series of the agricultural output variable (VAA) is also non-stationary and becomes stationary after taking the first difference (DVAA).

On the other hand, the two variables under study, DCA and DVAA, are integrated of the same order $I(1)$, which raises the possibility of the existence of a cointegration relationship between them, that is, the existence of a long-run relationship between these two variables.

4.2. Examining the Causal Relationship between the Agricultural Output Variable 'VAA' and the Agricultural Credit Variable 'CA':

By causality between variables, we mean the ability of one variable to influence another in the future; in this case, causality is unidirectional. In some cases, each variable affects the other, resulting in bidirectional causality (Mestoui, 2019, p. 143). To examine the causal relationship between the agricultural output variable 'VAA' and the agricultural credit variable 'CA' in Algeria during the period 2000–2023, we will rely on one of the most important tests used in econometrics, namely the Granger causality test. The following table presents the results of the test:

Table (04): Presents the results of the Granger causality test between the variables of the studied model during the period 2000–2023:

Pairwise Granger Causality Tests			
Date: 11/29/25 Time: 00:27			
Sample: 2000 2023			
Lags: 1			
Null Hypothesis:	Obs	F-Statistic	Prob.
DCA does not Granger Cause DVAA	22	1.51187	0.2339
DVAA does not Granger Cause DCA		0.29868	0.5911

Source: Outputs of the EViews 8 system, based on Appendix No. 1

From the above table, it is evident that the first probability value is $\text{Prob} = 0.2339 > 0.05$; therefore, we accept the null hypothesis that agricultural credit (DCA) does not cause agricultural output (DVAA). The second probability value is $\text{Prob} = 0.5911 > 0.05$; thus, we also accept the null hypothesis that agricultural output (DVAA) does not cause agricultural credit (DCA). Accordingly, there is no causal relationship between the agricultural credit variable (DCA) and the agricultural output variable (DVAA) in either direction.

4.3. Examining the Johansen Cointegration Test among the Variables:

The results of the Johansen cointegration test between the agricultural output variable and agricultural credit are as follows:

Table (05): Presents the results of the Johansen cointegration test between the studied variables

Date: 11/29/25 Time: 00:31
Sample (adjusted): 2001 2023
Included observations: 23 after adjustments
Trend assumption: Linear deterministic trend
Series: VAA CA
Lags interval (in first differences): No lags
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.311839	10.58718	15.49471	0.2382
At most 1	0.082938	1.991340	3.841466	0.1582

Trace test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: Outputs of the EViews 8 system, based on Appendix No. 1

From the above test results, it is evident that the calculated value of the Trace Statistic is less than the tabulated Critical Value for both the "None" and "At most 1" cases. Therefore, we accept the null hypothesis of no cointegration among the variables, that is, the absence of a long-run equilibrium relationship between the studied variables.

4.4. Determining the Optimal Lag Length P for the Studied Model:

To determine the optimal lag length P for the studied model, we rely on the lag structure—lag length criteria test. The algorithm of this test is based on selecting the statistically significant lag in the majority of the criteria. The results of this test indicate the following:

Table (05): Test of the optimal lag length for the model

VAR Lag Order Selection Criteria
Endogenous variables: VAA CA
Exogenous variables: C
Date: 11/29/25 Time: 00:36
Sample: 2000 2023
Included observations: 20

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-40.33341	NA	0.236396	4.233341	4.332914	4.252779
1	-4.397714	61.09068*	0.009741*	1.039771*	1.338491*	1.098085*
2	-0.686498	5.566824	0.010199	1.068650	1.566516	1.165838
3	2.652949	4.341281	0.011342	1.134705	1.831718	1.270769
4	4.570934	2.109783	0.015085	1.342907	2.239066	1.517846

* indicates lag order selected by the criterion

Source: Outputs of the EViews 8 system, based on Appendix No. 1

It is evident from the above table that all the criteria—AIC, FPE, LR, HQ, and SC—indicate a first-order lag. Accordingly, we will adopt in this study a lag length of $P = 1$, that is, the VAR(1) model.

