

# Assessment of the system, direction of changes, proposals for forecasting within the accident insurance system in Polish agriculture – implications for public policy

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## Abstract

The risk of occupational accidents and occupational diseases constitutes the primary type of risk associated with agricultural activity, due to the specific nature of work on a farm involving machinery, animals, and variable weather conditions. Consequently, the risk of harm and permanent physical injury remains relatively high. For this reason, accident insurance in agriculture plays a significant role in the social security system for farmers. This study aimed to identify the extent and direction of changes in the number of insured persons in agriculture, as well as payments of lump-sum compensation for occupational accidents and diseases in agriculture from 2014 to 2024, and to attempt to forecast these trends up to 2027. An effort was made to develop forecasts for selected phenomena using the linear trend function, Holt's exponential smoothing method, and the simple moving average method. The collected data were subjected to statistical analysis and an analysis of the dynamics of the phenomena using time series trends. An analysis was carried out of the correlation between the number of insured persons and the average amount of benefit paid in respect of accidents and occupational diseases in agriculture until 2027. For this purpose, Spearman's rank correlation coefficient and Pearson's linear correlation coefficient were applied. The *ex-post* study covered such factors as the number of insured persons and the costs of paid lump-sum compensation over an eleven-year research period, i.e. from 2014 until 2024. The obtained results indicate that the farmers' social insurance system in Poland is undergoing significant structural and demographic transformations, which affect its functioning and financial stability. The research demonstrated a decrease in the total amount of compensation paid, accompanied by an increase in the average value of a single benefit. This means that despite the declining number of benefits, the unit

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costs of their payment are increasing. The correlation analysis confirmed the existence of a very strong statistically significant negative relationship between the number of insured persons and the average amount of compensation, indicating that as the number of persons covered by the system decreases, the average value of the paid benefit increases. On the one hand, the observed decline in the number of benefits may contribute to reducing the financial burden on the system; on the other hand, the increasing value of individual benefits and the decreasing number of insured persons constitute a significant challenge for its future functioning.

**Keywords:** lump-sum compensation, KRUS, forecasting, social insurance, occupational accidents.

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## Introduction

According to J. Kulawik, there are still numerous, most often complex interactions between social insurance, including that for farmers, and various spheres of the economy, politics, and citizens' lives<sup>1</sup>. According to M. Postawka, social security and health insurance for farmers are the subject of much debate and controversy, most frequently in relation to the insurance systems covering the non-agricultural population<sup>2</sup>. As J. Kulawik notes, as individuals mature, they are confronted with an increasing number of life risks that interact with one another; this complicates a holistic understanding of these risks and makes managing them effectively even more challenging. Since every individual is unique, they perceive the same sources of threat differently and react to them in diverse ways, thus employing various methods and strategies to manage them<sup>3</sup>. According to J. Wilkin, the final element of the theory of rational behaviour is the role of institutions. Human actions take place within the constraints and opportunities created by institutions, both formal (e.g. law and the organisation of the state) and informal (social norms, tradition, or religion). J. Wilkin points out that the incorporation of institutional issues and the significance of institutions in economic processes into economic theory is a relatively recent development<sup>4</sup>. A. Czyżewski, R. Kata and A. Matuszczak indicate that one of the main

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1. J. Kulawik, *Teoria wyboru publicznego jako narzędzie objaśniania genezy i rozwoju ubezpieczeń społecznych* "Ubezpieczenia w Rolnictwie – Materiały i Studia" 2020, nr 2(74), pp. 115–141.

2. M. Postawka, *Obciążenie dochodów gospodarstw rolnych z tytułu ubezpieczeń społecznych i zdrowotnych rolników*, "Ubezpieczenia w Rolnictwie – Materiały i Studia" 2021, nr 2(76), pp. 53–63.

3. J. Kulawik, *Wybrane problemy zarządzania ryzykiem społecznym*, "Ubezpieczenia w Rolnictwie – Materiały i Studia" 2021, nr 2(76), p. 8.

4. J. Wilkin, *Teoria wyboru publicznego – homo oeconomicus w sferze polityki* [in:] *Teoria wyboru publicznego*, red. J. Wilkin, Warszawa, "Scholar" 2005, s. 16.

reasons for state intervention in the economy is market failure, which is particularly acute in the agricultural sector<sup>5</sup>. A significant line of research concerns the issue of catastrophic risk. J. Kulawik emphasises that low-probability, high-loss events require a specific systemic approach that combines market instruments with public intervention<sup>6</sup>. In the classical economic approach, F. Knight<sup>7</sup> distinguished between risk and uncertainty, indicating that risk refers to events whose probability can be estimated. Occupational accidents in agriculture fall within this category, as their occurrence is subject to statistical analysis.

In addition to risks related to natural and market factors, accident risks constitute a significant category arising from the specific nature of agricultural work. Accident insurance in agriculture should be analysed not only as a social security mechanism, but also as an economic instrument. It therefore has a stabilising function, reducing income volatility and mitigating the risk of poverty<sup>8</sup> as a result of reduced capacity to work. Farmers' accident insurance is regulated by the Act of 20 December 1990 on farmers' social insurance<sup>9</sup>. This Act distinguishes accident insurance as one of the pillars of the farmers' social security system, alongside pension and disability insurance and sickness insurance. The Agricultural Social Insurance Fund (KRUS, the Fund) is tasked with receiving reports of accidents and occupational diseases suffered by individual farmers, determining their legal status, and paying out the benefits due. In practice, in assessing the "strength" of accident protection, key importance is attached not only to the existence of entitlement, but also to the actual scale of payments (number of benefits granted) and the level of benefits (amount of compensation per 1% of injury, lump-sum amounts in specific cases). Data published by KRUS and the author indicate that despite the downward trend in the number of reported accidents, occupational diseases<sup>10</sup>, and paid lump-sum compensation, the accident rate remains a significant issue. The importance of the issue stems from the increasing percentage of physical injury over the past decade, as discussed in this article. In practice, this means that farmers suffer fewer injuries as a result of accidents on farms, but their consequences are usually more severe.

