Pak. j. life soc. Sci. (2024), 22(1): 6384-6407 E-ISSN: 2221-7630;P-ISSN: 1727-4915

Pakistan Journal of Life and Social Sciences
www.pjlss.edu.pk

https://doi.org/10.57239/PJLSS-2024-22.1.00470

RESEARCH ARTICLE

The Impact of Agricultural Insurance on the Development of Agricultural Sector in Algeria: A Standard Analytical Study from 2006 to 2020.

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ARTICLE INFO

Received: May 21, 2024

Accepted: Jul 1, 2024

Keywords

Agricultural Insurance,

Agricultural Sector

Static PANEL Data Model

Agricultural Production Volume

Fixed Effects Model

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ABSTRACT

This research paper addresses the fundamental question underlying its main problem: To what extent does agricultural insurance contribute to the development of the agricultural sector? Analysis of data from 2006-2020 reveals a consistent individual effect (attributable to agricultural insurance) on the volume and growth of agricultural production. Given the data's nature, which blends time series and cross-sectional data, we employed Panel models. The static PANEL Data Model, recognized for its effectiveness in economic analysis and measurement, indicates a positive impact of insurance on certain agricultural products, such as fruit trees and vines. Conversely, a negative effect was observed on grains (wheat and barley), attributed to the state's monopoly on these products, deemed essential for Algerian food security. The state's efforts to maintain a safe national stock and its distribution underscore this dynamic.

INTRODUCTION

The agricultural sector is pivotal for national economic development, enhancing gross local product and per capita income. Consequently, numerous countries have initiated programs to bolster agricultural production, thereby creating employment opportunities, improving rural living standards, and meeting local and global food demands (Norton, 2004; Guo and Wang, 2021). For Algeria, agriculture is a foundational economic pillar, offering a stable alternative to fuel dependency and addressing the challenges posed by oil price volatility. The sector stands as a bastion of wealth and a crucial element for achieving food security, especially in light of recent challenges like the Covid-19 pandemic (Malat'ák et al., 2007; Thompson, 2012). Despite its significance, agriculture faces myriad risks due to exposure to uncontrollable variables and natural calamities, rendering it one of

the most vulnerable sectors (D'Alessandro et al., 2015; Mind'je et al., 2019). Insurance plays a vital role in safeguarding farmers and their agricultural endeavors against such risks, offering peace of mind and financial stability. Through agreements with insurance entities, farmers can secure their resources, sustain and possibly enhance their productivity, thus propelling the sector forward (Cole and Xiong, 2017; Smith and Glauber, 2012). Insurance mitigates losses from risks via compensation, underscoring its necessity for farmers' protection and its contribution to agricultural advancement **(**Smith and Glauber, 2012; Falco et al., 2014; Müller et al., 2017). This study aims to delve into the impact of agricultural insurance on the sector's development, guided by the primary question:
What is the impact of agricultural insurance on the agricultural sector's development?

To comprehensively explore this topic, we consider the following sub-questions:

- ✓ Is the agricultural sector a viable alternative to fuels and a pathway to generating wealth?
- ✓ Can agricultural insurance effectively address environmental and climatic challenges, yielding positive outcomes for farmers?
- ✓ Does agricultural insurance play a role in the agricultural sector's development?

Study hypotheses:

To tackle these inquiries, we propose the following hypotheses:

- ✓ Agricultural insurance is a type of insurance that covers the risks to which the agricultural sector is exposed.
- ✓ The agricultural sector is known as the basic development sector and preserving the environment, creating environmental balance, and increasing green spaces
- ✓ Agricultural insurance contributes to increasing agricultural yields, provide security and comfort in the hearts to farmers, and preserving their interests.

Study objectives:

- ✓ To elucidate the concept of agricultural insurance
- ✓ To present various agricultural insurance products
- ✓ To illustrate the significance of agricultural insurance in mitigating agricultural risks
- ✓ To expound on the contribution of agricultural insurance to the agricultural sector's development

Study importance:

The insurance sector is crucial in any economy due to its role in risk management, loss reduction, and investment stimulation, especially in agriculture, the focus of our study. Agricultural insurance is vital for protecting farmers' interests and ensuring the continuity of their activities.

STUDY METHODOLOGY

In our study, we employed both descriptive and analytical methodologies. Theoretically, we explored agricultural insurance and its impact on the agricultural sector's growth from 2006 to 2020. Practically, we selected a sample of prevalent agricultural activities in Koléa, Tipaza province, including fruit trees, vines, wheat, and barley. This selection aimed to represent the region's dominant agricultural practices for which consistent data were available throughout the study period. Our analysis integrates time series and cross-sectional data to assess the influence of agricultural insurance on production capacity, utilizing the static PANEL Data Model for its enhanced efficiency and comprehensive analytical capabilities.

The theoretical foundations of agricultural insurance

The emergence of agricultural insurance

Historically, the ancient Egyptians are credited with the inception of insurance, as evidenced by records on temple walls and papyrus. They established cooperative societies to fund burial ceremonies, a practice driven by their beliefs in the afterlife and the substantial expenses associated with death rites, including tomb construction, mummification, and coffin procurement. (Richards, 2005) These societies facilitated the ceremonies financially, supported by annual member contributions derived from trade or agricultural yields (Hamouda et al., 2000)

The concept of "peasant insurance" emerged in 1788 with Benjamin Franklin in France, following natural disasters that affected French farmers. This led to the conceptualization of agricultural insurance as a strategic response to recurrent agricultural adversities (Arbour, 1999); Clark and Thomann, 2010). Subsequently, the United States pioneered agricultural insurance coverage, with Europe following suit through commercial and cooperative entities. The establishment of the first agricultural research institute by the FAO in 1920 marked a significant advancement in addressing agricultural production challenges (Staples and Sayward, 2006; Tacon and Metian, 2008).
The development of agricultural insurance also coincided with the establishment of agricultural cooperative funds around 1800, with regulatory milestones such as the law enacted on July 8, 1901, governing associations, institutions, and professional bodies (M.Mansour , 1999; Turvey, 2017; Fernández, 2014). In Algeria, agricultural insurance gained prominence during the colonial era, culminating in the creation of the Central Fund for Mutual Reinsurance in Agriculture by French authorities in 1907 (Legg, 2021; Best et al., 2008).