4.4. Estimation of the Studied VAR(1) Model and Analysis of the Results

Using the Ordinary Least Squares (OLS) method, the VAR(1) model was estimated, and the following results were obtained:

Table (06): Results of estimating the regression relationship between agricultural output and agricultural credit using VAR(1)

Vector Autoregression Estimates		
Date: 11/29/25 Time: 00:37		
Sample (adjusted): 2002 2023		
Included observations: 22 after adjustments		
Standard errors in () & t-statistics in []		
	DVAA	DCA
DVAA(-1)	0.406265 (0.24615) [1.65047]	1.994180 (3.64886) [0.54652]
DCA(-1)	0.018808 (0.01530) [1.22958]	-0.069215 (0.22675) [-0.30525]
C	0.047925 (0.02775) [1.72710]	0.141201 (0.41134) [0.34327]
R-squared	0.158076	0.024520
Adj. R-squared	0.069453	-0.078162
Sum sq. resids	0.164567	36.16199
S.E. equation	0.093067	1.379588
F-statistic	1.783684	0.238797
Log likelihood	22.63364	-36.68328
Akaike AIC	-1.784877	3.607570
Schwarz SC	-1.636098	3.756349
Mean dependent	0.082478	0.275721
S.D. dependent	0.096477	1.328640
Determinant resid covariance (dof adj.)		0.015905
Determinant resid covariance		0.011863
Log likelihood		-13.65594
Akaike information criterion		1.786903
Schwarz criterion		2.084460

Source: Outputs of the EViews 8 system, based on Appendix No. 1

Based on the estimation results of the VAR(1) model, we derived the following estimated equation:

$$DVAA = 0.406 DVAA(-1) + 0.018 DCA(-1) + 0.047$$

This equation shows the effect of agricultural credit $DCA(-1)$ and agricultural output $DVAA(-1)$, with a one-period lag, on agricultural output. Below is the statistical and economic interpretation of this estimated model:

A. Statistical Interpretation of the Results of the Estimated VAR(1) Model:

The value of the coefficient of determination $R^2 = 0.158076$ indicates the weak explanatory power of the studied model. That is, 80.15% of the changes in Algerian agricultural output during the period 2000–2023 are explained by agricultural credit and agricultural output itself with a time lag, whereas 20.84% of the changes in agricultural output over the same period are due to other factors outside the studied variables. This result is consistent with the Granger causality test presented above, which indicates the absence of an effect of agricultural credit on agricultural output.

On the other hand, the data in the above table show that the calculated Fisher statistic $F_c = 1.783684$ is less than the tabulated value $F_t = 5$; therefore, we accept the null hypothesis that the explanatory variables do not explain the dependent variable in this studied VAR(1) model. Moreover, the calculated Student's t-statistics T_c for all the coefficients of the explanatory variables are less than the tabulated value $T_t = 2$, meaning that they are not statistically significant. Accordingly, we conclude that the agricultural credit variable does not affect agricultural output in Algeria during the period 2000–2023.

B. Economic Interpretation of the Results of the Estimated VAR(1) Model:

The weakness, or in other words the absence, of the effect of the evolution of the volume of agricultural credit on agricultural output in Algeria during the period 2000–2023 can be explained by the weakness of agricultural financing in Algeria. This weakness of agricultural financing may, in turn, be attributed to the high level of risk associated with this type of financing and credit on the one hand, and to the banking policy pursued in Algeria, which primarily aims to finance foreign trade at the expense of other sectors, particularly the agricultural and tourism sectors, among others, on the other hand.

