Black Sea Journal of Agriculture
doi: 10.47115/bsagriculture.1609769

Open Access Journal
e-ISSN: 2618 – 6578

Research Article
Volume 8 - Issue 3 : 335-349 / May 2025

AGRICULTURAL INSURANCE MARKETING AND MANAGEMENT: A STRATEGIC APPROACH USING TIME SERIES ANALYSIS

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Abstract: Differentiation in insurance marketing varies across branches, serving as a significant determinant in shaping the strategies and policies to be adopted. While there are certain similarities between the insurance needs of producers in the agriculture, industry, and service sectors and those of households and consumers, notable differences also exist.
The primary aim of this study is to develop a strategic approach to the marketing and management of agricultural insurance, which ranks as one of the foremost measures against risks in the agricultural sector. To this end, the series of policy counts, and premium amounts produced in the branches of crop production and livestock life insurance during the 2013–2023 period were forecasted, and the model types yielding the most successful results were identified. The stationarity of each branch of agricultural insurance was achieved by taking the first-order difference of the time series. The most suitable model was determined for each series. According to the obtained models, it is projected that the number of policies and the amount of premiums for agricultural insurance will increase in the coming periods. To ensure that insurance companies, producers, and intermediaries maximize their benefits from these developments, several recommendations regarding marketing and management practices have been proposed. The findings of this research are anticipated to contribute to the strategic marketing management and planning processes of businesses.

Keywords: Insurance marketing, Management, Time series analysis, Insurance

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Received: December 30, 2024
Accepted: March 19, 2025
Published: May 15, 2025

Cite as: Altuntaş B, Özdemir HÖ., 2025. Agricultural insurance marketing and management: a strategic approach using time series analysis. BSJ Agri, 8(3): 335-349.

1. Introduction

Agriculture is a sector of critical importance not only for economic development and meeting the basic needs of societies but also for food security and social stability. However, the sector faces several threats to sustainable production, including natural disasters, climate change, and various risks. Compared to other sectors, agriculture is a sector that carries a higher risk of farmers losing income and experiencing imbalances in their income (Çukur and Saner, 2008). Consequently, these factors create high risks in agricultural production and endanger sustainability in the sector. One of the most effective methods of protection against these risks, which are common in the agricultural sector, is agricultural insurance (Binici et al., 2003). For this reason, governments attempt to protect farmers against income losses caused by economic risks following yield losses due to natural risks that threaten agricultural production (Dinler, 2000). Agricultural insurance is an effective tool to mitigate the impacts of these risks and ensure sustainability in agriculture. Natural disasters, droughts, floods, diseases, and pests are factors that lead to unpredictable losses for agricultural producers. In this context, farmers need effective risk management strategies to protect their income and sustain their agricultural activities. Agricultural insurance plays a crucial role in this regard by mitigating the impacts of these risks and ensuring the economic stability of farmers. By compensating farmers for potential losses, agricultural insurance provides them with the opportunity to produce more securely and supports agricultural sustainability. Risk management in agricultural production aims to reduce uncertainties faced by farmers and ensure a more stable income flow. Agricultural insurance offers various policies for both crop and livestock products, helping farmers protect themselves from natural disasters and other risks. These insurances not only aim to protect farmers' products and income but also contribute significantly to sustainability efforts in the agricultural sector. However, the widespread adoption of agricultural insurance is not always easy. Farmers' lack of sufficient knowledge about insurance products and their inability to properly assess risks result in low demand for insurance. This situation makes it difficult for insurance companies to invest in agricultural insurance and, consequently, leads to a vicious cycle in the sector. Raising awareness and educating farmers about these insurance products will both increase insurance demand and contribute to ensuring sustainability in the agricultural sector. The agricultural sector requires effective risk management

strategies and efficient marketing of agricultural insurance to achieve sustainable development goals. This study aims to emphasize the importance of agricultural insurance and develop strategies to encourage farmers to adopt these products. By doing so, risks in agricultural production can be minimized, and food security and economic stability can be ensured. The aim of this study is to approach the marketing and management of agricultural insurance from a strategic perspective and offer the necessary solutions to encourage farmers to take out insurance. By examining data from the past decade, strategies that can be implemented to prevent risks in agricultural production and ensure the continuity of farmers' incomes will be identified. Special attention will be given to strategies that can be developed by TARSIM (Insurance of Agriculture). Effective marketing of agricultural insurance is of critical importance in increasing farmers' interest in these products and ensuring the effectiveness of the insurance system. Insurance marketing involves not only promoting products but also understanding the needs of farmers and offering solutions that meet those needs. Increasing farmers' knowledge about insurance policies will help them better understand the value of the services offered by insurance companies.

1.1. Literature

1.1.1. Agricultural insurance: sustainability and risk management

Global climate change and the greenhouse effect are increasing the frequency and severity of natural disasters, leading to significant losses in farmer incomes and national economies. Additionally, highly lethal epidemics, such as the recent pandemic, have disrupted agricultural production, leading not only to income losses for farmers but also to a decline in production volume, causing significant economic damage. For example, a recent study by Setyawan et al. (2023) states that the pandemic has further worsened and destabilized production and income stability. As a result, agricultural insurance has become a vital tool for risk management during such unexpected crises. The agricultural sector is developing various methods to prevent these risks or minimize their impact. As the most common risk management tool, crop insurance plays a significant role in this regard. This type of insurance financially protects farmers from potential risks they may encounter during agricultural activities. Moreover, it helps farmers protect their crops and income against unforeseen circumstances such as natural disasters, diseases, pests, and droughts. Agricultural insurance offers farmers the opportunity to produce more securely, thus supporting the sustainability of agricultural activities. Therefore, agricultural insurance is considered a critical safeguard for those working in the agricultural sector. To ensure the continuity of agricultural production, it is necessary to implement agricultural insurance to stabilize crop prices and farmer incomes (Akçaöz et al., 2006). Agricultural insurance is offered in various branches such as crop products, cattle, sheep, poultry, bee hives, aquaculture, and greenhouse farming. Management functions such as planning, organizing, directing, and controlling are also of great importance in the insurance sector. Business managers in both crop and livestock production should make plans by considering meteorological factors and benefit from this information. Especially in crop production, there is a heavy dependence on natural conditions such as climate change and drought. Under these conditions, catastrophic damage may occur, leading to consequences that are difficult to compensate for. Another responsibility of insurance managers is to ensure the standardization of rules and methods and support the specialization of roles. Today, due to global warming, there has been an observed increase in the types and frequency of natural disasters, which makes specialization and diversification in the insurance sector essential. Uncertainty and increasing risks can complicate the decision-making processes of business owners. To manage effectively in line with their goals, business owners must have the necessary information. As noted by Akalın (1970) and Emhan (2009), risk refers to situations where the probability distribution of an event is known, but its uncertainty is not. Risks in agricultural production can be classified into categories such as diseases, price fluctuations, theft, and adverse weather conditions (Pehlivan and Akpınar, 2022). Şahin et al. (2008), Sayılı and Uzunoz (1998), and Karahan (2002) have divided these risks into two main groups: production risk, which originates from nature, and market risk, which arises from the market. Agriculture is an extremely vulnerable sector to unpredictable natural disasters, which can cause substantial damage to human life, property, the environment, and agricultural products (Yalaz, 2023). Moreover, due to the effects of climate change, the potential costs associated with these events are likely to increase in the future. Therefore, instability in the agricultural sector and fluctuations in farmers' incomes arise from these risks and uncertainties. Due to these risks, producers face difficulties in determining which crops to grow. Agricultural businesses, as a result of the risks they encounter throughout the production and marketing process, are unable to expand their operations (Şahin et al., 2008). The widespread adoption of agricultural insurance is not always easy due to factors such as farmers' insufficient knowledge about insurance alternatives and their inability to objectively assess the risks they face. Insufficient demand for insurance creates a vicious cycle, preventing insurance companies from investing in agricultural insurance (Meuwissen et al., 2003). Agricultural enterprises face constant risks in both crop and livestock production. Holloway (1979) categorized farmers' risk behavior into three groups: risk-seeking, risk-averse, and indifferent. The risks faced by businesses in crop production include factors such as hail, fire, floods, and drought, while those in livestock farming include risks like animal death, calf mortality, sunstroke, and fire. To manage risk, business managers in both crop and livestock production may seek to spread or eliminate