Post-independence, an Algerian and Egyptian company nationalized on May 27, 1966, laid the groundwork for state monopolies in various commercial and insurance sectors, including agricultural insurance. By 1972, the Algerian government established the National Fund for Agricultural Cooperation, enhancing cooperative insurance and extending its scope to banking services related to agriculture, fishing insurance and associated risks. By 2002, the National Fund for Agricultural Cooperation emerged as a pivotal entity in Algeria's agricultural sector, with a market demand estimated at approximately 2.27 billion Algerian dinars (M.Al-Djadidi, 2007).

The concept of agricultural insurance

Economists recognize marine insurance as the oldest form of insurance, with agricultural insurance emerging subsequently, possessing unique characteristics. Agricultural insurance offers farmers stability and robust protection for their finances, safeguarding their living standards. The absence of crop insurance leaves farmers susceptible to a potential decline in living standards if their crops fail (Mishra and Mishra, 2011; Morris, 2018).

Crop insurance not only secures a farmer's income but also has broader implications, reflecting on the rural community's economic stability and contributing to the national income. This type of insurance is facilitated by both private and governmental entities, often supported by government initiatives (Mahul and Stutley, 2010; Herbold, 2014). The growing interest in agricultural risk management and insurance aims to boost agriculture and investment, enhance credit accessibility, and ensure financial stability for farmers and other key players in the agricultural value chain (Zain Al-Abidin, 2004).

Definitions of agricultural insurance

Agricultural insurance serves as a mechanism safeguarding agricultural producers against uncontrollable risks affecting their productivity, ensuring their economic stability and operational continuity. (Zain Al-Abidin, 2004)

Defined comprehensively, agricultural insurance aims to alleviate the financial impact of risks in the agricultural sector. This is achieved by distributing loss burdens across a wide participant base. Significantly, agricultural insurance encompasses not only crops but also extends to livestock, horses, forests, aquaculture, and even agricultural greenhouses, highlighting its extensive coverage (Ammari and Amer, 2014)

From an operational standpoint, agricultural insurance is described as a contractual arrangement that empowers farmers to manage the unique risks associated with their agricultural endeavors. This differentiation underscores the distinct nature of agricultural activities compared to other economic sectors. (El Falah, 2008).

Legally, agricultural insurance is characterized as a time-bound agreement between the farmer and the insurance entity. Under this contract, the insurer commits to compensating the farmer for losses incurred due to insured risks, in return for a premium paid by the farmer, establishing a formal financial safeguard. (Al-Charafat, 2012).

Agricultural insurance is also perceived as a systematic transfer of risk from farmers to an insurance company. This transfer is quantified through a specific premium, paid by the farmer, against the measurable potential of loss, thus providing a financial equilibrium in the face of uncertainties (Ramiro, 2009).

Furthermore, agricultural insurance is recognized as a strategic method enabling farmers to stabilize their agricultural income and investments. It acts as a protective buffer against the severe effects of natural calamities or market downturns, ensuring agricultural sustainability (Ramesh, 2008)

Integrating these viewpoints, agricultural insurance emerges as a specialized type of insurance dedicated to shielding agricultural producers from potential risks inherent in agricultural production. By paying premiums proportional to the assessed risk, farmers secure a commitment from insurance companies for compensation in the event of risk materialization, as delineated in the contractual agreement between the insurer and the insured.

The importance and role of agricultural insurance:

Agricultural insurance is pivotal in providing stability and security for farmers by insuring their crops and assets against natural calamities. At its core, agricultural insurance operates on the principle of mutual aid, relying on the collective effort of individuals united by a common objective to pre-emptively address and mitigate potential risks.

This collective approach helps in distributing and lessening the impact of risks and subsequent damages among all members (De Haen and Hemrich, 2007; Alam et al., 2020). The essence of agricultural insurance lies in its proactive approach, allowing stakeholders to anticipate and manage the consequences of potential risks before they manifest. This strategic foresight enables the distribution and mitigation of risks across all participants, thereby lessening the overall impact of threats and subsequent damages.

Expanding on the significance of agricultural insurance, it encompasses the following critical aspects (Cafiero et al. (2007); Manhal, 2009; Timmer (2017):

Prevention, and safety as a matter of fact, insurance does not work to prevent the occurrence of danger, but it contributes to reducing the loss causes if it does occur. It also enables the farmer to expand production by attracting additional resources through credit. Agricultural insurance is considered a sure guarantee for financing agricultural production.

- **Preventive and Protective Nature:** While insurance does not prevent the occurrence of risks, it plays a crucial role in minimizing losses when risks materialize. It facilitates farmers

in expanding production through the acquisition of additional resources via credit, thus acting as a reliable guarantor for agricultural finance.

- **Stabilization of Food Supplies:** Agricultural insurance ensures a stable supply of food, contributing to social and political equilibrium within the country.
- **Compensation and Loss Distribution:** In the event of a loss affecting agricultural produce, the potential for a total income wipeout is high. However, distributing this loss among a group reduces the impact on each individual, thereby safeguarding agricultural operations.
- **Income Stability and Developmental Support:** By guaranteeing a minimum income for farmers, agricultural insurance fosters stability, thereby laying the groundwork for developmental progress. It also stimulates the expansion of agricultural activities and investment in rural areas, enhancing the national income.
- **Reduction in Government Expenditure:** Agricultural insurance alleviates the need for significant government spending on disaster mitigation, thereby conserving agricultural and rural resources.
- **Encouragement of Technological Advancement:** It instills confidence among farmers to adopt modern technological methods, which in turn enhances and increases production.
- **Facilitation of Agricultural Development:** Agricultural insurance serves as a crucial tool in managing climatic risks, thereby playing a vital role in the advancement of the agricultural sector.

The following table summarizes the pivotal roles and benefits of agricultural insurance:

Table 1: The roles and benefits of agricultural insurance.

Preserving agricultural and rural resources	Maintain activity	Guaranteed minimum income
Ensuring food security	Economic stability	Ensuring the financial solvency of the farmer/bank

Source:The agricultural insurance policy in the rural agricultural policy development on May 10, 2014.

