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FARM INCOME STABILIZATION EFFECTIVENESS AND INCOME STABILIZATION TOOL

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Abstract. There is a high and growing risk in agriculture, which makes choosing the right tool to support risk management in agriculture more urgent. Traditional agricultural production insurance is very expensive and often – as is the case in Poland – does not provide adequate coverage. Income insurance, which ensures more complex coverage, may be an alternative to it and, as there is no perfect correlation between the value of individual production types, may be offered at a comparatively lower price. Based on 2004–2013 data from 4,590 Community Farm Accountancy Data Network (FADN) farms, it was proved that aggregate production insurance allows for a much lower insurance premium rate in relation to insurance of specific production types.

Key words: income risk, insurance, FADN, income stabilization tool

INTRODUCTION

Agriculture has always been recognised as this type of economic activity where production and economic results volatility is very high (Hardaker et al., 2004). Many economists note that farming risk is likely to grow further in the future due to, on the one hand, climate change (EEA, 2012; Liesivaara and Myyra, 2014) and, on the other hand, greater price volatility (Chand, 2010; Gilbert, 2010). Furthermore, common agricultural policy reforms, which started to be introduced in 1992, play an important role in the European Union (EU) agriculture. Agricultural policy reorientation aimed at reducing interference in market processes and replacing that interference with income support policy made price risk in the EU agriculture much greater (von Ledebur and Schmitz, 2012).

The need to address the growing income volatility in European agriculture made EU policymakers extend a set of tools that might be financed under rural development (RD) in 2014–2020 to include instruments to support risk management in agriculture (Rozporządzenie..., 2013). The instrument called the Income Stabilization Tool (IST), which is a type of agricultural income insurance, should be considered the most interesting among these instruments.

The EU has already allowed for subsidising crop and livestock insurance as a part of state aid. These subsidies were provided for, among others: Spain, Portugal, Austria, the Czech Republic or Italy (Mahul and Stutley, 2010). A novelty here is putting more emphasis on risk management support and making such instruments part of the RD policy.

There is a number of studies on issues related to IST implementation effects emerged. There was, among others, a simulation of operation of this type of income insurance for cereal, milk and beef producers in the Belgian region of Wallonia and an income compensation amount for 1997–2007 data was calculated (Pigeon et al., 2012). Taking Finnish flock farms as an example, Liesivaara et al. (2012) pointed that moral hazard may arise when using the IST and indicated the most important differences between the IST and a Finnish crop

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insurance system. Another study indicated costs associated with IST implementation under European conditions and the instrument's impact on farmers' behaviour based on a model illustrating French cereal producers' behaviour (Mary et al., 2013). Janowicz-Lomott and Łyskawa (2014) pointed to difficulties associated with possible IST implementation in Poland and proposed their possible solutions.

To counteract effects of excessive risk in agriculture, most European countries still decide, however, to support traditional insurance that compensates for random losses in production. Nevertheless, due to numerous features that distinguish manufacturing conditions in agriculture from other sectors of the economy, agricultural insurance development faces serious difficulties. Systemic risk, which reveals in the correlation of loss occurrence due to dependence of production on weather conditions, forces insurers to make use of expensive reinsurance or create reserves in years with a lower loss ratio, which always leads to higher policy prices (Froot, 1999). This premium growth is also influenced by informational constraints (adverse selection and moral hazard) arising out of complexity of production processes in agriculture (Klimkowski, 2014). Furthermore, it is worth remembering that the most severe losses due to disasters (e.g. drought) generate so high socio-economic costs that state governments launch post-disaster aid schemes. Many agricultural producers consider these schemes as a free alternative to insurance coverage which leads to lower demand for insurance (Liesivaara and Myyra, 2014). As a result, there is virtually no such place in the world where the agricultural production insurance market developed without significant budget support (Smith and Glauber, 2012).

Similarly, demand for agricultural production insurance in Poland remained marginal for many years. The situation changed as late as in 2008 when insurance for recipients of direct payments was made compulsory. In 2013, over 151 thousand farmers bought policies and nearly 3.5 million hectares of crops were covered by insurance (GUS, 2015). However, the increase in the number of acquired insurance policies does not improve agricultural producers' safety significantly. The vast majority of policies provide coverage for hail and, less often, winterkill effects, while the most severe losses due to drought are not compensated. This results from high drought insurance prices which, depending on the region, are 2–20% of the sum insured (Kemeny et al., 2014).