risks. In this regard, insurance companies play a key role in mitigating these risks. According to the World Commission on Environment and Development (WCED), sustainable development can be defined as the practice of meeting present needs without compromising the ability of future generations to meet their own needs (Brundtland, 1985). In terms of specialization for sustainable development, significant progress has been made in ensuring sustainability in both crop and livestock production. The more sustainable the production, marketing, and management activities are, the more market balance will be achieved, and competition in the sector will increase. Increased competition will enhance confidence in the sector, improve efficiency, and positively affect the overall health of the agricultural sector. For the effective implementation of agricultural insurance, it is crucial for farmers to be well-informed and able to evaluate insurance alternatives. In this context, the marketing of agricultural insurance plays a critical role in offering products suited to farmers' needs and raising insurance awareness. The next section will discuss strategies for marketing agricultural insurance and evaluate their impact on farmers. Through this, the aim is to increase the widespread adoption of agricultural insurance and support sustainable agricultural production.

1.1.2. Insurance marketing

Insurance marketing refers to the process of offering insurance products to consumers and developing strategies for this process. The complex nature of insurance products reduces consumers' interest in these products, making it difficult to explain the necessity of insurance. Since insurance is a service sector, customer experience and trust-building are critical in-service marketing. The competitive environment in the sector is a significant factor affecting marketing strategies. Insurance marketing should primarily be regarded as a form of service marketing; the differences and characteristics in this field are also valid for insurance marketing (Özgüven, 2008). The only tangible element in the presentation of insurance services is the insurance policy. In fact, the marketed value is the insurance coverage stated in the policy, which is an abstract concept (Akpınar, 2017). The benefit that the customer derives from the insurance policy is the main area of focus for marketing. In the event of damage, the speed of resolution is crucial for customer satisfaction and the evaluation of the service. In insurance sales, an opportunity for a sale arises only when contact is made with individuals who have a need for insurance. This process is quite challenging and complex, as it involves selling an unknown product in an uncertain environment, with no clear idea of when the event may occur. The invisibility of the service offered by insurance companies decreases customers' willingness and interest in purchasing. Although the service becomes tangible when damage or loss occurs, if no damage happens, the service is often considered a wasted resource by the customer. Therefore, it is important to raise awareness among customers about insurance. The foundation of insurance marketing lies in the concept of service marketing, and in this context, educating and informing potential customers about the benefits and necessities of insurance products is crucial (Özgüven, 2008; Akdoğan, 1983). Insurance companies' analysis of customer data and prioritizing customer relationship management will be beneficial in developing marketing strategies focused on target consumers. Digital marketing channels play an essential role in reaching customers and establishing effective communication with them. Insurance companies try to meet customers' expectations in the best possible way by designing policies that are most suitable for their needs. Since these products cannot be produced or stored, customer-focused service delivery is necessary. Therefore, insurance companies must stay in contact with their customers in a competitive environment and act more sensitively to meet their expectations. As a result, in the highly competitive insurance sector, the concepts of customer, service, and quality are becoming increasingly important (Akpınar, 2017). Insurance companies provide many services to their consumers. These services include:

i. Guarantee: These are the guarantees provided by the insurance contract against uncertainties, and they are a distinguishing feature of the insurance contract.
ii. Organization: This refers to the organization of the insurance pool.
iii. Investment: This involves turning the funds accumulated in the organized insurance pool into the most profitable investment.
iv. Advice: Developing recommendations about the precautions that can be taken against possible damage.

In order to achieve profit, insurance companies adopt various strategic marketing approaches. Achieving customer satisfaction, implementing loyalty programs, designing different products, adding compensation products to policies that appeal to the customer's preferences, and creating a competitive edge are considered success criteria (Öztürk and Güven, 2013). In the insurance sector, distribution mix strategies are generally implemented through branches or agents. With the powers granted to the banking system, insurance products can be offered to customers through each branch. As the frequency and damage caused by natural disaster risks increase, premium prices rise. Producers tend to avoid purchasing crop insurance due to the high premium costs. Therefore, a portion of the insurance premiums is subsidized by the government. The amount of this subsidy, aimed at encouraging insurance purchases, is set at fifty percent (50%) of the premium cost and is updated annually by the Council of Ministers (TARSIM, 2013).

1.1.3. Time series analysis

The use of time series analysis in agricultural certification is seen to be important for the dissemination of effective insurance products, ensuring that these products are

accepted by the information within the target market and comprehensively monitoring the outcomes and consumption patterns in payments for management software. For example, Ngungu et al. (2018) emphasize the enhancement of time series techniques in the management of insurance investments and risk assessment strategies. Time series are numerical values that represent the sequential observation of variables over a specific period. It is not mandatory for the observed data to occur consecutively over time; however, regular intervals are necessary to observe the development of the series (Sevuktekin and Nargelecekenler, 2007). This analytical method is frequently used in examining time-dependent data and holds significant importance in various scientific fields, including economics, geophysics, agriculture, and medicine. To achieve the goal in a time series study, sufficient, high-quality, and reliable data are required (Çelik, 2013). In the process of time series analysis, accurately determining the model and testing its suitability for the data are crucial. A poorly determined model will not provide reliable results. After model selection, the appropriateness of the chosen model for the data should be carefully tested. When an appropriate model is established, it will be possible to make accurate predictions based on this model (Çelik, 2013). Time series analysis is an approach aimed at making predictions based on a variable's behavior in past periods (Kennedy, 2006). The observed data set can be predicted as a stochastic process consisting of random variables. This stochastic process is formed by y1, y2, .., yt values at period t. By modeling such a process, probabilities about the future behavior of the relevant series can be obtained (Cryer and Chan, 2008).

Time series analysis is based on examining past data for a specified period to identify certain trends. This analysis includes four main components (Şeker, 2015):

i. Trend Component: The stable state that emerges after a period of increase or decrease in the observed series over the long term. If the series shows an upward or downward direction, it indicates a trend. If the curve fluctuates, it is concluded that there is no trend in the series.
ii. Seasonality Component: The presence of seasonal variations in the observed series. The presence of fluctuations in the series at specific time intervals is examined.
iii. Cyclical Component: The presence of non-seasonal periodic changes observed in the economy. It refers to the rise or fall occurring in the medium term.
iv. Irregular (Random) Component: Changes characterized by uncertainty and expressed through error terms. It should be considered that there may be sudden increases or decreases in data at any time. For example, the sudden increase in mask sales during the pandemic does not mean that such changes will occur at all times.