5. A. Czyżewski, R. Kata, A. Matuszczak, *Mity i prawdy o Kasie Rolniczego Ubezpieczenia Społecznego*, "Ubezpieczenia w Rolnictwie – Materiały i Studia" 2022, nr 1(77), p. 66.
6. J. Kulawik, *Managing catastrophic risks in agriculture*, "Ubezpieczenia w Rolnictwie – Materiały i Studia" 2025, nr 1(83), pp. 7–42.
7. F.H. Knight, *Risk, uncertainty and profit*, Boston, Houghton Mifflin, 1921.
8. K.J. Arrow, *Essays in the theory of risk-bearing*, Amsterdam, North-Holland Publishing Company, 1971.
9. Ustawa o ubezpieczeniu społecznym rolników z 20 grudnia 1990 r., t.j. Dz. U. 2025 poz. 197.
10. A. Zielińska, *Accidents in agriculture and human capital: trend analysis and forecasting in the context of development economics*, "Annals of the Polish Association of Agricultural and Agribusiness Economists" 2025, Vol. XXVII, No. 4, pp. 208–222.

## Research methods

The aim of the study was to identify the level and direction of changes in insured persons in agriculture and benefit payments in the form of lump-sum compensation for occupational accidents and occupational diseases in agriculture in the years 2014–2024, and to attempt forecasting in this respect until 2027. The study covered all paid lump-sum compensation recorded in the Agricultural Social Insurance Fund over an eleven-year research period, i.e. from 2014 to 2024. To present the dynamics of changes, absolute and relative single-base and chain indices were applied. The study employed the method of correlation analysis between variables, including Spearman's rank correlation coefficient and Pearson's linear correlation coefficient. The source material forming the basis of the study consists of secondary data obtained from KRUS. In addition, legal acts and the relevant literature were included in the analysis, and the results were developed, inter alia, using time trend analysis. This is a method of data analysis aimed at identifying and determining long-term directions of change at regular time intervals, regardless of short-term fluctuations or seasonal variations<sup>11</sup>. Time trend analysis is also crucial for forecasting future values, strategic planning, identifying potential problems, and making informed decisions<sup>12</sup>.

Forecasting of variables was carried out using time series exhibiting a linear trend<sup>13</sup>. To assess the reliability of the forecasts made, due to the nature of systematic components, Holt's method and the naïve method in the "no-change increment" variant were applied. Both of these forecasting methods are used as ex post and ex ante errors<sup>14</sup>.

## Agriculture as a high-risk sector – a theoretical perspective

In the economic literature, agriculture is consistently classified as a sector with a high level of production and income uncertainty<sup>15</sup>. The risks stem from both exogenous (weather conditions, climate change, random events) and endogenous factors

11. A. Zielińska, *Analiza wskaźnikowa wypadkowości w rolnictwie*, "Turystyka i Rozwój Regionalny" 2025, nr 24, pp. 159–168.
12. A. Sokołowski, *Analiza szeregów czasowych i prognozowanie*, Kraków, Statsoft Polska, 2016.
13. R. Szostek, *Uogólniony model Holta na przykładzie prognozowania liczby pasażerów w transporcie lotniczym w Polsce*, "Ekonometria" 2012, nr 2(36), pp. 85–96.
14. A. Zielińska, *Accidents in agriculture and human capital: trend analysis and forecasting in the context of development economics*, "Annals of the Polish Association of Agricultural and Agribusiness Economists" 2025, Vol. XXVII, No. 4, pp. 208–222.
15. F.H. Knight, *Risk, uncertainty and profit*, Boston, Houghton Mifflin, 1921.

(farm structure, production technology, production decisions)<sup>2</sup>. Research conducted by P. Lundqvist shows that threats to health and safety in the psychosocial working environment of farmers include workload, finances, climate change and weather conditions, crime, globalisation, laws and regulations, loneliness, isolation, and lack of support. Problems related to poor mental health are generally more prevalent among farmers, especially older ones, than in other occupational groups. Farmers have a higher rate of depression and suicide attempts compared with other occupational groups, and the number of cases of mental illness among farmers has increased in recent years<sup>16</sup>. As noted by J. Pawłowska-Tyszko<sup>17</sup>, social insurance constitutes an important element of the legal system regulating the functioning of the agricultural sector in Poland. Its role stems from the specific nature of agricultural activity, which is characterised by a high level of risk. In terms of the economic theory of risk, social insurance serves as a classic risk transfer instrument, enabling income stabilisation and limiting the volatility of farm financial results<sup>18</sup>. As indicated by I. Jędrzejczyk, insurance constitutes a key element of the risk management system, transferring and distributing risks in the economy. This is particularly vital for agriculture, given the sector's extreme exposure to both accidental and catastrophic events. The author also emphasises that for the agricultural insurance system to function effectively, the state must play an active role, both in subsidising premiums and in establishing the system's institutional framework<sup>19</sup>. J. Pawłowska-Tyszko highlights that modern agriculture operates under a convergence of overlapping risks, necessitating a diverse range of mitigation strategies. Sulewski points out that the choice of such strategies often depends on a farmer's individual risk appetite; those more inclined to take risks are more likely to implement proactive management tools<sup>20</sup>. Contemporary literature highlights the growing role of insurance as a tool for stabilising agricultural income. V. Borisova and I. Samoshkina indicate that the development of insurance systems is heavily dependent on state support, which is key in subsidising premiums and limiting systemic risk<sup>21</sup>.

16. P. Lundqvist, *Wpływ uwarunkowań społecznych, ekonomicznych i środowiskowych na zdrowie psychiczne rolników – perspektywa międzynarodowa*, "Ubezpieczenia w Rolnictwie – Materiały i Studia" 2024, nr 2(82).

17. J. Pawłowska-Tyszko, *Uzasadnienie funkcjonowania ubezpieczeń społecznych, w tym ubezpieczenia społecznego w rolnictwie*, "Ubezpieczenia w Rolnictwie – Materiały i Studia" 2024, nr 1(81).