Obstacles to agricultural insurance

The successful implementation of agricultural insurance faces several challenges, as identified by various studies (Sinha, 2004; Cherry et al., 2008; Benin and Yu, 2012; Ghazanfar et al.,2015; Rehab, 2019):

- Accurate production information, statistics, and data regarding agriculture, including methods of agricultural production, extent of cultivated lands, and losses experienced within specific time frames prior to establishing insurance, are often insufficiently documented or unavailable.
- Many farmers exhibit a lack of understanding of insurance benefits, demonstrating apprehension towards new initiatives, a reluctance to incur additional financial burdens, and a tendency to rely on state-provided support, assistance, and facilities.
- The field of agricultural insurance is hampered by a shortage of specialists and a deficiency in practical field experience, which adversely impacts the accuracy of premium and compensation calculations.
- Governmental support for agricultural insurance is typically minimal, with high premium costs deterring insurance providers from covering areas deemed high-risk for agricultural endeavors.
- Agricultural insurance services frequently lack adequate representation in broader agricultural and insurance policy frameworks, leading to insufficient budget allocations, developmental program designations, and credit facilities for entities engaged in agricultural insurance, thereby hindering the promotion and widespread adoption of such services.

- The level of cultural, social, and political maturity necessary to support the effective implementation of insurance is often lacking, alongside an inadequate legal framework. This shortfall impedes the comprehensive understanding and fulfillment of prerequisites essential for the successful operation of agricultural insurance (Al-Aouaida and Al-Sayid, 2010).

Agricultural insurance products in Algeria

The agricultural sector holds a significant role in Algeria's economy and contributes to its economic and social advancement. Notably, Algeria leads in the importation of food and agricultural materials.

Table 2: The most important agricultural insurance products.

Plant production insurance	Animal production insurance	Industrial risks insurance	Car insurance	Ordinary risks insurance
• comprehensive agricultural insurance • Comprehensive insurance palm • comprehensive insurance Potato • Insurance against hail • Insurance against both hail and fire • Insurance against crop burning • Securing the irrigation network during operation • Insurance fruit trees • Comprehensive insurance	• Comprehensive insurance for cows • Sheep insurance • Comprehensive horse insurance • Comprehensive camel insurance • Comprehensive poultry insurance • Comprehensive beekeeping insurance • Turkey comprehensive insurance	• Fire and explosion insurance • Insurance for loss of exploitation after fire	• Securing the trailer • Insurance of tractors and agricultural equipment • Insurance of rented agricultural equipment	• Civil liability insurance for farms • Equestrian civil liability insurance • Veterinary liability insurance • Multi-risk insurance for residents • Insurance for water damage
• **-Tomatoes** • **Olive Comprehensive Insurance** • **Securing plastic houses**				

Source: CNA, 2021.

In pursuit of economic revitalization, the state has initiated various development projects within the economic establishment frameworks.

The insurance sector has introduced a variety of services through agricultural insurance products, primarily offered by the National Fund for Agricultural Cooperation (CNMA) and the Regional Fund for Agricultural Cooperation (CRMA). These products are central to the agricultural insurance market in Algeria (Boulahia, 2008)

The concept of agricultural development and its components

The concept of agricultural development:

The concept of agricultural development is defined by various ecological, economic, social, and cultural criteria that embody sustainable development. It offers a broader perspective on the processes involved: ensuring that the basic nutritional needs of current and future generations are met through the production and provision of diverse agricultural products; creating continuous employment opportunities and adequate income to foster a decent working and living environment across all sectors of agricultural production (Roseland, 2000; Waas et al., 2011).

Definition of agricultural development:

Agricultural development is characterized as a series of policies and procedures aimed at transforming the structure of the agricultural sector. This transformation facilitates the optimal use of available agricultural resources, leading to increased agricultural productivity and output, and ultimately contributing to the growth of national income and an enhanced quality of life for the community (Ghardi, 2012; Putsenteilo et al., 2020; Chaplitskaya et al., 2021).

It is defined as “a set of policies and procedures applied to alter the agricultural sector's structure and to guarantee the best possible utilization of available agricultural resources, ensuring an increase in productivity and output, which reflects on economic development and improves the living standards of individuals” (Al-Balawi, 1967).

Components and foundations of agricultural development:

For agricultural development to be effective, it must be supported by a foundation of essential natural and vital components, which include agricultural land, water resources, climatic conditions, and the biodiversity of plant and animal species. These elements are crucial for sustainable agricultural progress and will be explored in detail (Benin and Yu, 2012; Islam et al., 2018; Bulte and Lensink, 2023):

- **Natural resources:** These are gifts from nature, including land, water, and minerals, enabling humanity to meet its needs and aspirations. Such resources form the cornerstone of agricultural development, with agricultural lands and water resources being particularly critical.
- **Agricultural land:** The availability and quality of agricultural land are pivotal, making it a critical factor in the potential for agricultural development. It serves as the fundamental platform for agricultural production and is deemed strategic wealth that needs to be protected, conserved, and enhanced through available methods. It plays a significant role in the growth and expansion of productivity by increasing the agricultural area, crop acreage, or productivity per unit of land.
- **Water resources:** Water is a vital element for life and a key factor in agricultural production and intensification. The development of this sector depends on the availability and management of water resources, which are utilized for irrigation and expanding the irrigated areas. Climatic conditions further influence the extent of these irrigated areas.

Plant and animal resources:

The presence of diverse plant and animal resources is a crucial component of agricultural development, as their availability directly enhances the population's quality of life. Recognizing this, various countries have endeavored to boost plant and animal production by providing necessary

conditions, support, incentives, and the essential infrastructure. These efforts have resulted in increased agricultural output in both plant and animal sectors (Hammer et al., 2003; B. D. Smith, 2007; Flachowsky et al., 2013; Abed, 2018):

Plant production:

Plant production stands as the cornerstone of agricultural output, primarily due to its critical role in fulfilling the food requirements of the population and supplying raw materials to various manufacturing industries, a contribution known as the agricultural output contribution. It also generates foreign exchange by exporting food products or supplying local markets to reduce the need for food imports.

Animal Production:

Livestock production ranks as the second key component in agricultural development, providing essential nutrients to humans through meat, dairy products, and other derivatives like wool, hides, and hair. Moreover, it involves the utilization of farm animals to achieve cost-effective productivity.

The interdependence between plant and animal production forms a symbiotic relationship. Animal feed largely comes from plant outputs, their by-products, and residuals. In turn, agricultural lands benefit from animal waste, which serves as a natural source of organic fertilizer. This mutual dependence underscores the necessity of both sectors for holistic agricultural development, where each element reinforces and sustains the other.

Agricultural support policies in Algeria

Agricultural support in Algeria is defined as financial assistance provided directly by the state or its agencies within its territory to benefit the agricultural sector. This support can manifest as direct financial transfers, like loans and grants, potential fund transfers such as loan guarantees, revenue waivers through tax or customs exemptions, or in-kind support, including services or goods, alongside government guarantees (Ghardi, 2011).