The complex structure of insurance products, customer needs, and the competitive dynamics in the sector play a critical role in developing insurance marketing strategies. In this context, by using time series analysis, secondary data on the number of policies and insurance premiums for ten years of crop insurance and livestock life insurance will be examined.

2. Materials and Methods

2.1. Main Objective of the Study

The primary aim of this study is to contribute to the development of effective strategies for the marketing and management of agricultural insurance, and to create solution proposals that will increase efficiency and effectiveness in these processes. In line with this goal, the number of policies and insurance premiums for selected agricultural insurance branches (crop insurance and livestock life insurance) covering the past 10 years (2013-2023) have been examined in detail. Using the obtained time series, the study aims to forecast the number of agricultural insurance policies and premiums until 2030. By determining an appropriate time series model, predictions for future policy numbers and insurance premiums will be made, with the goal of supporting companies in developing their marketing and management strategies. Additionally, various recommendations will be made to guide the policies to be followed for the widespread adoption of agricultural insurance and the uptake of insurance by producers. In this context, the findings obtained through secondary data analysis will provide valuable insights into trends and customer behaviors in the agricultural insurance sector. Based on these insights, the study aims to develop concrete recommendations for insurance marketing and management.

2.2. Methodology

The study utilizes secondary data sources. For this purpose, annual data for the period 2013-2023 have been obtained from TARSİM reports and the Turkish Statistical Institute (TUIK) database. Time series analysis is a quantitative method frequently used to predict future data by examining data collected at regular intervals (Özcan and Yıldırım, 2021). The data analysis was conducted using SPSS 27 and Stata software packages. Initially, the time series were individually subjected to unit root tests. The series were tested for stationarity using the Augmented Dickey-Fuller (ADF) test. If no stationarity was found at the level of the series, differences was applied to achieve stationarity (Çamoğlu and Akıncı, 2012). The differencing process eliminates the issue of spurious regression and makes the analysis results more reliable (MacKinnon, 2010). To achieve stationarity, if differencing is performed d times, the variable is considered integrated of order d, denoted as I(d) (Kennedy, 2006). After testing the series with the ADF unit root test, forecasts for each series for the years 2013-2023 were made using the ARIMA, Holt, and Brown models. The Box-Jenkins approach provides a systematic framework for the analysis of time series data and is

particularly suitable for non-stationary series. It is widely used in time series analysis because it has the ability to solve a dataset, regardless of whether the series is stationary or contains seasonal components (Sevuktekin and Nargelecekenler, 2007). This approach may require methods such as differentiating or transformation to make the series stationary. Within the framework of time series analysis, the ARIMA model was used to determine the values of p (autoregressive), d (differencing), and q (moving average) by examining the autocorrelation (ACF) and partial autocorrelation (PACF) functions for each series. The Akaike Information Criterion (AIC) and Schwartz-Bayes Information Criterion (BIC) were used for selecting the appropriate model (Çelik, 2015). The Holt and Brown models, effective in forecasting data with trends and levels, were used to predict future values based on historical data. The model that produced the best result was selected as the forecasting model, and predictions for the future were made. In this process, the validity of the modeling was enhanced by focusing on the presence and nature of the trend.

3. Results

The distribution of the number of policies created in agricultural insurance and the distribution of insurance premiums according to branches are detailed in Figure 1 below.

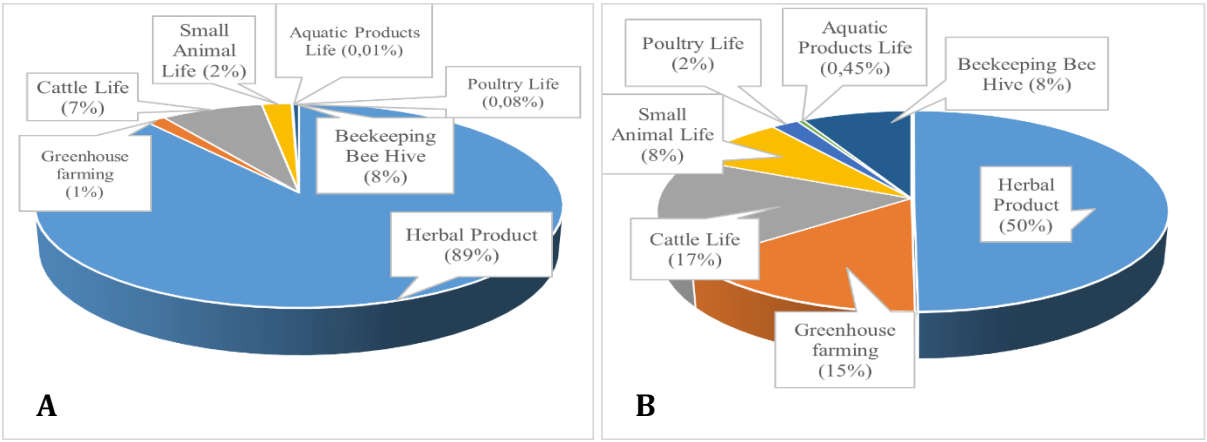

Figure 1. A) Policy distribution rates (%) and B)Insurance cost distribution rates (%) between 2013-2023 years.

Upon examining the distribution graphs, it is evident that the highest number of policies created between 2013-2023 was in the Crop Insurance branch, accounting for 89%. The share of crop insurance in the total insurance premium was calculated at 50%. The Livestock Life Insurance branch ranks second in terms of policy distribution, making up 7% of the total number of policies, while it accounts for 17% of the total insurance premium. Although the number of policies in Greenhouse Farming is 1%, it ranks third in terms of insurance premiums, representing 15% of the total premium. Small Livestock Life Insurance policies constitute about 2% of the total, with an 8% share in the insurance premium. Other branches, such as Beekeeping, Poultry, and Aquaculture, have policy numbers under 1%, with respective shares of 8%, 2%, and 0.45% in the total insurance premium. Agricultural insurance consists of various branches. This study specifically analyzes Crop Insurance, which holds the highest share in both policy numbers and premiums, and Livestock Life Insurance, which holds the second-largest share in terms of insurance premiums. The analysis conducted in this study utilizes the annual data set from 2013-2023. This data set includes the number of policies and insurance premiums categorized by agricultural insurance branches. Table 1 below presents the number of policies created by branch for each year, while Table 2 shows the insurance premiums by branch.

Table 1. Number of policies issued according to agricultural insurance branches by year (Number)

Branch / Year	Herbal Product	Cattle Life
2013	841.694	25.683
2014	1.029.586	23.320
2015	1.311.373	26.636
2016	1.366.550	35.777
2017	1.493.392	54.856
2018	1.607.121	90.904
2019	1.900.609	117.920
2020	1.952.825	181.773
2021	2.147.758	241.012
2022	2.654.588	278.199
2023	2.525.426	414.802

Source: Turkish Statistical Institute (TUIK,2024).