18. K.J. Arrow, *Essays in the theory of risk-bearing*, Amsterdam, North-Holland Publishing Company, 1971.

19. I. Jędrzejczyk *Ubezpieczenia na rzecz gospodarki globalnej, sektorów i regionów*, Oficyna Wydawnicza Edward Mitek, 2015.

20. P. Sulewski, *Sklonność rolników do ryzyka a stosowane strategie jego ograniczania*, "Roczniki Naukowe Ekonomii Rolnictwa i Rozwoju Obszarów Wiejskich" 2014, nr 101(4), pp. 116–126.

21. V. Borisova, I. Samoshkina, *Ubezpieczenia jako narzędzie zarządzania ryzykiem w produkcji rolniczej*, "Zeszyty Naukowe SGGW – Ekonomika i Organizacja Gospodarki Żywnościowej" 2012, nr 96, pp. 17–28.

From the perspective of public choice theory, under conditions of uncertainty agricultural insurance serves as a compensatory mechanism for farmers' limited ability to diversify risk on their own, resulting from low production flexibility and strong dependence on natural factors<sup>22</sup>. While J. Kulawik suggests that public social insurance emerged as a response to the gaps and imperfections of private markets, public choice theory takes this further by introducing the concept of state/government failure<sup>23</sup>. Within the Polish agricultural insurance system, benefits related to occupational accidents in agriculture occupy a special place. Their function is to compensate for the consequences of accident events (physical injury or the death of the insured person), while indirectly providing economic stability for the farmer's household. Here, the legal basis is primarily the Act on Social Insurance for Farmers, which defines accident insurance as a distinct category and sets out the scope of benefits and eligibility criteria<sup>24</sup>.

## The legal framework of agricultural accidents

An important element of the agricultural insurance system in Poland is farmers' social insurance. This regulation establishes a separate, sector-specific social security system administered by the Agricultural Social Insurance Fund. These national regulations are closely aligned with European Union law. Within the EU Common Agricultural Policy<sup>25</sup>, risk management instruments, including insurance, are explicitly cited as a means of supporting agricultural income. The provisions of CAP financing regulations are of particular importance. According to Article 11(1) of the Act of 20 December 1990 on farmers' social insurance<sup>26</sup>, "an accident at agricultural work is deemed to be a sudden event caused by an external factor, which occurs in the course of performing activities related to the conduct of agricultural activity or activities associated with the performance of such activities:

- 1) on the premises of the agricultural holding operated or regularly worked by the insured person, or on the premises of a household directly connected with such holding, or
- 2) on the way from the insured person's residence to the agricultural holding referred to in point 1, or on the way back, or

22. F.H. Knight, *Risk, uncertainty and profit*, Boston, Houghton Mifflin, 1921.

23. J. Kulawik, *Teoria wyboru publicznego jako narzędzie objaśniania genezy i rozwoju ubezpieczeń społecznych*, "Ubezpieczenia w Rolnictwie – Materiały i Studia" 2020, nr 2(74).

24. Ibidem, Dz. U. 2025 poz. 197.

25. Z. Floriańczyk, S. Figiel, M. Juchniewicz et al., *Transformacja FADN w FSDN: proces napędzany potrzebami dla lepszej oceny polityki rolnej*, "Zagadnienia Ekonomiki Rolnej" 2025, nr 4(385), pp. 1–23.

26. Ibidem, Dz. U. 2025 poz. 197.

- 3) in the course of performing, outside the agricultural holding referred to in point 1, routine activities related to the conduct of agricultural activity or in connection with the performance of such activities, or
- 4) on the way to the place of performance of the activities referred to in point 3, or on the way back<sup>27</sup>.

Interpreting this definition, B. Nyckowski identifies various “spheres” of insurance protection, ranging from full and unconditional cover for accidents occurring on the farm where the victim works or manages, to cover that is contingent upon specific requirements regarding accidents occurring off-premises. The statutory phrase “at agricultural work” is defined here by a temporal, spatial, and above all functional (purpose-related) link between the event and the agricultural activity<sup>27</sup>. Pursuant to Article 45(1) of the Act on farmers’ social insurance, the injured farmer, household member or other person is obliged to notify KRUS<sup>28</sup> of an occupational accident in agriculture without undue delay, but no later than within six months of the date on which it occurred. Accordingly, for compensation to be paid, KRUS must establish that the event constitutes an accident at work within the meaning of the law, and to issue a medical assessment regarding the nature and percentage of the resulting physical injury. In practice, disputes typically arise over the legal classification of the event (whether it was truly linked to farming activities), the medical assessment of the impairment percentage, or the causal link between the event and its health consequences. At the same time, it should be stressed that not every reported event is recognised as an occupational accident and results in the payment of compensation. Common grounds for refusal include:

- no causal link with the agricultural work performed;
- failure to meet the “sudden event” criterion;
- no physical injury established.

If KRUS issues a negative decision (i.e. one that does not recognise the event as an occupational accident), the insured person has the right to appeal against that decision through the standard social security channels. This appeals process significantly shapes the final accident statistics and the overall structure of payouts. From a systemic perspective, these payments serve both a compensatory and a stabilising function, helping farmers and their families navigate periods of reduced capacity to work. The author notes that<sup>29</sup>, beyond physical injury and suffering and a loss of full

27. B. Nyckowski, *Prowadzenie postępowania powypadkowego w Kasie Rolniczego Ubezpieczenia Społecznego. Zdarzenie z kategorii ‘Nagle zachorowania’. Studium przypadku na tle przepisów ustawowych i wyroków sądów*, “Ubezpieczenia w Rolnictwie – Materiały i Studia” 2022, nr 2(78), p. 141.

28. Ibidem, Dz. U. 2025 poz. 197.

29. A. Zielińska, *Analiza wskaźnikowa wypadkowości w rolnictwie*, “Turystyka i Rozwój” 2025, nr 24, pp. 159–168.

employability (which is not offset by disability pensions), an injured farmer loses their social standing and suffers a blow to personal ambitions and professional and social advancement. This is supported by the analysis of M. Wysokiński and A. Zielińska<sup>30</sup>, who observe that reduced income, due to lower earnings or reliance on a pension, strains the household budget and often forces family members into additional external employment, to the detriment of the farm itself. Analyses carried out by E. Giza and M. Podstawka demonstrate that farmers' occupational diseases have profound social, productive, and financial implications. From a social perspective, they render affected farmers unable to work, which in turn leads to a decline in the farm's output<sup>31</sup>.