The Organization for Economic Co-operation and Development (OECD) describes agricultural subsidies as the annual monetary value of all cumulative transfers from taxpayers and consumers resulting from governmental policy actions that bolster agriculture. These actions enhance farmers' revenues and diminish their production costs, irrespective of the policies' intentions or impacts on production, farm income, or agricultural product consumption (Djihad, et al ; 2011).

Since gaining independence, Algeria's agricultural policies have consistently aimed to elevate food security levels by advancing agricultural production and improving living conditions in rural areas. These policies were formulated in consideration of the prevailing political, economic, and social contexts, along with the financial and human resources available. These phases include (Zaoui, 2016):

- **The stage of self-management and agricultural wealth (1962-1979):**
  Initiated with the Tripoli Program, which outlined the agricultural reform launched in 1964. The program advocated for land distribution to individuals and the formation of cooperatives among the beneficiaries. The 1966 Agricultural Revolution Project set forth principles like defining real estate ownership and collective land exploitation, facilitating self-management principles, and crafting the Agricultural Revolution Law by the Ministry of Agrarian Reform in 1970.
  On November 08, 1971, it was proclaimed that "Land belongs to those who cultivate it, and only those who actively farm and invest in the land have entitlement to it." The agricultural revolution's failure stemmed from the state's cessation of support to farmers due to ownership changes and lax enforcement of agricultural policies, leading to widespread neglect and resource misuse.

This caused significant losses and a consistent deficit in productive units. The National Charter of 1976 emerged as a reformative measure, reaffirming the agricultural revolution's role in promoting equality and developing the agricultural sector. Key principles included prohibiting land and agricultural production means sales, expropriating properties exceeding set limits, redistributing them to small farmers, and fostering cooperative societies (Gharbi, 2008).

- **Initial reform of the agricultural sector (1980 - 1999):**

  During this period, in response to the persistent stagnation in agricultural production and investment management challenges, a series of reforms were initiated. These reforms included restructuring lands and peasant farms into investment entities, introducing the right to permanent usufruct of lands, and reinstating a portion of the nationalized lands from the agricultural revolution to their original owners. Socialist farms were established, and the agricultural financing system was revamped through the creation of a specialized bank, BADR, aimed at funding the agricultural sector. This bank facilitated the restructuring by merging farms and agricultural wealth cooperatives into a unified production system encompassing 5,000 farms (Zubiri, 1997).

  This era was marked by significant fluctuations, with the agricultural sector facing numerous crises, notably a reduction in funding and support triggered by the government's austerity measures to address the fuel revenue downturn. Additionally, the sector grappled with the challenges of transitioning from a socialist to a market economy system. Despite these obstacles, the period saw commendable achievements: the added value of agricultural production to the gross domestic product peaked at 13.04% in 1989, the highest since independence. By 1990, the arable land area reached approximately 7.67 million hectares, representing 3.22% of the total land area. However, the per capita share of arable land declined due to population growth (McMichael, 2009; Geels, 2013)

  The second reform (2000-2008):

  With the gradual restoration of security, political, and financial stability, Algeria launched the recovery program through the National Rural Development Plan (2000-2004), prioritizing investment support in the agriculture sector. In 2002, the plan was expanded to include the rural world, hence renamed the National Program for Agricultural and Rural Development. Its goals were:

  - Achieving food security
  - Exploiting most of the available resources while maintaining environmental protection
  - Improving social conditions within rural communities
  - Intensifying production and expanding cultivated lands

This reform led to increased growth rates in the agricultural sector compared to others, and a relative stabilization in agricultural imports, which constituted 1.6% of total imports in 2009. The cultivated area also increased to 3.13% of the total land area, up from 2.6% in 1962 (Tebani and Mederbal, 2018).

- **Agricultural development after 2009:**

Post-2009, Algeria's primary objective has been to sustain national food security and transform agriculture into a catalyst for economic growth. The strategy rests on two pillars crucial for achieving food security and self-sufficiency: (Laoubi and Yamao, 2012; Hamamouche et al., 2018; Tebani and Mederbal, 2018).

- **Agricultural Renewal:** This initiative focuses on economic development and the agricultural sector's role in food security. It promotes the intensification and modernization

of production to add value from production to consumption, aiming for sustainable development through integration among stakeholders and protection of farmers' incomes.

- **Rural Renewal:** A novel strategy for fostering socio-economic balance, targeting all rural households, particularly those in challenging areas like mountains. It represents an extensive aspect of agricultural renewal, reaching beyond to include various rural activities, striving for sustainable regional development through collaboration with farmers' organizations, professional associations, and technical services.
- **Economic Recovery Program (2010-2014):** For the Economic Growth Support Programme, an allocation of 21,214 billion dinars was made, divided into three distinct segments (Boufleh, 2012).

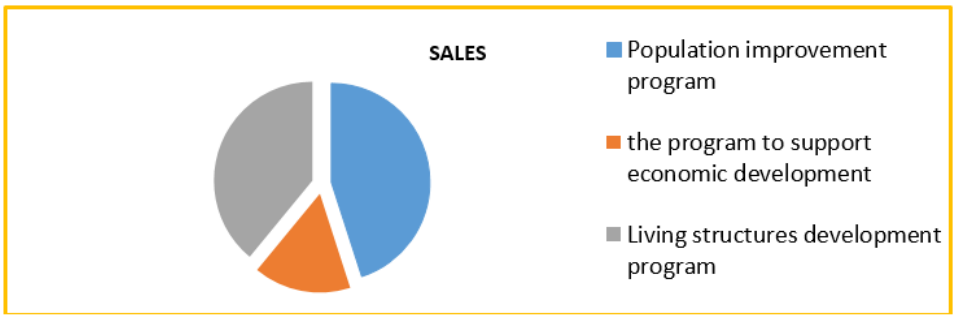

Figure No. 1: Economic Growth Support Program 2010-2014
Source: Data from the Economic Support Program 2010-2014

In the Economic Recovery Program's allocation, 45% was earmarked for improving population living conditions, 16% for economic development support, and 39% for developing basic infrastructure. Of the 3,500 billion dinars designated for the economic development support program, 1,000 billion dinars were allocated to agriculture and rural development, 2,000 billion dinars to the public sector, and the remaining funds were directed towards supporting small and medium enterprises and employment initiatives. Despite this allocation, the anticipated outcomes were not fully realized in the agricultural and rural sectors, largely due to the sector's vulnerability to climatic conditions, droughts, and fires, which adversely impacted its development during this period.