Table 2. Insurance costs by agricultural insurance branches by year (Million TL)

Branch / Year	Herbal Product	Cattle Life
2013	7.567	1.747
2014	9.288	1.950
2015	12.568	2.475
2016	15.861	3.497
2017	18.655	5.441
2018	23.153	9.892
2019	29.741	12.221
2020	39.305	21.785
2021	55.578	32.187
2022	143.568	76.289
2023	222.859	88.249

Source: Turkish Statistical Institute (TUIK,2024).

Between 2013 and 2023, Crop Insurance experienced an average growth rate of approximately 12% in the number of policies, while the growth rate for insurance premiums was significantly higher, at an average of 44%. The increase in policy numbers can be attributed to farmers' growing awareness of the risks they face in crop production and their desire to protect themselves against such risks. The substantial rise in crop insurance premiums is largely due to the sharp increase in insurance premium amounts, driven by inflationary pressures. For Livestock Life Insurance, the average growth rate in policy numbers between the years was 33%, while the average increase in insurance premiums was also 44%. This increase can be explained by the growing professionalism in the livestock sector and the heightened threat posed by animal diseases, which have become a more significant risk for farmers.

3.1. Crop Insurance Policy Numbers and Premiums

The time series of policy numbers created for crop insurance between 2013 and 2023 has been analyzed. It is observed that there is an increasing trend over time for crop insurance policies. To check the stationarity of the series, an analysis of autocorrelation and partial autocorrelation has been conducted. It was found that the series is not stationary and still contains certain correlations at varying levels. Figure 2 shows the autocorrelation plot of the crop insurance policy numbers of series, and the partial correlation.

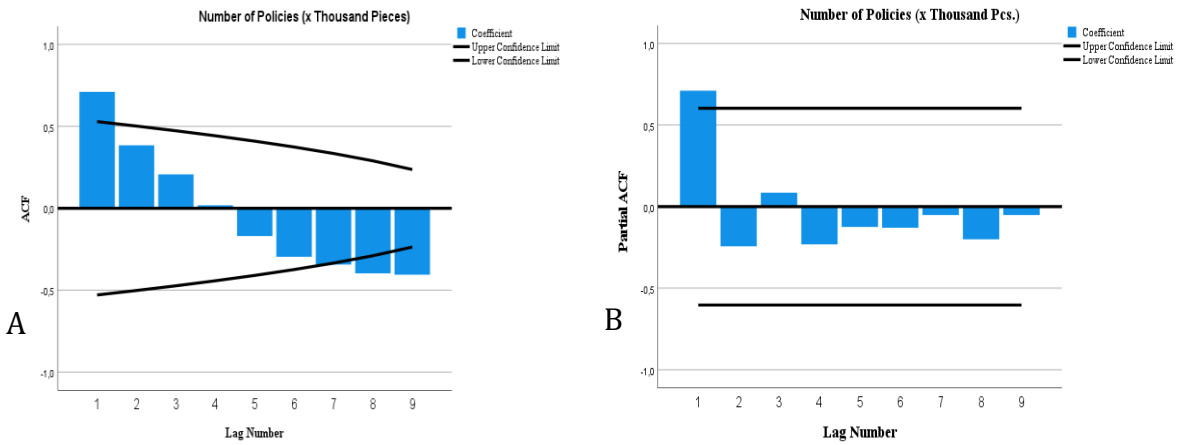

Figure 2. A) Plant products insurance policy number autocorrelation and B) Partial autocorrelation in the number of plant insurance policies.

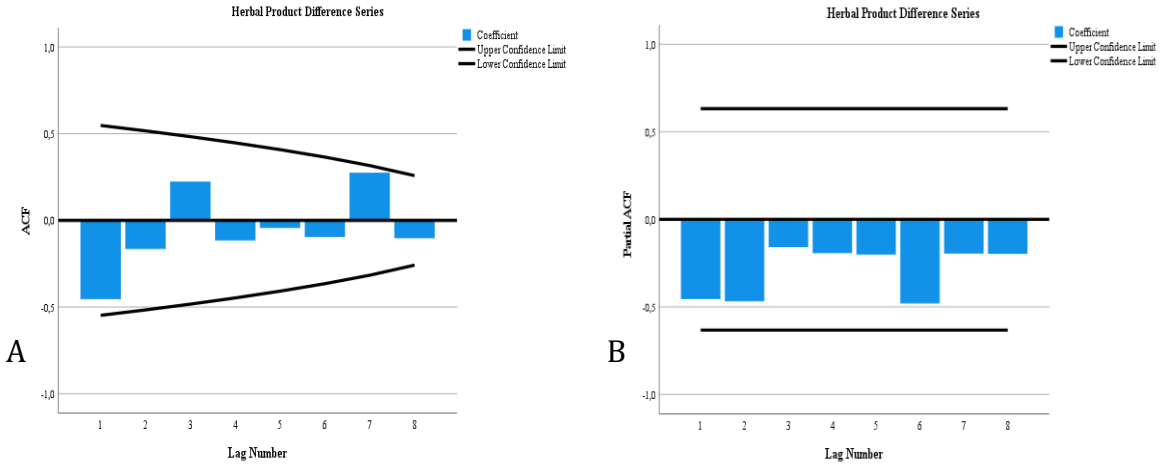

Figure 3. A) Crop insurance policy number difference series partial autocorrelation and B) Crop insurance policy number difference series partial autocorrelation.

Therefore, the first difference operation was applied, and a differenced series was created. Subsequently, stationarity was achieved by checking the ACF and PACF. After the differencing operation, the autocorrelations weakened significantly, and the p-value was high, indicating that the series became stationary. The autocorrelation test results for the different series are shown in Figure 3. below. The Box-Ljung test results confirm that the autocorrelations of the series are zero. Based on these results, the series modeling phase was initiated, and the ARIMA model was chosen. For the p (autoregressive) parameter, the PACF graph was examined, and the first sharp jump was selected as the value for p. In this graph, p could be 1, 2, or 6. For the d (differencing) parameter, the number of differences applied is taken, and since stationarity was achieved after the first difference in this series, the value of 1 was chosen. The "q" parameter, which represents the moving average, was determined by examining the ACF graph. This parameter indicates the predictive power of past error terms for future values. The first jump point in the ACF graph helps in determining the suitable value for q. In this case, 1 and 7 were identified as suitable values. ARIMA models were created for each combination, and the goodness-of-fit statistics were checked. The ARIMA (1,1,1) model provided the lowest MAPE value, and predictions were made using this model. The model's fit statistics are as follows: Constant R^2: 0.443, R^2: 0.998; RMSE: 114.694; MAPE: 3.816; MAE: 79.315; and Normalized BIC: 9.985. Subsequently, the trend in the number of agricultural insurance policies for crop insurance was identified and forecasting was performed until 2030. The results of the trend analysis for crop insurance policy numbers are shown in Figure 4 below.