The primary benefit paid for accidents at work and occupational diseases is "lump-sum compensation". Pursuant to Article 10(1)(1) of the Act of 20 December 1990 on farmers' social insurance, lump-sum compensation is payable to an insured person who has suffered permanent or long-term physical injury as a result of an occupational accident in agriculture or an agricultural occupational disease, and in the event of the injured person's death – to eligible members of their family<sup>32</sup>. The structure of this compensation is based on the principle of proportionality. While this simplified normative approach ensures efficient payouts, it limits the ability to tailor the benefit to the specific economic impact of an accident. At the implementing level, from 1 January 2025 lump-sum compensation amounts to PLN 1,431 for each percentage point of permanent or long-term physical injury<sup>33</sup>. Changes in the compensation amount per 1% of physical injury in Poland in the years 2014–2025 are presented in Table 8.

## Research Results

The number of persons covered by farmers' social insurance in Poland has been steadily declining (see Table 1) – from nearly 1,432,725 persons in 2014 to 984,848 in 2024, which represents a decrease of 447,877 insured persons, i.e. 31%. Between 2014 and 2024, the number of insured persons in agriculture in Poland fell on average by 4% year on year (geometric mean).

30. M. Wysokiński, A. Zielińska, *Ekonomiczno-organizacyjne uwarunkowania bezpieczeństwa pracy w rolnictwie*, Warszawa, the Warsaw University of Life Sciences, 2016.

31. E. Giza, M. Podstawka, *Choroby zawodowe rolników ubezpieczonych w KRUS*, "Ubezpieczenia w Rolnictwie – Materiały i Studia" 2023, nr 1(79), pp. 197–147.

32. Ibidem, Dz. U. 2025 poz. 197.

33. Rozporządzenie Ministra Rolnictwa i Rozwoju Wsi z 17 stycznia 2025 r. zmieniające rozporządzenie w sprawie określenia wysokości jednorazowego odszkodowania z tytułu wypadku przy pracy rolniczej lub rolniczej choroby zawodowej oraz zasiłku chorobowego, Dz. U. 2025 poz. 101.

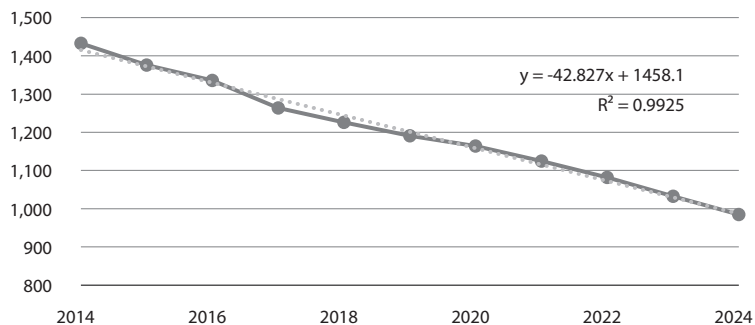
Table 1. People insured under the agricultural scheme and trends in their numbers in Poland between 2014 and 2024

Year	Number of insured	Absolute increases		Relative increases	
		single-base 2014	chain	single-base 2014	chain
2014	1,432,725	0	x	0%	x
2015	1,375,462	-57,263	-57,263.0	-4%	-4%
2016	1,335,198	-97,527	-40,264.0	-7%	-3%
2017	1,263,663	-169,062	-71,535.0	-12%	-5%
2018	1,226,173	-206,552	-37,490.0	-14%	-3%
2019	1,191,044	-241,681	-35,129.0	-17%	-3%
2020	1,164,235	-268,490	-26,809.0	-19%	-2%
2021	1,124,709	-308,016	-39,526.0	-21%	-3%
2022	1,082,030	-350,695	-42,679.0	-24%	-4%
2023	1,032,390	-400,335	-49,640.0	-28%	-5%
2024	984,848	-447,877	-47,542.0	-31%	-5%

Source: Author's own study based on data from the Agricultural Social Insurance Fund.

The decline in the number of insured persons over the last two years of the period under review (2023–2024) is a cause for concern, as the number of insured persons fell by an average of around 5% year on year, amounting to 49,640 people in 2023 and 47,542 people in 2024.

Figure 1. Number of people insured under the agricultural scheme in Poland, in thousands, 2014–2024



Source: Author's own study based on data from the Agricultural Social Insurance Fund.

The forecast results and ex post forecast error measures are presented in Table 2.

**Table 2. Forecast and ex post forecast error measures for the number of insured farmers in Poland between 2025 and 2027**

Forecasting method	Forecast number of insured farmers in 2025 (thousand)	Forecast number of insured farmers in 2026 (thousand)	Forecast number of insured farmers in 2027 (thousand)	RMSE*	RMSPE**
Naïve – no-change increment	937.306	x	x	17.4	1.41%
Holt's	939.823	895.000	850.000	14.35	1.18%
Linear trend function	944.176	901.349	858.522	11.75	0.94%

\*RMSE – root mean square error.

\*\*RMSPE – root mean square percentage error.

Source: Own elaboration.

The forecast number of persons insured under the agriculture scheme in Poland will continue to decline. In 2025, it will amount to 944,176 persons, as evidenced by the lowest ex post forecast error measures among the methods used. Based on trend function analysis, the number of individuals insured within the agricultural sector is forecasted to fall to 858,522 in 2027.