Laws to Support the Agricultural Sector in Algeria (2015 to Present):

In pursuit of a novel and promising development paradigm, Algeria enacted multiple laws aimed at positioning the agricultural sector at the forefront of economic policy. This initiative seeks to establish agriculture as a sustainable alternative to fuel dependency, fostering a future rich in job opportunities, entrepreneurship, and innovation (Boukhars, 2019.).

To elevate the agricultural sector's performance and its contribution to the national domestic product, as well as to attain food security and independence, Algeria implemented several ambitious programs, such as the Economic Growth Consolidation Program (2015-2019). This program was structured around key projects like the municipal development plan (PCD), serving as a tangible mechanism for local development and a collaborative effort between the state and municipalities. It represents a comprehensive development strategy at the local level, symbolizing decentralization and aiming to fulfill farmers' needs and bolster the economic foundation (Barhouma and Charif, 2008).

In 2020, agreements were established between the Ministries of Agriculture and Small and Emerging Enterprises to support projects for young people and rural women. Additionally, the National Organization for Enterprises and Crafts signed a cooperation agreement with the National Union of

Farmers to assist young agricultural entrepreneurs in launching their investments, under the motto "Youth is the lifeblood of agricultural development." This initiative promises technical and scientific support for 150 emerging enterprises, emphasizing the youth's role in national economic development and enhancing the agricultural sector's productivity (Petruzzella et al, 2020).

A standard study of the extent of the impact of agricultural insurance on the development of the agricultural sector in Algeria (2006-2020)

STUDY METHODOLOGY

This research utilized PANEL models to track and analyze the impact of agricultural insurance on the growth of the agricultural sector. By estimating the three fundamental models for PANEL data and conducting comparisons, the study aimed to identify the most fitting model for the data.

Introducing the study variables

The study aimed to craft a model aligned with the Algerian economy's specificities, incorporating the following variables:

- **Dependent Variable: Agricultural Production (PROD):**

Defined as the outcome measured in the experiment, which responds to changes in the independent variable, highlighting its dependence. The study examines the influence of insurance size in the agricultural sector on agricultural production.

- **Independent Variable: Amount of Insurance in the Agricultural Sector (ASR):**

This variable is crucial for predicting and explaining variations in response. Here, the insurance volume in the agricultural sector is posited to predict the agricultural sector's growth level.

The study model is formulated as:

$$PROD_{it} = c + \beta_j \, \mathrm{ASR}_{j(it)} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where: (β, c) are the model parameters,

(i;1: n) represent the sections (agricultural activities)

(t: 1: T) represents time, and

ε it represents the anarchic line.

Descriptive statistics for the study variables:

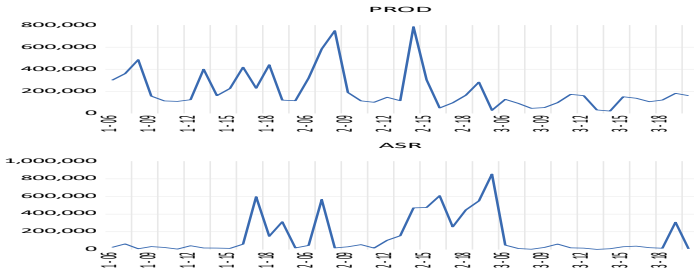

Figure No.2: Graphical representation of the study variables.

Source: *Created by the researcher using outputs from the EVIEWS 12 software.*

At this stage, the study presents a graphical representation of the cross-sectional time series for the variables. This graphical representation aims to provide an initial overview and elucidate the primary characteristics of the data related to the model under examination.

To provide a preliminary insight and detail the significant attributes of the data used in the study, central tendency statistics were computed. These statistics are displayed in the following table:

Table 3: Descriptive statistics for study variables

Variables	ASR	PROD
Arithmetic environnement	147164.9	209157
Mediator	32140.8	150000
Highest value	854425.3	785200
Lowest value	300	20000
Standard déviation	218293	176979.8
The total	6622422	9412065
Sum of Squares	2.10E +12	1.38E +12
Number of views	45	45

Source: Created by the researcher using outputs from the EVIEWS 12 software.

Analysis of table 1 results:

The average volume of insurance in the agricultural sector (ASR) at the Regional Fund for Agricultural Cooperation over the study period (2006-2020) was 147,164.9 DZD. Meanwhile, the average total agricultural production (PROD) for farmers insured by the aforementioned institution was 209,157 quintals.

The highest recorded insurance volume in the sector was 854,425.3 DZD for vineyard products in 2020, indicating an increase in insured farmers for vineyard production. Conversely, the lowest recorded value was 300 DZD for wheat and barley products in 2013.

For the production variable (PROD), the highest recorded value was 785,200 quintals for vineyard products in 2014, while the lowest was 20,000 quintals for wheat and barley products in the same year.

The study's variables exhibited high standard deviation values, indicating significant dispersion in the observations of total insurance in the agricultural sector and total agricultural production among the sample items during the study period.

To address the heterogeneity in the units of study variables and to minimize standard deviation values, the natural logarithm will be applied to these variables. Introducing the natural logarithm ensures the linearity of the relationship between the variables.

Static analysis of panel models "results analysis"

The analysis will focus on the static estimation of the model measuring the impact of agricultural insurance on agricultural sector productivity growth among farmers contracted with the Regional Fund for Agricultural Cooperation in Koléa from 2006 to 2020. The three primary Panel models will be estimated and compared to ascertain the most suitable model for the study data. The selected model will then be validated to ensure it is free from measurement issues that could compromise the accuracy and reliability of the results.

Prior to this, Hsiao's homogeneity testing methodology will be employed to confirm the suitability of the Panel Data Model for the study data, by verifying the existence of individual differences between the segments of the study sample (agricultural activities).

Apply the stages of the Hsaio homogeneity test

As previously discussed, if the data exhibit homogeneity, the model will have fixed or random individual effects. Conversely, if homogeneity is absent, the synthesis model is directly accepted. The study model can be expressed as:

$$PROD_{it} = c + \beta_j \mathbf{ASR}_{j(it)} + \varepsilon_{it}$$

Where: (β, c) are the model parameters, and (i;1: n) represent the sections (agricultural activities)

(t: 1: T) represents time, and ε_{it} represents the random error term.