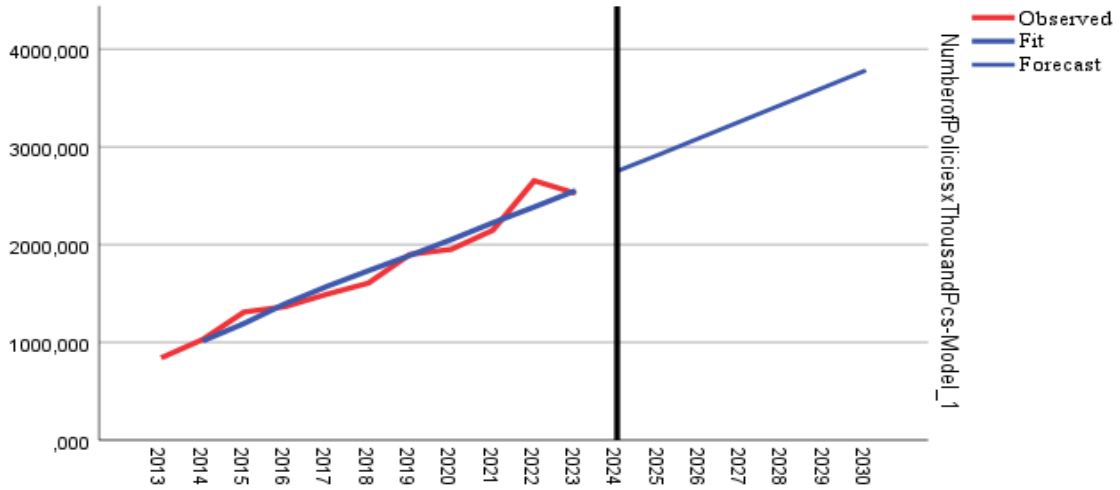

Figure 4. Trend analysis of the number of plant products insurance policies (thousand units).

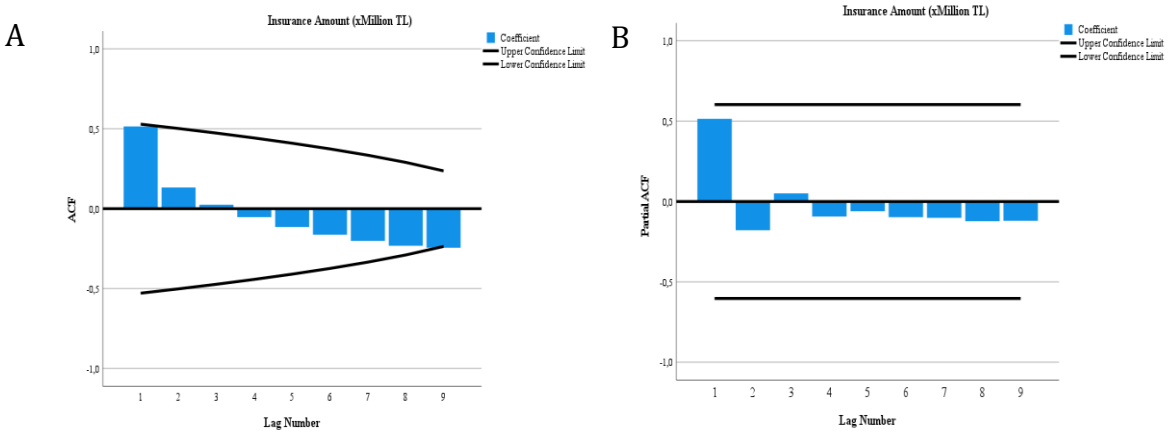

Figure 5. A) Autocorrelation of plant product insurance cost and B) Partial autocorrelation of crop insurance cost.

The number of policies produced in crop insurance is expected to be around 2.752 million in 2024, and this number is projected to reach 3.783 million by 2030. This represents an estimated growth rate of approximately 38%. The same analysis protocol was applied to the series of crop insurance premiums. The obtained autocorrelation and partial autocorrelation are shown in Figure 5. below. As can be seen from the figures, due to the stationary nature of the series, the model selection phase was initiated. In the analysis where the Brown model was preferred, the fit statistics were calculated as follows: R^2: 0.887, RMSE: 22,979.250, MAPE: 9.409, MAE: 8.619, and Normalized BIC: 20.303. While the model generally fits the data well, it indicates areas where improvements are needed. Expanding the data set to cover a broader time period would likely lead to better results. Additionally, since the insurance premiums are calculated in Turkish Lira, the rapid premium increase observed between 2021 and 2023, as shown in Figure 6, may have caused deviations in these values. Despite this, the model was accepted for forecasting, as the indicators for prediction performance are positive, even though this aspect was not covered in the scope of this study. Figure 10 below illustrates that there will be an increase in the premiums for crop insurance in the coming years. It is projected that crop insurance premiums will rise by approximately 157% by 2030. This indicates that a significant accumulation in the insurance pool is expected.

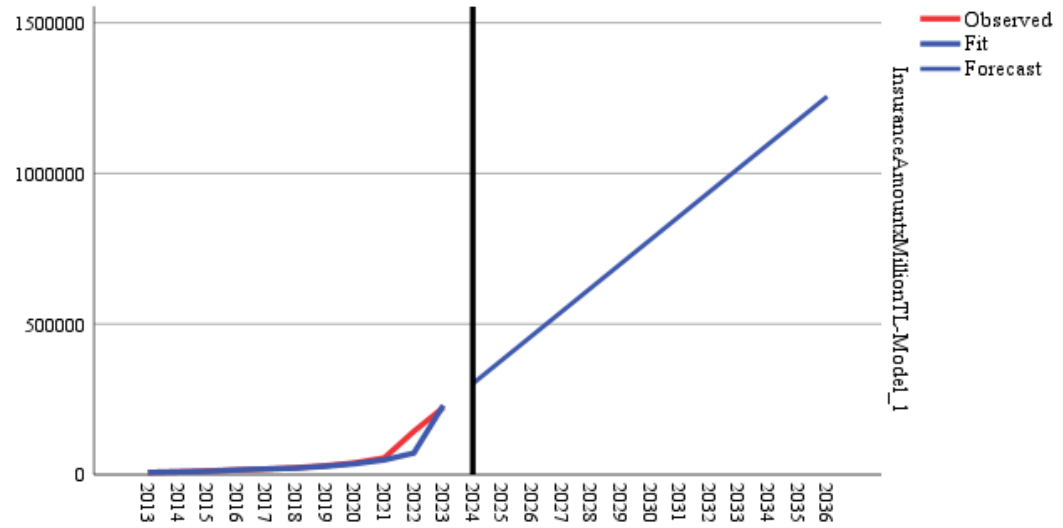

Figure 6. Plant products insurance fees trend analysis (million TL).

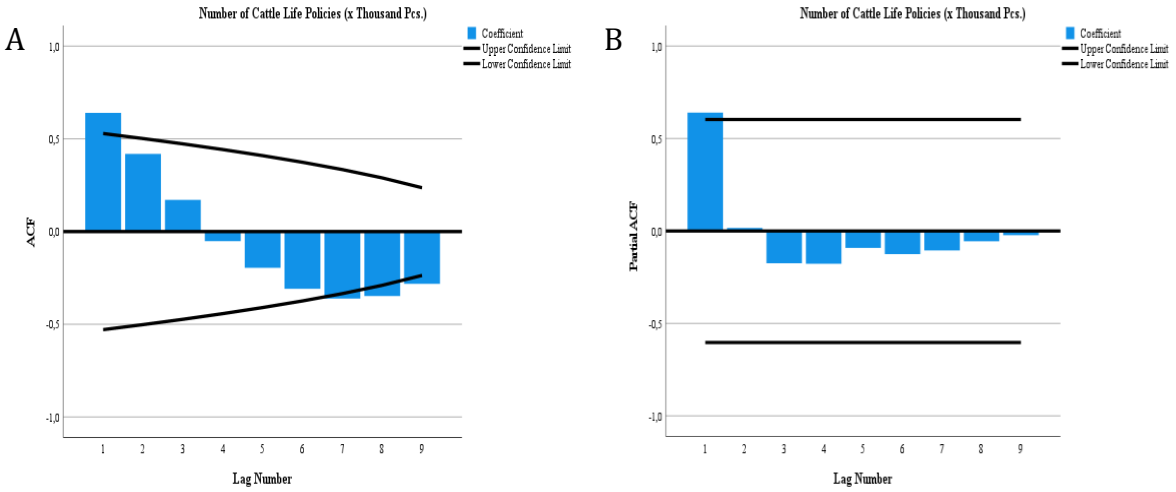

Figure 7. A) Cattle life policies autocorrelation and B) Partial autocorrelation.