**Table 3. Benefits granted in agriculture and their dynamics in Poland between 2014 and 2024**

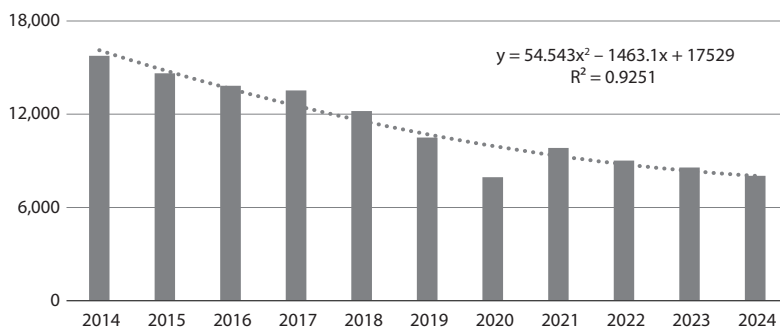
Year	Number of accidents and occupational diseases resulting in the payment of lump-sum compensation	Absolute increases		Relative increases	
		single-base 2014	chain	single-base 2014	chain
2014	15,757	0	x	0%	x
2015	14,632	-1,125	-1,125.0	-7%	-7%
2016	13,837	-1,920	-795.0	-12%	-5%
2017	13,526	-2,231	-311.0	-14%	-2%
2018	12,200	-3,557	-1,326.0	-23%	-10%
2019	10,500	-5,257	-1,700.0	-33%	-14%
2020	7,945	-7,812	-2,555.0	-50%	-24%
2021	9,830	-5,927	1,885.0	-38%	24%
2022	9,022	-6,735	-808.0	-43%	-8%
2023	8,571	-7,186	-451.0	-46%	-5%
2024	8,035	-7,722	-536.0	-49%	-6%

Source: Own elaboration.

For the benefit analysis, the data presented in Table 3 are of key importance. The number of benefits granted to farmers in Poland has been steadily declining, from nearly 15,757 in 2014 to 8,035 in 2024, representing a decrease of 7,722 granted benefits, i.e. 49%. Analysis of the statistical data indicates that over the last decade there has been a gradual decline in the number of reported occupational accidents in agriculture<sup>34</sup> and in the number of lump-sum compensation payouts. The number of benefits granted in agriculture in Poland between 2014 and 2024 decreased on average by 7% year on year (geometric mean). This downward trend can be attributed to preventive actions and technical progress within the agricultural sector.

An assessment of the dynamics of this phenomenon (see Table 3) indicates that in 2024, compared with 2014 – that is, over the last 10 years – the number of granted benefits fell by as much as 49%. The sharpest year-on-year decline in benefit awards during this period occurred in 2020, when the number of benefits granted fell by 24% compared to 2019. This is likely attributable to the COVID-19 pandemic, which altered farmers’ working conditions at the time. This theory appears to be confirmed by the change in 2021 compared with the previous year, when the number of granted benefits in Poland increased by 24%.

Figure 2. Benefits granted to farmers in Poland between 2014 and 2024 in respect of accidents at work and occupational diseases



Source: Author’s own study based on KRUS data.

When forecasting the number of benefits granted in agriculture in the coming years, it should be noted that this phenomenon is characterised by a downward trend and random fluctuations (see Figure 2); therefore, such methods as the naïve method

34. A. Zielińska, *Accidents in agriculture and human capital: trend analysis and forecasting in the context of development economics*, “Annals of the Polish Association of Agricultural and Agribusiness Economists” 2025, Vol. XXVII, No. 4, pp. 208–222.

(in the no-change increment variant), Holt's method, and the trend function may be used for forecasting. The forecast results and ex post forecast error measures are presented in Table 4.

**Table 4. Forecast and ex post forecast error measures for the number of benefits granted in agriculture in Poland between 2025 and 2027**

Forecasting method	Forecast number of benefits granted in agriculture in 2025	Forecast number of benefits granted in agriculture in 2026	Forecast number of benefits granted in agriculture in 2027	RMSE*	RMSPE**
Naïve – no-change increment	7,499	x	x	1,806	12.09%
Holt's	7,025	6,071	5,118	1,198	12.69%
Linear trend function	6,708	5,599	4,796	880	13.59%

\*RMSE – root mean square error.

\*\*RMSPE – root mean square percentage error.

Source: Own elaboration.

The forecast number of benefits granted in agriculture in Poland in 2025 will be approximately 7,499, and in 2027 it will probably be around 5,118, as evidenced by the lowest ex post forecast error measures among the methods used. The most frequently paid accident benefit is lump-sum compensation. It is payable, inter alia, to the insured person (a farmer or household member) in the event of permanent or long-term physical injury resulting from an occupational accident in agriculture, and in the event of death – to eligible family members. The amount of the benefit is proportional in nature: it is determined as the product of (a) the rate per 1% of injury and (b) the percentage of injury assessed by the competent adjudicating authority. The amount of compensation payments to farmers in Poland has been steadily declining (see Table 5), from nearly PLN 69 million in 2014 to PLN 59 million in 2024, representing a decrease in benefit payments of more than PLN 10 million, i.e. 15%. The amount of compensation payments to farmers in Poland between 2014 and 2024 decreased on average by 2% year on year (geometric mean).

Table 5. Amount of lump-sum compensation payments to farmers and their dynamics in Poland between 2014 and 2024 in respect of accidents at work and occupational diseases (PLN thousand)

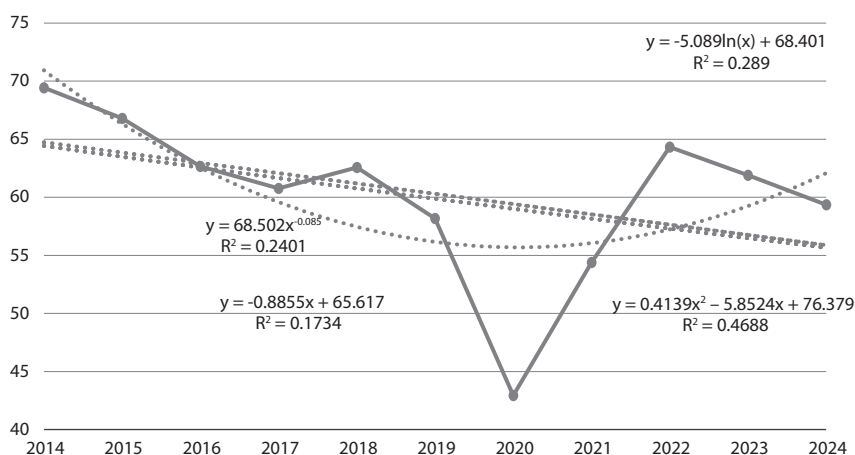
Year	Payout amount (PLN thousand)	Absolute increases		Relative increases	
		single-base 2014	chain	single-base 2014	chain
2014	69,439.7	0	x	0%	x
2015	66,803.0	-2,636.7	-2,636.7	-4%	-4%
2016	62,671.4	-6,768.3	-4,131.5	-10%	-6%
2017	60,771.9	-8,667.7	-1,899.	-12%	-3%
2018	62,564.6	-6,875.1	1,792.6	-10%	3%
2019	58,179.2	-11,260.5	-4,385.4	-16%	-7%
2020	42,931.3	-26,508.4	-15,247.9	-38%	-26%
2021	54,387.8	-15,051.9	11,456.5	-22%	27%
2022	64,326.9	-5,112.8	9,939.0	-7%	18%
2023	61,897.2	-7,542.5	-2,429.6	-11%	-4%
2024	59,369.9	-10,069.7	-2,527.2	-15%	-4%