Imperfections of traditional agricultural production insurance make it necessary to explore possibilities and consequences of implementing new risk management tools in farms. One of such solutions may be the IST whose main advantage is coverage for all income risks rather than just the production risk of selected production types. Insuring the total farm income instead of particular production types may lead to a much lower premium in relation to the object of insurance because, in line with Markowitz's portfolio theory, portfolio variance may be much reduced due to diversification. Therefore, studies in this paper were carried out in this respect. The paper aims at indicating the extent to which having the entire production value – rather than specific production types – insured will lower the premium rate. The main aim of this paper is to evaluate benefits arising from implementing insurance which operates like IST. These benefits emerge from covering the value instead of volume of production and the whole agricultural production instead of single specific losses.

DATA AND METHODOLOGY

The paper uses individual data on 4590 Polish farms that kept agricultural accounts within the Community Farm Accountancy Data Network (FADN) in 2006–2013 on an ongoing basis. The FADN database contains accounting data of commercial farms whose economic size, defined as the total standard production value, exceeds a certain threshold (EUR 4000 in 2013). For more information on selecting the farm sample and characteristics of the group analysed, please refer to Floriańczyk et al. (2014).

We studied volatility in production performance of the farms analysed. We analysed data on total production (variable symbol – SE131), crop and livestock production, as well as specific production types referred to below. These data are cumulative annual values (PLN) whose components include sale, internal use or transfers to a household. The following production types were analysed: cereals, protein crops, potatoes, sugar beets, oilseeds, industrial crops, vegetables and flowers, fruit, milk and cow's milk preparations, cattle livestock, pig livestock, sheep and goat livestock, poultry livestock, hen eggs.

Table 1. Number of analysed farms and average annual value of production in different types of farming groups
Tabela 1. Liczebność populacji nieprzerwanie prowadzących wybrany kierunek produkcji rolnej oraz średnia roczna wartość tej produkcji

Production type Kierunek produkcji	Variable symbol by FADN Symbol zmiennej wg FADN	Number of analysed farms Liczba badanych gospodarstw	Average annual value by production type (PLN) Średnia roczna wartość danego kierunku produkcji (zł)
Cereals Zboża	SE140	4 114	52 574
Protein crops Rośliny białkowe	SE145	24	12 285
Potatoes Ziemniaki	SE150	1 064	18 348
Sugar beets Buraki cukrowe	SE155	547	40 274
Oilseeds Rośliny oleiste	SE160	466	75 337
Industrial crops Rośliny przemysłowe	SE165	42	31 615
Vegetables Warzywa	SE170	421	135 913
Fruit Owoce	SE175	262	95 329
Milk Mleko	SE216	2 016	70 778
Cattle livestock Żywiec wołowy	SE220	1 598	20 190
Pig livestock Żywiec wieprzowy	SE225	1 919	96 444
Sheep and goat livestock Żywiec barani i kozi	SE230	19	13 292
Poultry livestock Żywiec drobiowy	SE235	39	911 975
Hen eggs Jaja kurze	SE240	40	292 484
Crop production Produkcja roślinna	SE135	4 412	98 681
Livestock production Produkcja zwierzęca	SE206	3 546	122 272

Source: own elaboration based on the FADN database.
Źródło: opracowanie własne na podstawie danych FADN.

As part of analysing production volume changes in individual farms, each analysed variable was provided with a group of farms whose analysed variable was at least PLN 1000 in each subsequent year from 2004 to 2013. This was supposed to exclude farms engaged in a given production type occasionally or those that ceased to manufacture a specific product. The number of analysed farms that continuously exceed a threshold for specific production types is presented in Table 1 which also includes the average annual value of production in constant 2004 prices.

Collected data were used to carry out a simulation analysis. Firstly, data on production value were expressed in real terms (2004 prices), using annual inflation rates published by the NBP. A compensation payment scheme was applied in accordance with EU regulations of Article 39 of the aforementioned Regulation (Rozporządzenie..., 2013) on the IST. The number and value of compensations were then calculated. It was assumed that a farm will get the compensation when the value of the production type analysed in a given year will be lower than the average level of that production during the previous three years. The value of compensation is 70% of the difference between the current year's production value and 70% of the average value from the previous three years and can be expressed by the following formula:

$$O_t = 7/10 \cdot ((7/10 \cdot Y_t^h) - Y_t)$$

where: O_t – value of compensation in year t, Y_t^h – historical value (the preceding three years average) for year t, and Y_t – value of production in year t. The need to calculate the historical average shortens time series, thus making 2007 the first year for which eligibility for compensation was simulated. Graphically, the IST payment scheme is shown in Figure 1. At the same time, it is worth noting that IST insurance originally covers revenue minus costs rather than the value of production. Selecting production as an index triggering compensation payment was due to data availability and the willingness to illustrate why it is better to insure total production rather than specific production types, as is the case with traditional insurance policies.