3.2. Cattle Life Insurance Policy Numbers and Insurance Premiums

The observed series for the number of policies created in cattle life insurance between 2013 and 2023 was first analyzed. When looking at the number of policies produced for cattle life insurance between 2013 and 2023, it is observed that there has been an increase over time, indicating the presence of a trend effect. To check the stationarity of the series, the autocorrelation and partial autocorrelation analyses shown in Figures 7 below were conducted. It was found that the series was not stationary and still contained certain correlations. Therefore, a first difference operation was performed to create the difference series. After conducting ACF and PACF checks, stationarity was achieved in the series. Following the differencing, the autocorrelations weakened significantly, and since the p-value was high, the series became stationary. Figure 8 resulting from the difference operations are shown below. The results of the Box-Ljung test (after the first lag, with a p-value of 0.443, P>0.05) indicate that the autocorrelations of the series are zero.

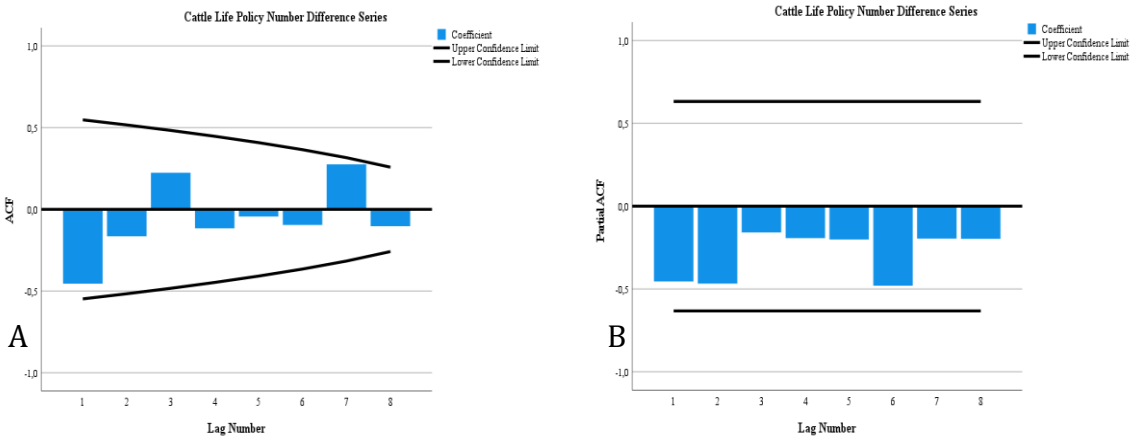

Figure 8. A) Cattle life policy number difference series autocorrelation and B) Cattle life policy number difference series partial autocorrelation.

Based on these results, the modeling process was initiated, and the ARIMA model was selected. For the p (autoregressive) parameter, the PACF graph was examined, and the first sharp jump was chosen as the value. In this graph, p values of 1, 2, and 6 could be possible. The parameter d (differencing) refers to the number of differences applied, and since stationarity was achieved after the first difference in this series, the value 1 was selected. For the "q" parameter, which represents the moving average, the ACF graph was used. This parameter indicates the power of past error terms to predict the future. The first jump point in the ACF helps determine the appropriate q value. In this case, 1 and 7 are suitable values. The ARIMA model was constructed for each combination, and the fit statistics were checked. Among the models, ARIMA (2,0,1) produced the lowest MAPE value, so forecasting was performed using this model.

The model's fit statistics are as follows: *Stationary R^2: 0.964, R^2: 0.972, RMSE: 13.535, MAPE: 3.983, MAE: 5.759, Normalized BIC: 11.876.* Since the fit statistics of the ARIMA (2,0,1) model were considered acceptable, forecasting was carried out. The trend analysis and predicted policy numbers are detailed in Figure 15. The trend in the number of policies for livestock life insurance is expected to continue upwards until 2030, with an estimated increase of around 83%. Lastly, the series for the insurance premiums of livestock life insurance policies was analyzed. To first determine whether the series is stationary, a unit root test was applied. The results obtained are presented in detail in Figures 16 and 17. Upon examining these graphics, the Box-Ljung test results show that the p-value after the first lag is greater than 0.05 (P>0.05; P=0.104), indicating that the series is stationary.

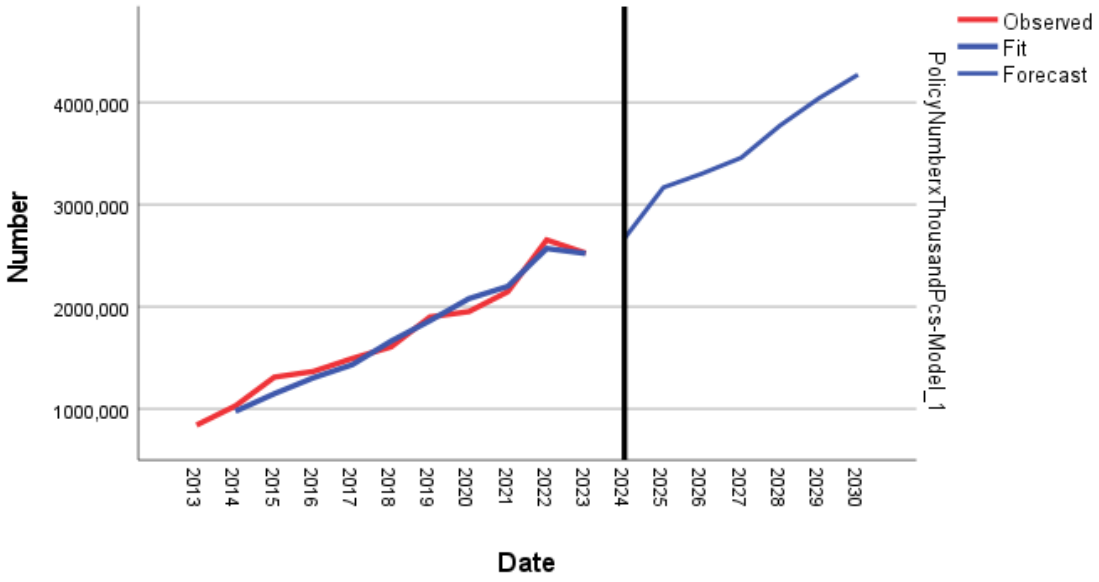

Figure 9. Cattle life insurance policy number trend analysis (thousand units).