- **First step:** Testing the overall homogeneity hypothesis (identical constants and coefficients). After estimating the model and calculating Fisher's statistic, we obtain:

$$F_1 = 6.230117 \qquad Prop.-F_1 = 0.0005$$

The calculated Fisher statistic is greater than the tabulated value, inferred from the statistic's probability value, which is below the critical threshold of 0.05. Thus, we reject the null hypothesis of the Panel model's overall homogeneity and accept the alternative hypothesis, moving to the second step of the analysis.

- **Second step:** Testing the coefficients' homogeneity hypothesis. Estimating the model and calculating Fisher's statistic for this hypothesis yields:

$$F_2 = 3.167661 \qquad Prop - F_1 = 0.0531$$

Since the Fisher statistic's probability value is above the critical threshold of 0.05, we accept the null hypothesis that the model coefficients are homogeneous, proceeding to the third step.

- **Third step**: Testing the constants' homogeneity hypothesis in the model. Upon calculating Fisher's statistic for this hypothesis, we find:

F1= 8.403943 Prop-F1= 0.0008

Given the calculated value exceeds the tabulated value, we reject the null hypothesis of homogeneous constants in the model, concluding that the estimated Panel model has fixed or random individual effects.

Table 4: Summary of Hsaio test results.

Hypotheses	F-Stat	P-Value
H1	6.230117	0.000563
H2	3.167661	0.053118
H3	8.403943	0.000874

Source: *Created by the researcher using outputs from the EVIEWS 12 software.*

Estimation results of cross-sectional time series models

In this section, the three models (Pooled Regression Model [PRM], Fixed Effects Model [FEM], and Random Effects Model [REM]) are estimated using the appropriate method in the EVIEWS 12 software. Following data entry, the results are as follows:

Aggregate regression model

The model parameters, determined using the formula presented above, are depicted in the table below:

Table 5: Estimating the pooled regression model.

Prob	t-statistics	Coefficients	Variables
0.0996	1.65993	0.214469	LNASR
0.0026	3.07672	0.368134	Fixed
	0.174449	Determination coefficient	

	0.152924	Corrected determination coefficient	
	3.45879		F-statistic
	0.039766		P-value F-
	1.649724		Durbin-Watson stat

Source: Created by the researcher using outputs from the EVIEWS 12 software.

From the estimated pooled regression model, several observations can be made:

- **Significance of the parameters**: The parameters associated with the agricultural insurance variable and the estimation constant were statistically significant at the 10% level. This conclusion is drawn from the t-statistic values for these parameters, which were below the critical value of 0.10.
- **Overall significance**: The F-statistic value of 3.45 indicates that the model is significant at the 5% level, affirming the model's overall significance.
- **Quality of fit**: The determination coefficient was 0.17, suggesting that the independent variable (amount of insurance in the agricultural sector) accounts for 17% of the variation in agricultural production. The remaining 83% of the variation is attributed to other factors not included in the model, represented by the error term.

Fixed effects model

The estimation of the fixed-effects model is presented in the table below:

Table 6: Estimating the fixed effects model:

Variables	Coefficients	Statistic t	Prob
LNASR	0.482527	6.005464	0.0004
Determination coefficient	0.618817		
Corrected determination coefficient	0.561658		
F-statistic	13.82818		
p-value F-	0.0000		
Durbin-Watson stat	1.853443		
p-value F-		0.0000	
Durbin-Watson stat		1.853443	

Source: Created by the researcher using outputs from the EVIEWS 12 software.

From the fixed effects model estimation, the following can be concluded:

- **Cross-sectional variation:**

The constant in the fixed effects model differs across each cross-sectional data set (agricultural activity).

- **Significance of the parameters:**

The agricultural insurance variable (LNASR) and the model's constant are statistically significant at the 5% level, as indicated by the t-statistical probability values being below the critical value of 0.05.

- **Overall significance:**

The F-statistic value of 13.82818 signifies that the model is completely significant at the 5% level, confirming that the Fisher test value exceeds the tabular value of 2.52.

- **Quality of fit:**

The determination coefficient of 0.61 implies that the independent variable explains 61% of the variability in agricultural production, with the remaining 39% accounted for by other factors not included in the model.

Random effects model:

The estimation of the random-effects model is presented in the following table:

Table 7: Random effects model estimation

Variables	Coefficients	Statistic t	Prob
LNASR	0.192699	2.486278	0.0823
Fixed	10.94823	12.48916	0.0000
Determination coefficient	0.232764		
Corrected determinetion coefficient	0.21027		
F-statistic	2.456589		
p-value F-	0.054071		
Durbin-Watson stat	1.714555		

Source: Created by the researcher using outputs from the EVIEWS 12 software.

From the random effects model estimation, we can conclude the following:

- **Significance of parameters:** The equation estimates indicate that the variables are significant at the 10% level.
- **Overall significance:** The F-statistic value of 2.456589 suggests that the model is not significant at the 10% level, implying the model's overall insignificance.
- **Quality of fit:** The coefficient of determination is 0.23, indicating that the independent variable explains 23% of the variability in the return on assets index, with the remaining 77% attributable to other factors not included in the model.
  After estimating the three models: pooled regression model, fixed effects model, and random effects model, a comparison is made to select the most appropriate and statistically reliable model for the study, which will be used in the economic analysis process, supported by statistical tests.

Results of comparison tests between the study models

The restricted Fisher test, the Lagrange multiplier test, and the Hausman test are used for model comparison.

Fisher's restricted F test:

The comparison between the pooled and fixed effects models is illustrated by the formula below:

$$F(N-1, NT-N-K) = \frac{\frac{\left(R^2_{FEM}-R^2_{PRM}\right)}{(N-1)}}{\left(1-\frac{R^2_{FEM}}{NT-N-K}\right)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Fisher tabular value: $F_t\left((3-1.45-3-1)\ ,5\%\right) = F(2,41) = 2.21$

Fisher's calculated value: $\frac{\frac{F_C(0.61-0.17)}{2}}{\frac{(1-0.61)}{41}} = 23.12$

Assumptions of Fisher's restricted test:

The pooled regression model is fit.....H0
A fixed-effects model is appropriate.....H1
Since the calculated F is greater than the tabular F, we accept hypothesis H1, indicating that the fixed effects model is appropriate.