Based on the cumulative value of compensations in subsequent years, a minimum premium, which – if collected from all manufacturers – would allow for payment of previously calculated premiums, was calculated. It was assumed that overall premium payments should be higher in the first year than overall compensation payments while, in the subsequent years, overall premium payments plus accumulated surpluses from previous years should exceed overall compensation payments.

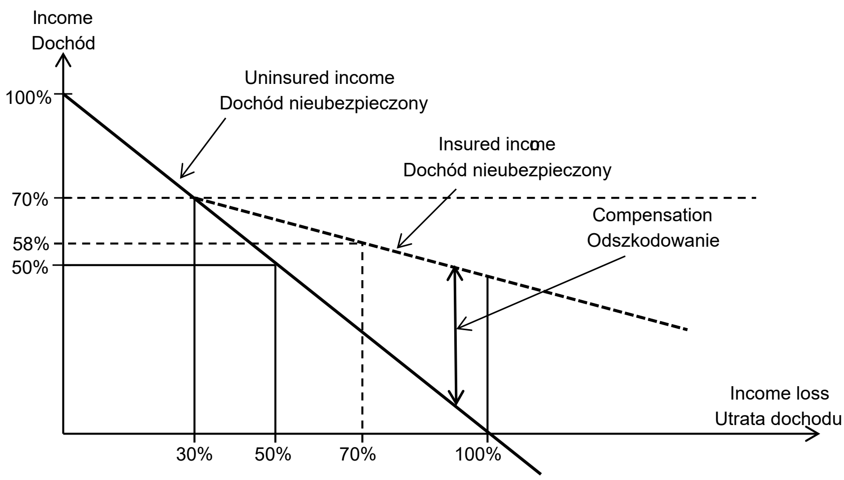

Fig. 1. Schematic principle of operation of the income stabilization tool
Source: own elaboration.
Rys. 1. Schemat wypłat narzędzia stabilizacji dochodów
Źródło: opracowanie własne.

FINDINGS

Findings on production performance volatility reveal that production is diversified significantly both in time and between the production types analysed. With regard to volatility in specific years, it may be observed, in particular, that the number of compensations increased in 2007–2009, dropped over the next two years and grew once again in 2013. Differences between specific production types remain significant. For example, in the vegetable production, there were many recorded significant drops in value production mostly in 2011 and 2012. Figure 2 presents the number of compensations in relation to the size of the analysed groups for selected production types in 2007–2013.

As the analysed insurance operation scheme covers the value of production rather than the volume of production – as is the case with traditional policies, it can be concluded that insurance covers price risk as well. Therefore, changes in the number of farms eligible for compensation seem to be closely dependent on prices of agricultural commodities. This is evident by comparing Figure 2 that presents the share of farms whose production value is below the historical average with Figure 3 that shows changes in annual prices of selected agricultural products. For example, a sharp rise in cereal prices in 2007, 2010 and 2011 significantly reduced the number of farms eligible for compensation in those years. In turn, a fall in prices in 2009 and 2013 increased the number of farms whose cereal production value was much lower than the average of previous years. Similar dependencies apply to most analysed markets.

There was a much higher volatility in the number of farms eligible for compensation than in the average value of compensation. Significant changes in the average value of compensation in the group analysed were mostly observed for those production types where the number of farms constantly engaged in production in the period under analysis was relatively small. This applies primarily to industrial crops, sheep and goat livestock, poultry or egg production. Table 2 presents the ratio of the number of farms, whose value of analysed production types was lower than the pre-defined threshold, to the number of analysed farms and the ratio of the value of compensations to historical production for each of the analysed production types and for all years. What is more, the first right-hand column presents the average of these values for 2007–2013.