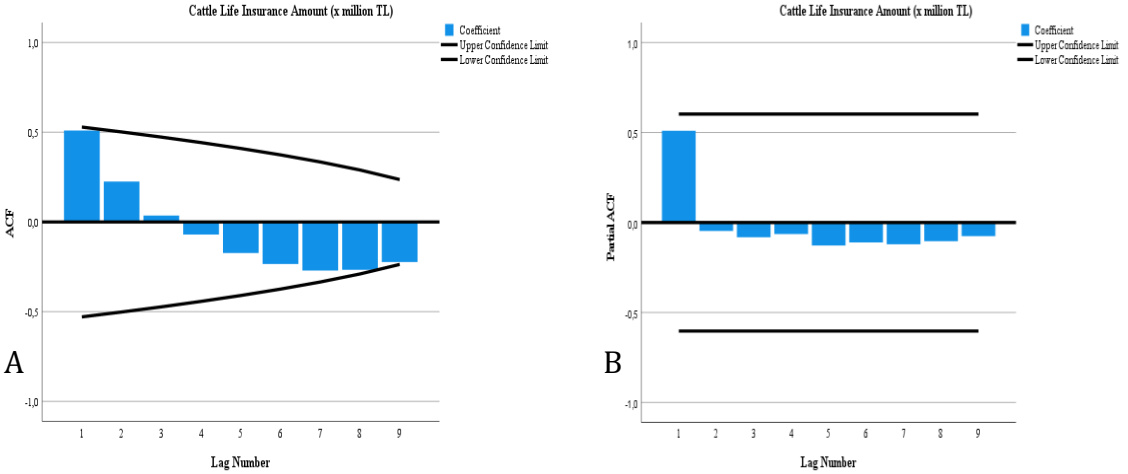

Figure 10. A) Cattle life insurance cost autocorrelation and B) Cattle life insurance cost partial autocorrelation.

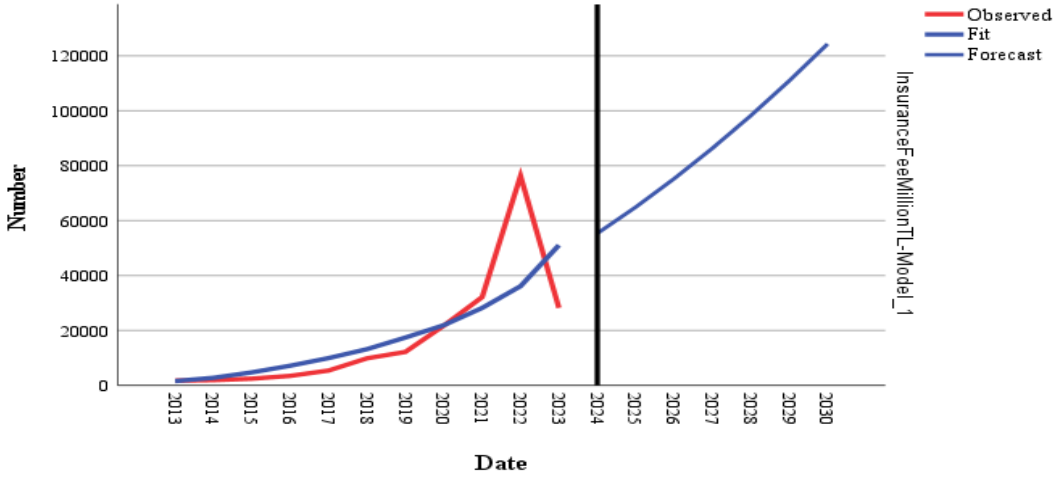

Figure 11. Cattle life insurance cost trend analysis (million TL).

Since the series is stationary, the model selection process proceeded, and analyses were conducted on the Holt, Brown, and ARIMA models to achieve the best MAPE value. The ARIMA (1,0,1) model, which showed the best fit, was selected for forecasting. The ARIMA model's fit statistics are as follows: Stationary R^2: 0.772, R^2: 0.842; RMSE: 16,461.786; MAPE: 21.798; MAE: 5,792.836, and Normalized BIC: 19.041. Although the model requires some improvements, the indicators suggest that it can be considered acceptable in terms of fit. The insurance premiums are calculated in Turkish Lira. As reflected in Figure 8, high inflation in macroeconomic indicators has also affected insurance premiums. Since this aspect is beyond the scope of this study, it has been disregarded, and the focus has been on evaluating the prediction scores. Although a sharp increase is observed from 2021 to 2022, such an extraordinary development has been taken into account in the analysis, and the trend analysis has been normalized. The trend graph indicates that there is an expected increase of approximately 65% in livestock life insurance premiums by 2030.

4. Discussion

Agriculture is a vital element of human civilization, deeply intertwined with global economies, biodiversity, and the historical evolution of human life. It also plays a crucial role in poverty alleviation, economic growth, and environmental sustainability. Agricultural insurance aims to compensate for losses that may occur during agricultural production processes. Drought, floods, frost, hailstorms, and other disasters significantly impact farmers' income and production capacities. Insurance allows for the management of these risks. Therefore, reducing risks and compensating for losses contribute to ensuring stability in the sector and fostering economic development. Agricultural insurance has consistently been a subject of interest among researchers from past to present. In his study, Glauber (2004) emphasized the importance of strategic approaches in the marketing of agricultural insurance. This study develops a strategic approach and provides businesses with strategic recommendations from both marketing and management perspectives, considering future trends in agricultural insurance. This study offers several practical findings and recommendations. One of the key findings is that *time*