4.4. Testing the Validity of the Studied VAR(1) Model:

To examine the validity of the studied model, several statistical tests were employed as follows:

A. Test of Homoskedasticity of the Residuals of the Estimated Model: The test of homoskedasticity of the residuals of the estimated VAR(1) model above indicates the following:

Table (07): Test of residual homoskedasticity for the estimated VAR(1) model

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 11/29/25 Time: 00:41

Sample: 2000 2023

Included observations: 22

Joint test:		
Chi-sq	df	Prob.
5.615244	12	0.9342

Source: Outputs of the EViews 8 system, based on Appendix No. 1

From the above table, it is evident that the calculated probability value of the Chi-Square statistic is $\text{Prob} = 0.9342$, which is greater than the tabulated value of 0.05. Therefore, we accept the null hypothesis of homoskedasticity of the residuals for the estimated model above; that is, the studied VAR(1) model does not suffer from the problem of heteroskedasticity of the residuals.

B. Examination of the Autocorrelation Test of the Residuals of the Estimated Model:

The autocorrelation test of the residuals of the estimated model yielded the results presented below:

Table (08): Autocorrelation of the residuals of the estimated VAR(1) model

VAR Residual Portmanteau Tests for Autocorrelations

Null Hypothesis: no residual autocorrelations up to lag h

Date: 11/29/25 Time: 00:44

Sample: 2000 2023

Included observations: 22

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	1.099091	NA*	1.151429	NA*	NA*
2	2.817179	0.5889	3.041325	0.5509	4
3	3.822147	0.8728	4.204973	0.8382	8
4	9.540729	0.6562	11.19435	0.5123	12
5	10.52654	0.8377	12.47010	0.7110	16
6	11.26962	0.9389	13.49184	0.8553	20
7	13.76782	0.9517	17.15586	0.8419	24
8	18.39954	0.9156	24.43428	0.6584	28
9	24.94095	0.8084	35.50436	0.3065	32
10	29.35951	0.7754	43.60506	0.1795	36
11	29.96728	0.8761	44.82059	0.2767	40
12	34.55351	0.8455	54.91031	0.1254	44

*The test is valid only for lags larger than the VAR lag order.

df is degrees of freedom for (approximate) chi-square distribution

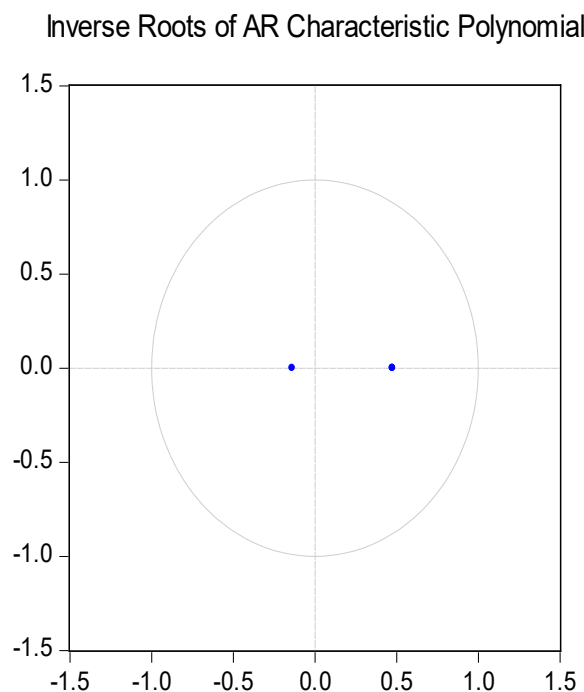
Source: Outputs of the EViews 8 system, based on Appendix No. 1

It is evident from the above table that all the calculated probability statistics (Prob) are greater than the tabulated value of 0.05. Therefore, we reject the hypothesis indicating the existence of autocorrelation in the residuals of the estimated VAR(1) model.

C. Test of Residual Stability: Inverse Roots of the AR Characteristic Polynomial for the Estimated VAR(1) Model:

To examine the stability of the residuals of the estimated VAR(1) model, we rely on the test of the inverse roots of the AR characteristic polynomial (Inverse Roots of AR Characteristic Polynomial). The results of this test indicate the following:

Figure (03): Inverse roots test for the estimated VAR(1) model



Source: Outputs of the EViews 8 system, based on Appendix No. 1

The results of the “Inverse Roots of AR Characteristic Polynomial” test regarding residual stability show that all roots lie within the unit circle. Accordingly, the studied VAR(1) model does not suffer from the problem of residual instability, and therefore the residuals are stable.