Source: Own elaboration.

The largest decline in the amount of compensation paid to farmers during this period, assessed year on year, occurred in 2020, when the amount of compensation paid fell by as much as 26% compared with 2019 (a decline of more than PLN 15 million). This is likely attributable to the COVID-19 pandemic, which altered farmers' working conditions at the time. This theory appears to be confirmed by the change in 2021 compared with the previous year, when the number of benefit payouts in Poland increased by 27%.

When forecasting the amount of compensation payments to farmers in the coming years, it should be noted that this phenomenon is characterised by a downward trend and random fluctuations (see Figure 3). Therefore, such methods as the naïve method (in the no-change increment variant) and Holt's method may be used for forecasting. Given that the coefficient of determination for various analytical forms of the trend function (linear, power, exponential, and logarithmic) did not exceed 0.5, no forecasts were made on the basis of the trend line.

Chart 3. Amount of benefit payments to farmers in Poland between 2014 and 2024 in respect of accidents and occupational diseases (PLN million)



Source: Author's own study based on KRUS data.

The forecast results and ex post forecast error measures are presented in Table 6.

Table 6. Forecast and ex post forecast error measures for the amount of compensation payments to farmers in Poland between 2025 and 2027

Forecasting method	Forecast amount of compensation payments to farmers in Poland in 2025 (PLN million)	Forecast amount of compensation payments to farmers in Poland in 2026 (PLN million)	Forecast amount of compensation payments to farmers in Poland in 2027 (PLN million)	RMSE*	RMSPE**
Naïve – no-change increment	56.842	n.a.	n.a.	10.78	20.06%
Holt's	56.345	53.708	51.072	7.98	14.74%

\*RMSE – root mean square error.

\*\*RMSPE – root mean square percentage error.

Source: Own elaboration.

The forecast number of benefits granted in agriculture in Poland in 2025 will amount to PLN 56,345 thousand, and in 2027 to PLN 51,072 thousand, as evidenced by the lowest ex post forecast error measures for Holt's method. Analysis of the average amount of agricultural compensation payments in Poland between 2014 and

2024 indicates that this amount has been systematically increasing (see Table 7) – from PLN 4,407 in 2014 to PLN 7,389 in 2024, representing an increase in the average compensation payment of PLN 2,982, i.e. 68%. Between 2014 and 2024, the average amount of agricultural compensation payments in Poland increased on average by 5% year on year (geometric mean).

**Table 7. Average amount of benefit payments in respect of accidents at work and occupational diseases and their dynamics in Poland between 2014 and 2024**

Year	Average amount of payments (PLN)	Absolute increases		Relative increases	
		single-base 2014	chain	single-base 2014	chain
2014	4,407	0	x	0%	x
2015	4,566	159	158.6	4%	4%
2016	4,529	122	-36.3	3%	-1%
2017	4,493	86	-36.3	2%	-1%
2018	5,128	721	635.3	16%	14%
2019	5,541	1,134	412.6	26%	8%
2020	5,404	997	-137.3	23%	-2%
2021	5,533	1,126	129.3	26%	2%
2022	7,130	2,723	1,597.2	62%	29%
2023	7,222	2,815	91.7	64%	1%
2024	7,389	2,982	167.2	68%	2%

Source: Own elaboration.

The largest increase in the average amount of compensation paid to farmers during this period, assessed year on year, occurred in 2022, when the average amounts of compensation paid increased by as much as 29% compared with 2021 (which represented an increase in the average amount of the paid benefit by as much as PLN 1,597<sup>35</sup>). The amount of lump-sum compensation per 1% of physical injury is presented in Table 8. In the years in which an increase in the amount per 1% of injury was recorded (2018 and 2022), a marked increase in the average amount of compensation paid is also noticeable. At the same time, the average level of physical injury is increasing, which confirms the stated thesis that accidents are becoming increasingly severe in their

35. From 1 January 2022, the amount per 1% of injury increased from PLN 809 to PLN 1,033 (by more than 27%), which also translated into an increase in the average amount of compensation paid. A similar change can be observed in 2025, when the rate increased to PLN 1,431 per 1% of injury.

consequences. An important aspect is also the systematic increase in the amount of lump-sum compensation per 1% of physical injury – between 2014 and 2022 this increase amounted to 47%, while over the period 2014–2025 it reached 104%.

**Table 8. Amounts of compensation per 1% of physical injury compared with the average amount of payments in Poland between 2014 and 2025 (PLN)**

Year	Amount of lump-sum compensation per 1% of physical injury (PLN)	Average amount of payments (PLN)	Average percentage level of injury (col. 3/col. 2)
1	2	3	4
From 1 July 2014	700 <sup>36</sup>	4,407	6.3
2015	700	4,566	6.5
2016	700	4,529	6.5
2017	700	4,493	6.4
From 17 May 2018	809 <sup>37</sup>	5,128	6.3
2019	809	5,541	6.8
2020	809	5,404	6.7
2021	809	5,533	6.8
From 1 January 2022	1,033 <sup>38</sup>	7,130	6.9
2023	1,033	7,222	7.0
2024	1,033	7,389	7.2
From 1 January 2025	1,431 <sup>39</sup>	n.d.	n.d.