series analysis is a valuable method for understanding changes in agricultural insurance demand, conducting risk assessments, developing marketing strategies, and making management decisions. This observation has also been emphasized in previous studies by Skees and Barnett (1999) and Goodwin (2001). The findings of the research indicate that the number of agricultural insurance policies and premium amounts will continue to follow an upward trend in the coming years. A similar study was conducted by Çekici (2009), in which the impact of climate change and global warming on agricultural insurance in Türkiye was examined. The study utilized a broad dataset, employing a time series of annual agricultural insurance premiums from 1986 to 2007. Using Pegels' exponential smoothing technique, projections for 2008 and 2009 were made. The results indicated that agricultural insurance in Türkiye had begun to spread, with the trend expected to continue upward. The use of data from 2013 to 2023 in this study is particularly significant, as it extends the forecasts made up until 2009, bringing them into the present. As noted by Çekici (2009), the continuation of the increasing trend has, in a sense, been confirmed by this study, adding an original contribution to the literature. Kızıloğlu (2017) conducted an applied study to identify the factors influencing farmers' decisions to purchase agricultural insurance. The study found that farmers' education levels, land sizes, annual incomes, and disaster risks significantly affected their insurance adoption. Similarly, Başer et al. (2023) examined the factors influencing farmers' decisions to ensure perennial crops and concluded that education level, experience, crop type, and land size were key determinants. The findings of this study also support existing literature. Over time, the inclusion of more educated individuals in the agricultural sector, land consolidation efforts allowing for larger and more diverse cultivated areas, and farmers' increased awareness of disaster-related damages have likely contributed to the rise in the number of insurance policies. This trend is also observable in time-series analysis graphs. With this, over the years, the strategies implemented by insurance companies to understand consumers and to meet their needs have had a positive impact on the number of policies produced. Insurance premiums have also increased in proportion to the number of policies. This indicates that farmers' trust in the insurance system has increased. In the future, it is important for insurance agents to maintain open communication channels with consumers, informing them about risks and compensation for damage. Employees play a key role in this process, and it should be emphasized that no customer should be lost. Employees should be encouraged to provide clear and transparent information during insurance sales, and motivational practices should be implemented. In their study conducted by Kaygısız et al. (2022), it is stated that in order to ensure and encourage more producers to benefit from insurance in agricultural production, the insurance fee in the insurance policy should be reduced to a reasonable level, the insurance policy fee should be discounted and some other necessary arrangements should be made. At this point, it is obvious that the support given by the state is of great importance in the spread of agricultural insurance. In Turkiye, agricultural insurance is 50% state subsidized. In recent years, producers have become more conscious, which is reflected in the increase in the number of policies and premiums. Financial support incentivizes producers to insure their products. Without this support, the high premium costs could lead to difficulties in payment. Therefore, the state should continue to improve and sustain this incentive system. Producers who benefit from the insurance system are increasingly insuring every aspect of their agricultural activities. This system not only protects the producers but also accumulates significant funds in the insurance pool. The accumulated premiums contribute to societal development and provide financing for sectors in need. Therefore, it is important to keep insurance premiums at reasonable levels for producers and to inform them about the benefits of insurance to encourage more farmers to integrate into the system. For agricultural insurance to be widely adopted and embraced by farmers, it is necessary to convince them of the benefits of the products. Insurance companies should carefully analyze farmers' socio-economic structures, agricultural activities, and risk perceptions. Based on this analysis, the structure and marketing strategies of the insurance products should be shaped accordingly. It is essential to convey the benefits of the insurance product to farmers. Otherwise, they will not show interest in or demand the product. Therefore, farmer education programs should be organized, and the insurance system should be explained in detail. Farmers should be encouraged to view insurance products as a solution rather than a burden. To achieve this, messages should be delivered through communication channels suited to their needs. Tailored products should be developed, taking into account regional differences, and specific policies should be offered. The adoption of technology-based approaches in damage assessment will increase farmers' trust in insurance, ensure objectivity in damage assessments, enhance transparency, and speed up the process. Drones and satellite technologies could be utilized for this purpose. Another recommendation is to increase farmers' motivation by sharing the experiences of other farmers who have benefited from insurance. Insurance companies can direct their efforts to these testimonials, which can significantly contribute to the persuasion process. The marketing of agricultural insurance is not just about selling a financial product; it also involves raising awareness among farmers, ensuring the sustainability of the sector, and contributing to economic development. Effective marketing strategies that increase farmers' interest in insurance can help manage risks more effectively. The success of these efforts will be enhanced by using education, personalized communication, and government support. Ultimately, the widespread adoption of agricultural insurance will provide multifaceted benefits to both farmers and the agricultural sector. Kamilcelebi (2012) highlighted the issue of insurance

sector mergers or sales to foreign companies. This issue needs significant attention. It is important to conduct necessary studies within the framework of organizational theory in the insurance sector and address the potential challenges due to an inability to adapt to environmental changes. The concept of "organizational aging" describes how organizations with old structures struggle to adapt to environmental changes. If organizations fail to keep up, they may be forced to close down according to the "decay theory." As seen in the data, insurance organizations are experiencing growth in their structures and transaction volumes. This growth will bring about environmental changes. Insurance managers in Türkiye are advised to adapt to these changes and tackle potential entropy situations. According to the contingency strategy in organizational theory, the growing agricultural product market is expected to expand the insurance market as well. Another responsibility for insurance managers is to standardize rules and methods and ensure the specialization of roles, with centralized decision-making. According to Akçaöz et al. (2006), accurately identifying the damages caused by risks in agricultural production will allow for rational determination of premiums that are in line with farmers' payment capacities. For agricultural insurance to be accepted by farmers, it is essential to involve experts in the damage assessment process. This will help prevent errors and increase farmers' trust in insurance companies. To boost entrepreneurship and risk-taking in the agricultural sector, it is important to create environments where producers feel more secure. In agriculture, risk management plays a key role in creating such environments. In addition to income insurance, it should also be considered that damage caused by disasters can be compensated through agricultural insurance. Addressing farmers' social security issues is also essential. This study contributes to identifying future trends in agricultural insurance and provides insights into the management and marketing strategies of insurance companies. However, it has certain limitations. The scope of the study is limited to analyses conducted on the number and value of crop production and cattle farming insurance policies. Agricultural insurance also encompasses other product categories such as greenhouse farming, aquaculture, beekeeping, small ruminants, and poultry. Therefore, incorporating these additional product groups in future research could yield different findings. Another limitation of the study is that the dataset covers the period from 2013 to 2023. This period was selected primarily to examine the prolonged adverse global economic conditions and their impact on agricultural insurance in greater depth. However, it also captures the effects of the COVID-19 pandemic, making the study period particularly relevant. Nevertheless, extending the time series to cover a longer period in future studies could lead to different insights. Additionally, the study employs the ARIMA model for modeling policy values. Since the time series analysis of policy values was conducted using current prices, there is a potential concern that this approach might negatively influence the results. To address this issue, researchers tested the validity and reliability of the models and confirmed that no adverse effects were present in the series, effectively controlling for inflationary effects. Specifically, stationarity tests (Dickey-Fuller ADF) were conducted to ensure the stability of the series. Ljung-Box tests were performed to assess autocorrelation, and the model's forecasting performance was evaluated using AIC, BIC, and RMSE criteria, all of which indicated low error rates. As a result, the models demonstrated good fit, low error values, and consistent outcomes, reinforcing the reliability and validity of the analysis conducted with current prices. Furthermore, the sharp increase observed during a specific period was identified as a *temporary shock*, as the series returned to its previous pattern in subsequent years. The shock effect observed between 2021 and 2022 did not result in a permanent structural break in the series. This is evident from the fact that the series resumed its normal course afterward. Additionally, the Ljung-Box test confirmed that no permanent deterioration occurred in the series following the anomaly. The analysis suggests that the sharp rise observed in a single year within the 2013–2023 dataset did not disrupt the overall trend and that such temporary fluctuations are inherent to economic systems. Thus, the inflationary surge had a limited impact on the model's ability to capture the overall trend. Nonetheless, future studies are advised to use real prices instead of current prices to enhance robustness. Future research could focus on identifying the factors influencing farmers' adoption and utilization of agricultural insurance. Such studies could provide significant contributions to the development of strategies for the sustainable production of insurance policies. Finally, research could be designed to explore the underlying reasons for changes detected through time series analysis in agricultural insurance. Understanding the factors driving shifts in farmers' insurance product preferences could yield valuable insights for customer segmentation and target market selection strategies, ultimately informing more effective decision-making processes.

Author Contributions

The percentages of the authors' contributions are presented below. All authors reviewed and approved the final version of the manuscript.

	B.A.	H.O.O.
C	60	40
D	60	40
S	50	50
DCP	50	50
DAI	80	20
L	60	40
W	80	20
CR	80	20
SR	70	30
PM	80	20
FA	50	50

C= concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because there was no study on animals or humans.

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