Based on the results of the three tests above, it can be concluded that the studied VAR(1) model does not suffer from residual autocorrelation, heteroskedasticity, or residual instability.

5. Conclusion:

In this scientific study, we examined two important variables in the national economy, namely agricultural output on the one hand and agricultural credit on the other. We presented and analyzed their development over the period 2000–2023, in addition to estimating the statistical relationship between them using the Vector Autoregression model VAR(1) during this period.

The study showed that there was fluctuation in the development of both agricultural credit and agricultural output in Algeria over the period under consideration. The empirical analysis also demonstrated the non-stationarity of the two time series, meaning that both the agricultural credit variable and the agricultural output variable become stationary only after taking the first difference. Furthermore, the study found no causal relationship in either direction between the agricultural output variable and the agricultural credit variable in both the short and the long run, as evidenced by the Granger causality test and the Johansen cointegration test.

On the other hand, the results of estimating the studied VAR(1) model revealed the weak explanatory power of the model, that is, the weak ability of the explanatory variables to account for the dependent variable, namely agricultural output, over the period 2000–2023. This is indicated by the coefficient of determination $R^2 = 0.158076$, which shows that 15.80% of the changes in Algerian agricultural output during the period 2000–2023 are explained by agricultural credit and agricultural output itself with a time lag, whereas 84.20% of the changes in agricultural output over the same period are due to other factors outside the variables under study. In the same context, the Fisher test confirms the weak explanatory power of the model through its calculated value $F_c = 1.783684$, which is less than the tabulated value of 5.

Accordingly, this scientific study leads us to conclude that the development of the volume of agricultural credit in Algeria has no effect on agricultural output in either the short run or the long run; therefore, we reject the two aforementioned hypotheses.

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7. Appendix :

Appendix No. 1 Unit: USD

In VAA	In CA	Agricultural Value Added “VAA”	Agricultural loans “CA”	Year (t)
22,24925269	16,48896931	4599680531	14490000	2000
22,38711268	15,51478917	5279581547	5470000	2001
22,36717591	20,14414353	5175366049	560390000	2002
22,55010106	20,61741631	6214188970	899560000	2003
22,68304147	20,73338447	7097734407	1010170000	2004
22,6722396	20,74186185	7021478211	1018770000	2005

The Impact of Agricultural Loan Development on Agricultural Output in Algeria During the Period 2000-2023, An Econometric Study Using the Vector Autoregressive (VAR) Model.

22,78193656	20,92513662	7835547249	1223689880	2006
22,92198761	21,02940096	9013484884	1358165816	2007
23,02693577	21,71407017	10010854283	2693400000	2008
23,21168673	21,55300036	12042245081	2292710000	2009
23,31779376	21,52069195	13390264669	2219820000	2010
23,46188393	18,08422851	15465598309	71430000	2011
23,62648604	18,52800932	18232764157	111330000	2012
23,76535398	19,23524878	20948941896	225820000	2013
23,83578128	20,10427948	22477514214	538490000	2014
23,70633495	19,9332112	19748333505	453820000	2015
23,71937342	19,2081376	20007507648	219780000	2016
23,76528202	19,2081376	20947434456	219780000	2017
23,80862744	19,2081376	21875375663	219780000	2018
23,82369963	19,2081376	22207582618	219780000	2019
23,77538475	19,73708898	21160133400	373000000	2020
23,76415718	19,73708898	20923885198	373000000	2021
23,89912605	21,26675224	23947410815	1722000000	2022
24,20161872	21,58065546	32406301180	2357000000	2023

Source: Prepared by researchers based on:

- Reports of the arab organiuation for agricultural development: 2002...2023.
- Data of World bank (<https://data.albankaldawali.org>), date:05-02-2025.