The table data indicate that in both crop and livestock production insurance and total production insurance as well, coverage for cumulative production makes both figures on frequency of occurrence and the value

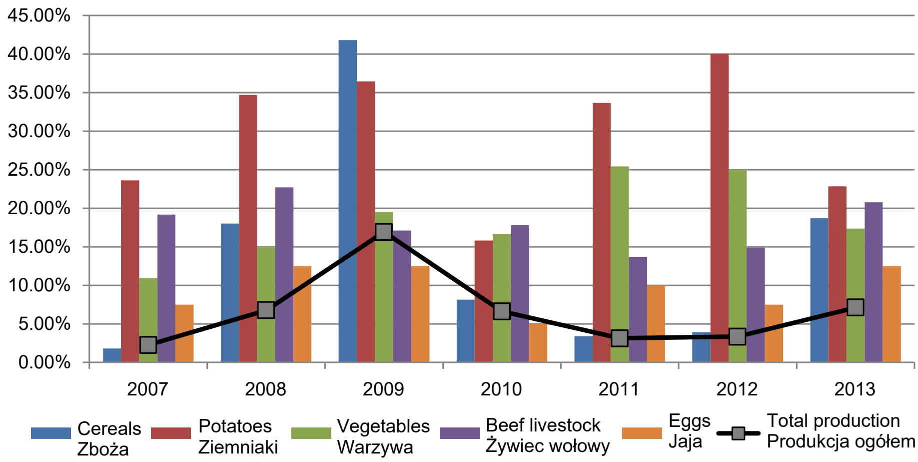

Fig. 2. Share of farms eligible for compensation in 2007–2013 by production type
Source: own elaboration based on the FADN database.
Rys. 2. Odsetek gospodarstw kwalifikujących się do odszkodowania w ramach wybranych kierunków produkcji w latach 2007–2013
Źródło: opracowanie własne na podstawie danych FADN.

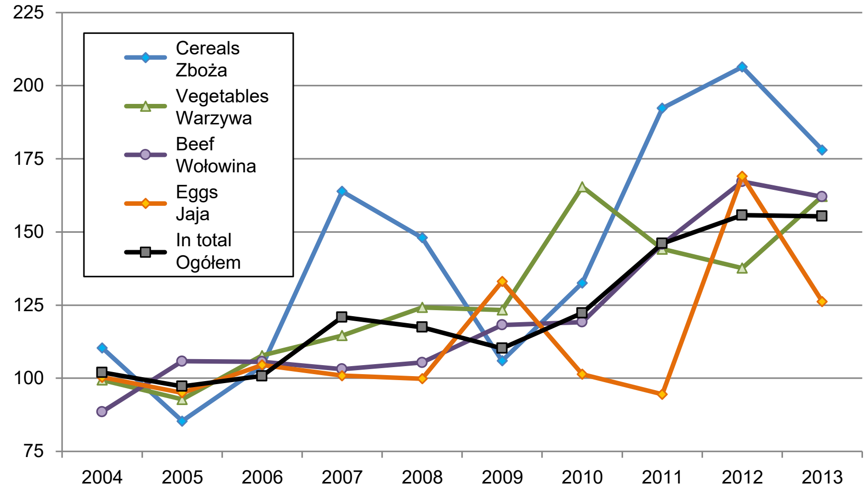

Fig. 3. Price indices of selected Polish agricultural commodities in 2004–2013 (average for 2004–2006 equals 100)
Source: own elaboration based on the FAOSTAT data.
Rys. 3. Zmiany indeksów cen wybranych produktów rolnych w Polsce w latach 2004–2013 (wartość 100 dla średniej cen z lat 2004–2006)
Źródło: opracowanie własne na podstawie danych FAOSTAT.

Table 2. Share of farms eligible for compensations and value of compensation in relation to historical average value of production in 2007–2013 (%)
Tabela 2. Odsetek gospodarstw kwalifikujących się do otrzymania odszkodowania oraz stosunek średniej wartości odszkodowania do produkcji historycznej w latach 2007–2013 (%)

		2007	2008	2009	2010	2011	2012	2013	Average Średnia
1		2	3	4	5	6	7	8	9
Cereals Zboża	A	1.80	17.99	41.78	8.12	3.38	3.91	18.67	13.66
	B	7.95	10.87	9.96	6.67	7.50	7.75	9.13	8.55
Protein crops Rośliny białkowe	A	1.80	17.99	41.78	8.12	3.38	3.91	18.67	13.66
	B	7.95	10.87	9.96	6.67	7.50	7.75	9.13	8.55
Potatoes Ziemniaki	A	23.59	34.68	36.47	15.79	33.65	40.04	22.84	29.58
	B	11.30	12.37	12.38	10.96	14.12	17.12	9.21	12.49
Sugar beets Buraki cukrowe	A	44.61	45.52	6.76	8.04	1.28	2.38	6.03	16.38
	B	10.05	16.24	15.23	5.68	32.36	7.90	5.90	13.34
Oilseeds Rośliny oleiste	A	4.72	4.51	11.59	14.16	27.04	24.46	10.73	13.89
	B	5.45	6.71	6.76	10.87	16.96	11.66	10.20	9.80
Industrial crops Rośliny przemysłowe	A	9.52	14.29	7.14	7.14	4.76	2.38	40.48	12.24
	B	6.87	15.06	40.55	9.46	17.37	21.23	16.86	18.20
Vegetables Warzywa	A	10.93	14.96	19.48	16.63	25.42	24.94	17.34	18.53
	B	4.19	8.26	6.22	6.26	8.44	7.00	5.81	6.60