Lagrange multiplier test

This test is based on the following assumptions:

The pooled regression model is fit.....H0
A fixed or random effects model is appropriate.....H1

Table 8: Lagrange multiplier test

Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives			
	Cross-section	Time	Both
Breusch-Pagan	2.433179	1.591374	4.024553
	-0.1188	-0.2071	-0.0448

Source: Created by the researcher using outputs from the EVIEWS 12 software.

According to the Breusch-Pagan test results, with a statistical value of 2.433179, hypothesis H1 is accepted since the probability value for this test is less than 0.05. This suggests that a model with random or fixed effects is suitable for the study data.

Hausman test

To determine the most appropriate model for the study's data, the Hausman test is employed following the indication from Fisher's restricted test that the fixed effects model is appropriate, and the Breusch-Pagan test suggesting that either the fixed or random effects model could be optimal. The Hausman test hypotheses are as follows:

Hausman test hypotheses:

A random effects model is appropriate.....H0
A fixed effects model is appropriate.....H1

The test results are explained in the following table:

Table 9: Hausman test

	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	10.230558	1	0.0001

Source: Created by the researcher using outputs from the EVIEWS 12 software.

The statistical value is 10.230558=2χ and the tabulated value for this test was at a degree of freedom of 5 and a significance level of 5% (3.25). The probability value for this test is:

$$\boldsymbol{Prop = 0.0001 > 0.05}$$

Therefore, we accept the alternative hypothesis, that is fixed effects model is appropriate.

Statistical and economic analysis of the preferred model (fixed effects model)
In terms of statistics

The fixed effects model exhibits varying constants across each cross-sectional dataset (agricultural activity), rendering the constant parameter statistically and economically insignificant. As indicated in Table 4, the parameters associated with the agricultural insurance variable are statistically significant. The Fisher statistic of 13.82818, a relatively high value, signifies the complete significance of the model.

Concerning the issue of autocorrelation between errors, the Durbin-Watson statistic of 1.85 is close to 2, suggesting no autocorrelation problem in the model's errors.

- **Testing the independence of sections:**

The Pesaran CD test was conducted to verify the independence of the cross-sections in the estimated fixed effects model.

Table 10: Residual Cross-Section Dependence Test

Null hypotesis No cross-section dependence (correlation) in residuals			
Periods included: 15			
Cross-sections included : 3			
Total panel observations : 45			
Test	Statistic	d.f.	Prob.
Pesaran CD	-1.152547		0.2491

Source: Created by the researcher using outputs from the EVIEWS 12 software.

The Pesaran CD statistic of -1.15 is statistically insignificant at the 5% significance level, with a probability value of 0.2491, which is above the critical threshold of 0.05. This result supports the acceptance of the null hypothesis, indicating no cross-sectional correlation problem in the fixed effects model.

- **Explanatory power:**

The model's explanatory power is indicated by the coefficient of determination, which stands at 0.61. This high value suggests that 81% of the variability in the production volume of the studied agricultural activities is attributable to the variables included in the model, while the remaining 19% is due to other factors not incorporated into the model. This level of explanation is relatively acceptable, considering that agricultural production is influenced by various factors, notably climatic conditions, thus validating the model from a statistical perspective.

In terms of Economic:

Through the estimated fixed effects model shown in Table 4, the following we conclude the following: From the estimated fixed effects model presented in Table 4, it is inferred that the positive coefficient associated with agricultural insurance (CRR) demonstrates its beneficial impact on the production volume of the Regional Fund for Agricultural Cooperation's study sample. An increase in insurance volume by 1% leads to a production increase of 0.48%, indicating a significant elasticity that underscores the positive influence of agricultural insurance on enhancing productivity for the studied products.

- **Individual Fixed Effects Among Agricultural Activities:**

Table 11: Individual fixed and random effects in the fund under study:

Fixed effects	Agricultural activity
0.361980	Fruit trees
0.054765	The vineyard
-0.416745	Wheat and barley

Source: Created by the researcher using outputs from the EVIEWS 12 software.

The analysis of fixed individual effects reveals distinct impacts on different agricultural products:

- Positive fixed individual effects are observed for fruit trees and vineyards. This suggests that agricultural insurance, although not mandatory, is deemed essential for protecting these crops against numerous risks like floods, hail, ice, fires, storms, and drought. The role of insurance is pivotal in ensuring the long-term sustainability, continuation, and expansion of these agricultural activities.
- On the other hand, a negative fixed individual effect is noted for wheat and barley. These crops are vital to the Algerian populace, forming a core part of their daily diet, with an individual's annual consumption averaging around 100 kilograms of wheat. This underlines the strategic importance of these grains. Despite Algeria's food gap in wheat and barley, efforts are ongoing to alleviate this issue by managing supply and demand factors and securing adequate reserves of these staples.
- The reluctance of farmers to insure wheat and barley is attributed to their reliance on governmental support and the provision of production mechanisms to enhance crop yields. The government's monopolization of storage and distribution for local wheat exacerbates this issue.

The findings related to wheat and barley cannot be considered comprehensive or universally applicable, as the study's scope was confined to the Regional Fund for Agricultural Cooperation in Koléa. This limitation prompts further inquiry into why Algeria maintains control over wheat and barley markets, whether private companies exist to insure these crops, and if the Bureau or National Grain Observatory has fulfilled its responsibilities effectively.

CONCLUSION

Developing the agricultural sector in Algeria necessitates ongoing efforts to identify agricultural reforms that align with an environment conducive to development. The rehabilitation of the Algerian agricultural sector is deemed a critical priority, given its considerable potential to diversify the economy's resources and income streams, currently 98% reliant on fuels, and to achieve self-sufficiency in various domains.

One of the pivotal elements for advancing the agricultural sector is reducing the import bill and enhancing agricultural insurance, as it offers financial compensation when necessary. This can mitigate the losses farmers may face due to the significant risks associated with agricultural production, which is heavily dependent on natural conditions, thereby limiting control over the production process.

However, the reluctance of farmers to insure their products has hindered progress, attributed to the absence of a prevalent insurance culture among farm operators and a lack of awareness regarding the significance of agricultural insurance. Furthermore, the limited appeal of insurance products to farmers is due to their lack of diversity and failure to cover all activities.