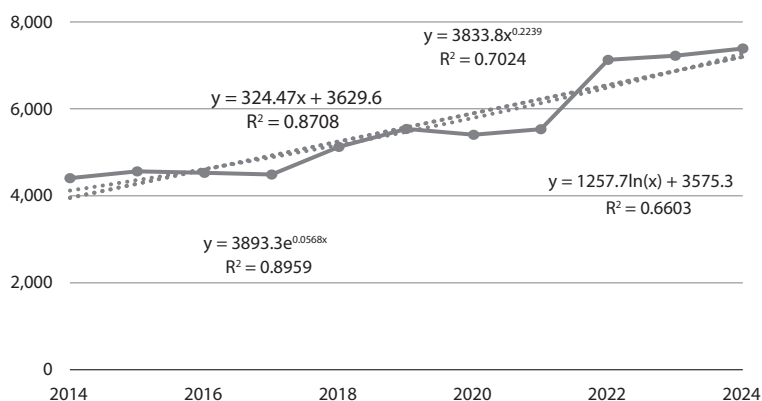
Source: Own elaboration.

When forecasting the average amount of agricultural compensation payments in Poland in the coming years, it should be noted that this phenomenon is characterised by an upward trend and random fluctuations (see Figure 4). Therefore, the following

36. Rozporządzenie Ministra Rolnictwa i Rozwoju Wsi z 19 maja 2014 r. zmieniające rozporządzenie w sprawie określenia wysokości jednorazowego odszkodowania z tytułu wypadku przy pracy rolniczej lub rolniczej choroby zawodowej oraz zasiłku chorobowego, Dz. U. 2014 poz. 703.
37. Rozporządzenie Ministra Rolnictwa i Rozwoju Wsi z 12 kwietnia 2018 r. zmieniające rozporządzenie w sprawie określenia wysokości jednorazowego odszkodowania z tytułu wypadku przy pracy rolniczej lub rolniczej choroby zawodowej oraz zasiłku chorobowego, Dz. U. 2018 poz. 827.
38. Rozporządzenie Ministra Rolnictwa i Rozwoju Wsi z 20 grudnia 2021 r. w sprawie określenia wysokości jednorazowego odszkodowania z tytułu wypadku przy pracy rolniczej lub rolniczej choroby zawodowej oraz zasiłku chorobowego, Dz. U. 2021 poz. 2396.
39. Rozporządzenie Ministra Rolnictwa i Rozwoju Wsi z 17 stycznia 2025 r. zmieniające rozporządzenie w sprawie określenia wysokości jednorazowego odszkodowania z tytułu wypadku przy pracy rolniczej lub rolniczej choroby zawodowej oraz zasiłku chorobowego, Dz. U. 2025 poz. 101.

methods may be used for forecasting: the naïve method in the no-change increment variant, Holt’s method, and the trend function. The analytical form was selected from among various types of function on the basis of the coefficient of determination.

Figure 4. Average amount of compensation payments to farmers in Poland between 2014 and 2024 (PLN)



Source: Author’s own study based on data from the Agricultural Social Insurance Fund.

The forecast results and ex post forecast error measures are presented in Table 9.

Table 9. Forecast and ex post forecast error measures for the average amount of compensation payments to farmers in Poland in 2025 (PLN)

Forecasting method	Forecast average amount of compensation payments to farmers in Poland in 2025 (PLN)	Forecast average amount of compensation payments to farmers in Poland in 2026 (PLN)	Forecast average amount of compensation payments to farmers in Poland in 2027 (PLN)	RMSE*	RMSPE**
Naïve – no-change increment	7,556.14	n.a.	n.a.	770.20	8.76%
Holt’s	8,200.67	8,820.32	9,439.98	510.55	7.97%
Linear trend function	7,523.24	7,847.71	8,172.18	395.26	7.29%

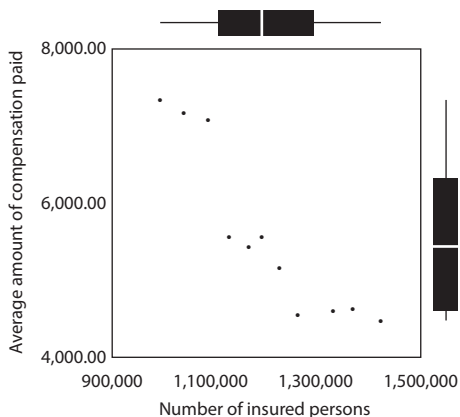
\*RMSE – root mean square error.

\*\*RMSPE – root mean square percentage error.

Source: Own elaboration.

The forecast average amount of compensation payments to farmers in Poland in 2025 will amount to PLN 7,523.24, and in 2027 – PLN 8,172.18, as evidenced by the lowest ex post forecast error measures for the trend function. Analysing the data presented in Figure 5, a negative correlation between the average amount of compensation paid and the number of insured persons can be observed.

Figure 5. Correlation diagram of the number of insured persons and the average amount of compensation paid to farmers in Poland (PLN)



Source: Own elaboration.

The assessment of the strength of the relationship (given the quantitative level of measurement of both variables) was carried out using Pearson’s linear correlation coefficient and Spearman’s rank correlation coefficient, and is presented in Table 10.

Table 9. Correlation coefficients for the number of insured persons and the average amount of compensation paid to farmers in Poland

Correlation measure	Coefficient value	Test probability
Pearson’s linear correlation coefficient	-0,919**	0.0001
Spearman’s rank correlation coefficient	-0.936**	0.0001

\*\* Correlation significant at the 0.01 level (two-tailed test).

Source: Own elaboration.