Table 2 cont. – Tabela 2 cd.

1		2	3	4	5	6	7	8	9
Fruit Owoce	A	17.56	24.43	27.10	22.90	15.27	14.50	14.50	19.47
	B	12.54	10.09	14.13	11.26	16.83	6.73	17.97	12.79
Milk Mleko	A	5.51	6.35	17.36	9.82	7.34	6.40	7.59	8.62
	B	1.44	1.81	3.59	2.33	1.65	3.09	2.89	2.40
Cattle livestock Żywiec wołowy	A	19.15	22.72	17.08	17.77	13.70	14.89	20.78	18.01
	B	16.25	15.43	13.40	13.88	12.04	11.30	13.32	13.66
Pig livestock Żywiec wieprzowy	A	17.20	16.10	14.59	21.94	14.23	13.65	18.71	16.63
	B	5.89	4.65	5.53	5.62	4.78	4.00	5.77	5.18
Sheep and goat livestock Żywiec barani i kozi	A	36.84	31.58	26.32	47.37	10.53	15.79	26.32	27.82
	B	30.28	20.78	16.84	21.48	14.24	6.55	10.61	17.26
Poultry Drób	A	2.56	5.13	7.69	2.56	0.00	2.56	2.56	3.30
	B	1.07	0.62	13.38	11.56	0.00	33.80	0.45	8.70
Eggs Jaja	A	7.50	12.50	12.50	5.00	10.00	7.50	12.50	9.64
	B	0.09	7.79	26.84	0.18	0.16	1.78	15.84	7.53
Crop production Produkcja roślinna	A	2.40	14.96	35.92	10.40	4.13	7.03	15.89	12.96
	B	9.79	7.19	6.74	6.10	8.46	5.94	5.43	7.09
Livestock production Produkcja zwierzęca	A	8.40	9.50	14.10	13.71	7.87	8.07	11.84	10.50
	B	5.12	6.60	6.73	5.10	4.79	4.77	5.35	5.49
Total production Produkcja ogółem	A	2.25	6.76	16.91	6.61	3.12	3.34	7.11	6.59
	B	6.66	6.93	6.75	5.60	6.57	6.99	5.33	6.40

A = Share of farms with compensations.
B = Value of compensation/historical average production.
Source: own elaboration based on the FADN database.
A = Odsetek gospodarstw z odszkodowaniami.
B = Wartość odszkodowań/produkcja historyczna.
Źródło: opracowanie własne na podstawie danych FADN.

of compensations lower than if the IST were related to specific production types. This means that policies relating to the entire value of production would be cheaper and thus more accessible to agricultural producers. The number of compensations for poultry production or the amount of compensations for milk production are the only exceptions in this regard. As regards the former, it is due to the small size of the sample analysed, while as for the latter – it is probably due to lower volatility in milk prices in the period considered. Generally, it can be observed that crop production types have a higher loss ratio, as they are more dependent on weather conditions (high yield volatility) and price volatility is greater.

The findings referred to above were also a basis for calculating a minimum premium which, if collected, would balance compensation expenses. A farm-paid premium depended on the average volume of production in the last three years. Therefore, the premium rate was set as a percentage of historical production. Such a method of payment for insurance is beneficial to an agricultural producer in so far as the premium would increase after years in which

Table 3. Minimum insurance premium in relation to the value of average historical production for different types of farming groups (%)
Tabela 3. Minimalne stawki składki dla poszczególnych kierunków produkcji jako odsetek produkcji historycznej (%)