Therefore, to enhance the role of agricultural insurance and contribute positively to the development of this strategic sector, the following measures are essential:

- Intensify awareness campaigns to build trust among farmers.
- Increase focus on agricultural insurance, encouraging farmers to invest in products that provide security in the face of natural disasters, particularly given Algeria's location in areas with variable climate conditions.
- Urge insurance institutions to lower contributions for agricultural insurance.
- Tailor insurance types to the needs of the agricultural sector. Public and private insurance entities should analyze the market to establish an insurance system that aids sector

development, with the state providing guarantees for a portion of the insurance to foster trust in these institutions among farmers.
- Expand the agricultural insurance market in the future, motivating farmers and livestock breeders to insure their investments against various risks like drought, fires, and crop damage. This will facilitate the adoption of a national strategy for managing agricultural risks.

Considering the aims and significance of this research, and based on the statistical analysis results and subsequent discussions, the researcher arrived at the following conclusions:
- The agricultural sector remains heavily reliant on existing natural and climatic conditions, as verified by the normative study findings. In 2017, the agricultural yield, particularly of wheat and barley, positively impacted by 70%, while the growth rate of agricultural production fell by 23.02%. This decline is mainly attributed to the lack of skilled labor, underutilization of arable land, and water scarcity, highlighting drought as a significant economic issue coupled with inadequate adoption of modern irrigation methods.
- Insurance companies, crucial to the economy, primarily aim to provide financial compensation to the agricultural community, especially farmers.
- Agricultural insurance must play a vital role in advancing the agricultural sector. To fulfill the set objectives, governmental intervention is necessary to ensure and establish a conducive regulatory framework for insurance development.
- Agriculture in Algeria, as a strategic sector, warrants full support and prioritization.
- Agricultural insurance constitutes a significant venture across diverse agricultural activities.
- The reliance on agricultural insurance within the sector remains minimal, owing to its unique nature and the challenges in meeting insurance prerequisites, particularly concerning viable guarantees.
- Farmers refrain from insuring their wheat and barley yields (cereals) because of the state's specialized agency in this realm, the Algerian Cereals Office (OAIC), alongside the existence of a private grain bank.

➢ **Hypothesis testing:**
- **The first hypothesis is confirmed**: Agricultural insurance has an effective role in the economy, due to the financial compensation it provides, which can reduce the severity of losses in the agricultural sector, which contributes to renewing the capacity of farm investment.
- **The second hypothesis is partially validated:** As the agricultural sector is an essential contribution to address issues of balanced development between rural and urban areas to achieve food security and self-sufficiency.
- **The third hypothesis is entirely validated**: The results of the study study results indicating that a 1% increase in insurance volume leads to a 0.48% increase in production. This substantial elasticity underscores the positive influence of agricultural insurance on enhancing farmers' productivity, particularly in fruit trees and vineyards. Conversely, a negative fixed individual effect exists for wheat and barley yields because these are not typically insured by farmers, given the state's support.

➢ **Recommendations:**

Based on the findings, several recommendations have been proposed to assist the Algerian government in developing the agricultural sector and leveraging it for economic enhancement:
- Various strategies exist for managing agricultural risks and diversifying crops and products, including direct compensation mechanisms like guarantee or disaster funds, and structured non-governmental aid for agricultural calamities. Agricultural insurance has proven to be the most efficient among these strategies, ensuring equitable cost distribution to support this sector.

- Promote collaboration and conduct joint field studies on agricultural insurance at the national level in Algeria to gather extensive information and data, aiding the technical framework of the agricultural insurance program.
- Enhance the regulatory and legislative framework for the insurance sector in Algeria, specifying insurance products tailored to the agricultural sector.
- Facilitate coordination between relevant governmental bodies and private insurance firms to offer insurance based on initial damage assessment, with the approach evolving to align with climatic indicators once a sufficient network of stations is established across the insured regions.
- Actively contribute to reaching a broader spectrum of targets in rural areas and penetrating the vulnerable segments in remote locations.
- Implement suitable measures and processes for loss estimation, compensation approval, assessor training, and ensuring adequate on-site presence.

APPENDICES:

The first product: Fruit trees

Year	Agricultural insurance	Production in (quintal)	Area (hectares)	Yield (quintals/ hectares)	Growth rate %
2006	23604	300000	7000	42.85	-
2007	62779.90	360000	7300	49.31	20
2008	7681.25	486000	9000	54	35
2009	32140.80	155897	1300	119.92	-67
2010	22308.75	112000	1000	112	-20.8
2011	3726.50	108000	4000	27	-12.5
2012	42000	123000	6000	20.5	13.8
2013	16200	400000	2500	160	33.33
2014	15211	160000	4000	40	-60
2015	11312.49	225000	2000	112.5	40.6
2016	59644	418000	8000	52.25	85
2017	597150	228000	3250	70.15	-45.45
2018	149642.97	440000	5000	88	92.9
2019	312835	119080	5500	21.65	-72.9
2020	16630	114000	1000	114	-4.26

The second product: The vineyard

Year	Agricultural insurance	Production in (quintal)	Area (hectares)	Yield (quintals/ hectares)	Growth rate %
2006	44458.1	319781	4160	76.87	-
2007	564864	584100	8850	66	82.65
2008	16984.22	748800	9600	78	28.19
2009	30038	188595	2500	75.44	-74.81
2010	54288.40	112600	2000	56.3	-40.29
2011	15000	100000	4000	25	-11.19
2012	103599.5	145246	7490	18.38	45.24
2013	154788.40	114265	2000	57.13	-21.32
2014	471210.42	200785	7000	28.68	75.71
2015	475506.33	303600	4800	63.25	51.2
2016	608681.2	48230	1000	48.23	-84.11
2017	255707.54	94996	1666	57	96.96

2018	447365.51	163900	2000	81.95	72.53
2019	549908.55	283000	7200	39.9	72.66
2020	854425.29	27175	1087	25	-90.39

The third product: Wheat and barley

Year	Agricultural insurance	Production in (quintal)	Area (hectares)	Yield (quintals/ hectares50)	Growth rate %
2006	49000.50	126400	2528	50	-
2007	10550	90000	1000	90	-28.79
2008	2301.45	44800	1600	28	-50.22
2009	22690.62	52000	1300	40	16.07
2010	60844.50	96300	2140	45	85.19
2011	18003.50	172000	2150	80	78.6
2012	14644	160000	8000	20	-6.97
2013	300	30000	2000	15	-81.25
2014	8118	20000	1000	20	-33.33
2015	30651.84	150000	5000	30	-25
2016	36902.08	136400	2200	62	-9.06
2017	19760	105000	1500	70	-23.02
2018	13061.6	120000	6000	20	14.25
2019	308315.93	180700	6100	29.62	50.58
2020	6485.60	160000	8000	20	-11.45

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