The correlation analysis revealed a very strong, negative, and statistically significant relationship between the number of persons insured under the farmers’ social insurance system and the average amount of compensation paid. The value of

Pearson's linear correlation coefficient was -0.919, while Spearman's rank correlation coefficient was -0.936, at a significance level of  $p = 0.0001$ , which confirms the existence of a very strong and negative correlation between the two variables, that is, the statistical significance of this relationship. This means that as the number of persons covered by farmers' social insurance declines, the average amount of compensation paid increases systematically. The slightly higher value of Spearman's correlation coefficient further indicates that the relationship between the variables under study is curvilinear in nature, which means that the rate of increase in benefit values is not uniform throughout the period analysed. As for the functioning of the Agricultural Social Insurance Fund, this phenomenon is of considerable economic significance, as it indicates an increase in the unit cost of benefits despite the declining number of insured persons. This may mean that the decline in the number of beneficiaries is not translating proportionately into a reduction in the financial burden on the system, which in the longer term may be relevant to its financial stability.

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## Conclusion

Drawing on both a review of the literature and original research, it can be concluded that the farmers' social insurance system in Poland performs vital stabilisation and redistributive functions. From the perspective of risk management theory, insurance constitutes an indispensable element in stabilising agricultural activity, while from an institutional perspective it is a tool for implementing agricultural and social policy objectives. An analysis of the legal regulations concerning agricultural insurance indicates its key role in ensuring the economic and social stability of agriculture. When looking at agricultural insurance in terms of compensation payments for accidents at work, the following conclusions can be drawn:

1. The results clearly confirm the ongoing decline in the number of people covered by the social insurance scheme for farmers in Poland. During the period under review, a 31% decline was recorded, indicating profound and lasting changes taking place in the agricultural sector and its social base. Calculations based on the geometric mean further showed that between 2014 and 2024 the number of insured persons decreased on average by around 4% per year, indicating the systematic and long-term nature of this trend. Particular attention should, however, be paid to the intensification of this phenomenon in the last two years of the period under analysis (2023–2024), when the rate of decline in the number of insured persons rose to around 5% per year. This may point to a deepening of unfavourable structural shifts in agriculture, an acceleration of de-agrarianisation, a reduction

- in the number of farms, and demographic changes in rural areas, including the outflow of population to non-agricultural sectors.
2. The forecasting carried out, using the linear trend function and Holt's exponential smoothing method, indicates that the downward trend in the number of persons insured in agriculture in Poland will continue in the coming years. On the basis of the methods applied, it was estimated that in 2026 the number of insured persons will amount to 901,000, while the forecast produced using Holt's method yielded the lowest values of ex post forecast error measures among the variants analysed, which confirms its high forecasting accuracy. At the same time, the forecast based on the linear trend function points to a further systematic decline in the number of insured persons, to 858,522 in 2027. These results confirm that the downward trend observed in the historical period is permanent in nature and will also continue over the forecasting horizon. This may point to ongoing structural changes in agriculture and a gradual decline in the population covered by the farmers' social insurance system.
  3. The analysis carried out showed a clear and lasting downward trend in the number of benefits in respect of occupational accidents in agriculture and occupational diseases resulting in the payment of lump-sum compensation in Poland. Between 2014 and 2024, the number of benefits granted decreased by 49%, and the average annual rate of decline amounted to around 7%. This indicates a significant reduction in the scale of accident incidence in agriculture. This trend may be interpreted as the result of improved working conditions, technical progress, the mechanisation of agriculture, and the effectiveness of preventive measures implemented by the Agricultural Social Insurance Fund, which should be assessed as a positive phenomenon from both a social and an economic perspective. At the same time, the forecasts indicate a further decline in the number of benefits in the coming years, which means that the changes observed are long-term in nature and will also continue in the future. However, it should be taken into account that the observed decline may also be partly related to the shrinking number of persons covered by the farmers' social insurance system. The decline in the number of benefits results from the decline in the number of persons insured by KRUS and does not eliminate the importance of accident insurance as an element of farmers' social security.
  4. The total amount of compensation paid to farmers in Poland shows a downward trend, although the pace of this decline is slower than in the case of the number of benefits. Between 2014 and 2024, the amount of payments decreased by around 15%, with forecasts indicating its further reduction in the coming years. A particularly significant drop was recorded in 2020, which can be attributed to the impact of the COVID-19 pandemic on farm operations.

5. A diverging trend is observed regarding the average value of a single compensation claim, which rose by 68% during the period, with an average annual growth rate of approximately 5%. Both the level of the average cost of compensation and the scale of physical injury are increasing systematically. This points not only to rising financial benefits but also to the increasing severity of the consequences of accidents. This increase may also result from changes in the amount of lump-sum compensation per 1% of physical injury, rising socio-economic costs of accidents, and changes in the structure of accident events.
6. As for the functioning of the Agricultural Social Insurance Fund, the observed trends are complex in nature. On the one hand, the decline in the number of benefits and in their total value may contribute to reducing the financial burden on the system. On the other hand, the declining number of persons covered by insurance and the increase in the value of individual benefits may, in the longer term, affect the scale of the system's operation and its financial stability.
7. A very strong and negative relationship was found between the number of insured farmers and the average amount of compensation paid. This may result from several key economic and institutional factors. First, the increase in the average value of compensation may be linked to changes in legal provisions and to increases in the amount of benefits paid by the Agricultural Social Insurance Fund, which is a consequence of the indexation of benefits and their adjustment to the rising cost of living and wage levels in the economy. Second, the decline in the number of persons covered by the farmers' social insurance system may lead to a change in the structure of beneficiaries, in which a relatively larger share is accounted for by persons suffering more serious accidents, resulting in higher amounts of compensation. Consequently, despite fewer claims being paid, their average value increases. Third, the observed increase in the average amount of compensation may also be the effect of technical progress and the modernisation of agriculture, which on the one hand contribute to reducing the number of accidents, but on the other may be associated with higher costs of the consequences of accident events, resulting from the greater value of the equipment used and higher labour productivity.
8. The findings indicate that the farmers' social insurance system in Poland is undergoing significant transformation, driven by both demographic and structural shifts in agriculture and improvements in workplace safety. These trends are of considerable importance for the future functioning of KRUS and its role in the social security system for the rural population. While the current model for accident and occupational disease benefits promotes administrative efficiency, it raises questions regarding the adequacy of compensation levels. In the author's

view, further improvement of the system should take into account both accident prevention and the effectiveness of compensation mechanisms.

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