Production type Rodzaj produkcji	Min. premium rate Min. stawka składki
Crop production – Produkcja roślinna	1.5
Cereals – Zboża	2
Protein crops – Rośliny białkowe	4.5
Potatoes – Ziemniaki	4.5
Sugar beets – Buraki cukrowe	4.5
Oilseeds – Rośliny oleiste	2.5
Industrial crops – Rośliny przemysłowe	3
Vegetables – Warzywa	1.5
Fruit – Owoce	3
Livestock production – Produkcja zwierzęca	1
Milk – Mleko	0.5
Cattle livestock – Żywiec wołowy	4
Pig livestock – Żywiec wieprzowy	1
Sheep and goat lives – Żywiec barani i kozi	8
Poultry – Drób	1
Total production – Produkcja ogółem	1

Source: own elaboration based on the FADN database.
Źródło: opracowanie własne na podstawie danych FADN.

production volume grew and would drop if there was a sharp decline in achieved production in the previous years.

It was assumed that overall premium payments in the first year must exceed overall compensation payments while, in subsequent years, overall premium payments will be increased by reserves transferred from the previous years. This in a way affected findings on the minimum rate. The premium rate raised for those production types whose loss rate grew mostly in the first years under analysis. If production declined primarily in the last years, a sudden increase in overall compensation payments could be additionally financed by surpluses accumulated in the initial period. Despite this drawback, it was decided not to change the method of calculation of the minimum premium rate, because the problem of the accumulation of reserves for compensation payments in the future is also important in real economic processes.

Table 3 presents results of simulations of the minimum premium rate that allows for financing compensation payments from premiums in the subsequent years. It may be noted that, apart from exceptional milk production circumstances, each subsequent level of aggregation makes the premium rate required to compensate for compensation payment costs lower or the same. In particular, this mechanism is clearly appropriate for crop production. Thanks to aggregation effect, insurance for each production type would be much higher than overall production value insurance.

SUMMARY

The simulation carried out above for implementation of the instrument, whose payment function was based on the IST's operation as described in regulations on RD policy tools after 2014, was supposed to illustrate benefits of comprehensive agricultural income insurance. Traditional insurance policies provide coverage for losses in production of crops or animal species specified therein. There are several reasons why IST-type instruments are superior to traditional insurance. First of all, such insurance covers income – which is an economic objective function for every entrepreneur – rather than just part of production value. Secondly, both production risk and price risk are covered. The third advantage in place – a lower premium percentage – was verified above. In accordance with the findings, the value of total on-farm agricultural production is indeed characterised by significantly lower volatility than the value of specific production types. Naturally, the reason for this is production diversification in the absence of full correlation between changes in the value of different production types. The next advantage of IST-type instruments is due to an additional condition, i.e. no correlation between yields and prices. Although the King-Davenant law in the era of emerging international trade liberalisation is much weaker than is the case with closed economies, there is, however, no rule against it.

All the mechanisms described above enable agricultural income insurance to become a highly effective alternative to traditional agricultural insurance. It is a proportionally cheaper and more efficient agricultural income stabilization tool. As it was proved using FADN data, the more aggregated production that is insured, the lower premium is needed relatively to the value of sum insured. However, it seems that the main barrier to introduce an IST-like solution is related to the fact that Polish agricultural producers do not keep accounts. It will not be overcome in the years to come, which not only makes it impossible to verify actually earned income by farmers, but also to determine the historical average used to calculate a compensation payment threshold.

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ZAKRES UBEZPIECZENIA A SKUTECZNOŚĆ STABILIZACJI DOCHODÓW

Streszczenie. Wysokie i rosnące ryzyko gospodarowania w rolnictwie sprawia, że coraz bardziej naglącą kwestią staje się wybór odpowiedniego narzędzia wspierającego zarządzanie ryzykiem. Tradycyjne ubezpieczenia produkcji rolnej są niezwykle kosztowne i często – tak jak w przypadku Polski – nie zapewniają odpowiedniej ochrony. Alternatywą może być ubezpieczenie dochodów, które zapewnia pełniejszą ochronę, a z uwagi na brak doskonałej korelacji między wartością poszczególnych kierunków produkcji może być oferowane po stosunkowo niższej cenie. Na podstawie danych z 4590 gospodarstw prowadzących rachunkowość FADN w latach 2004–2013 dowiedziono, że ubezpieczenia zagregowanej produkcji pozwalają na znaczące obniżenie stawki składki ubezpieczeniowej w stosunku do ubezpieczeń poszczególnych kierunków produkcji.

Słowa kluczowe: ryzyko dochodowe, ubezpieczenia, FADN, narzędzie stabilizacji dochodów

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