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RISKS IN THE FARMS IN POLAND AND THEIR FINANCING – RESEARCH FINDINGS

Summary: A combination of the CAP instruments for financing risks will differ depending on the economic factors in a particular country, e.g. the risk awareness among farmers and their willingness to use insurance instruments. The goal of the article is to give answers to the following questions: Which risks are most important to the farmers in Poland? How are they financed? What factors increase the probability of using crop insurance which is subsidized by state and designed for financing crop loss? The answers were provided on the basis of an analysis of a representative poll taken in March 2012 from 750 respondents with the use of the CATI methodology. It turned out that the most important risks were: volatility of the prices on the crop markets and agricultural inputs, winterkill and spring frost. The most popular source of financing crop loss is own capital. The most important factors affecting the probability of using crop insurance are: location and size of the farm, rape cultivation, having very good or good type of soil, previous use of crop insurance, historical record of losses connected with flooding or hail, perception of risk connected with losses resulting from winterkill, opinion about insurance need and cost.

Keywords: Agriculture insurance, farm risk, risk management, probability model of crop insurance.

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1. Introduction

One of the priorities of Common Agricultural Policy (CAP) in the years 2014–2020 is farm risk management. The December 2013 regulation particularly indicated risk funding instruments, including crop insurance, and determined the framework of their operation [EP and Council Regulation No 1305/2013, Art. 37, p. 487]. It was assumed that the instruments are dedicated for farms in order to allow financing catastrophic losses, so further government subsidies for these were accepted. So far, i.e. since 2006, only ca. 30% of farms in Poland have used subsidised insurance despite its obligation [Rojewski 2014]. Other subsidised instruments allowed by CAP, i.e. mutual funds and income stabilisation funds, have never been in use in

Poland yet. Hence, a very urgent and practical question has to be asked about the shape of the agricultural policy concerning farm risk management.

In the context of the above remarks, the purpose of the paper is to study the risk awareness among Polish farmers and their willingness to use insurance instruments. The following research questions have to be put forward: Which of the perils are most dangerous in the farmers' opinion? How are they financed? What factors affect the probability of having a dedicated source of financing crop loss, i.e. subsidised crop insurance? The following three hypotheses were tested:

1. The most important perils for Polish farmers are production and price risk.
2. The most popular method of financing crop loss is own capital.
3. There are factors differentiating farmers between those who insure their crops and those who do not (insure their crops) and as a consequence it is possible to construct a practically applicable tool to identify individuals with a greater propensity for insurance.

The verification of these hypotheses was based on statistical and econometric analysis of CATI research conducted on survey questionnaire. The research covered farms larger than 1 ha located in the area of Poland, outside county towns, according to the agricultural census of 2002. The total focus group amounted to 750 surveys ($N = 750$) and was assembled on the basis of two criteria: farm size and location. In the first stage some descriptive statistics were calculated, the chi-square test of independence was carried out in order to see whether the respondents' features (especially the objective and relatively permanent ones) depend on their inclusion in the insured or uninsured group. Subsequently, a logit model was constructed to assess if the knowledge of the respondents' and farms' features can be used for their accurate classification as insured or uninsured.

The available research on the subject of crop insurance demand in Poland is limited to the analysis of the number of concluded deals dynamics, the insured area size or type of the insured perils [Kaczała, Łyskawa 2008; Janc 2012; Rojewski 2012, 2014]. More detailed analyses of demand for crop insurance, i.e. the factors which really affect the purchase of insurance and future demand forecasts are usually focused on other markets, mainly in the US [Coble et al. 1996; Goodwin, Vandeveer, Deal 2004; Mishra, Goodwin 2003; Sherrick et al. 2004; Garrido, Zilberman 2008; Ogurtsov, Van Asseldonk, Huirne 2009].

2. Farmers' assessment of perils

Farms are liable to various perils (more in: [Kaczała, Łyskawa 2008]). They can be systematised in different ways, depending on their manageability and controllability in particular. [Kasten 2014; OECD 2011] The structure of the most dangerous perils which a farm may face has been based on the respondents' replies. Farm managers were asked to assess 13 perils in the scale from 1 to 7, where 1 denoted a negligible

peril, while 7 a definitely dangerous one. Figure 1 presents the percentage of replies in which a given peril was evaluated as dangerous (from 5 to 7).

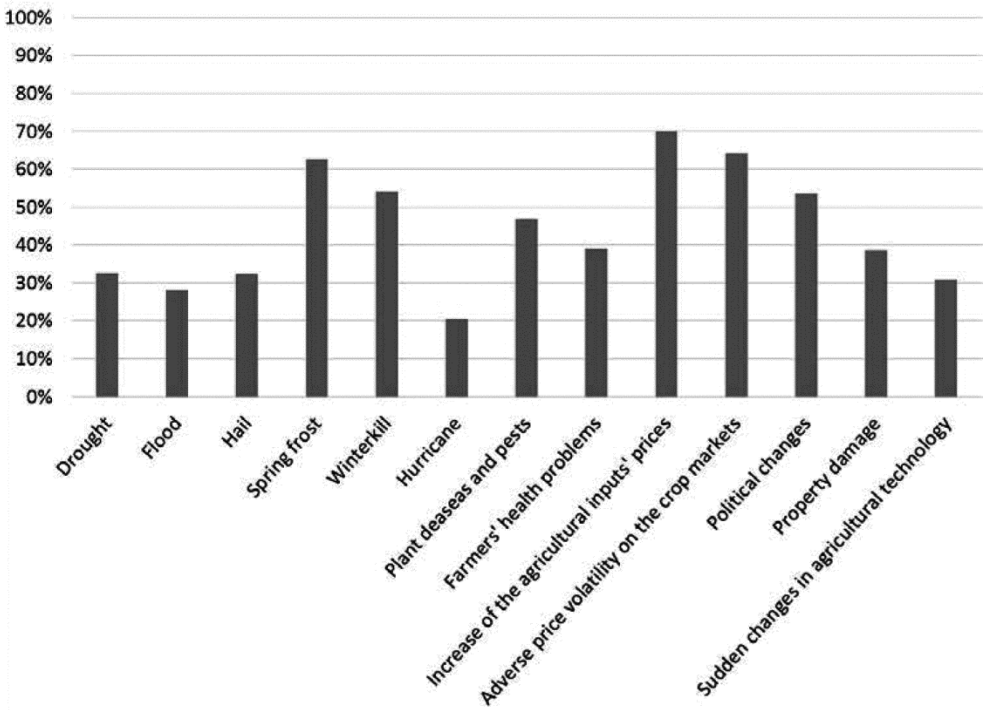

Figure 1. The most important perils for farms as perceived by farmers

Source: own study based on the questionnaires.

As can be seen, among the most dangerous occurrences are the ones affecting prices and crops as well as political ones. As for crops, one has to add that losses above 20% may cause approximately 8% of the farms to go bankrupt, 30% loss may result in 23% of the farms having financial problems, 40% loss can lead to bankruptcy of 40% of the farms, while the loss of more than a half of the crops may result in a little more than 6 out of 10 farms going bust. Therefore one may be tempted to question monitoring the effects of these perils, especially financial auditing.

3. Insurance-based crop loss financing

3.1. Usage of crop loss funding sources

Based on the respondents' answers the structure of crop loss funding was established.[1] It was created for all the respondents (Total) and also for a separate group of those who admitted to recently concluding an crop insurance contract (Insured) as well as those who did not have any insurance (Uninsured) (Figure 2).

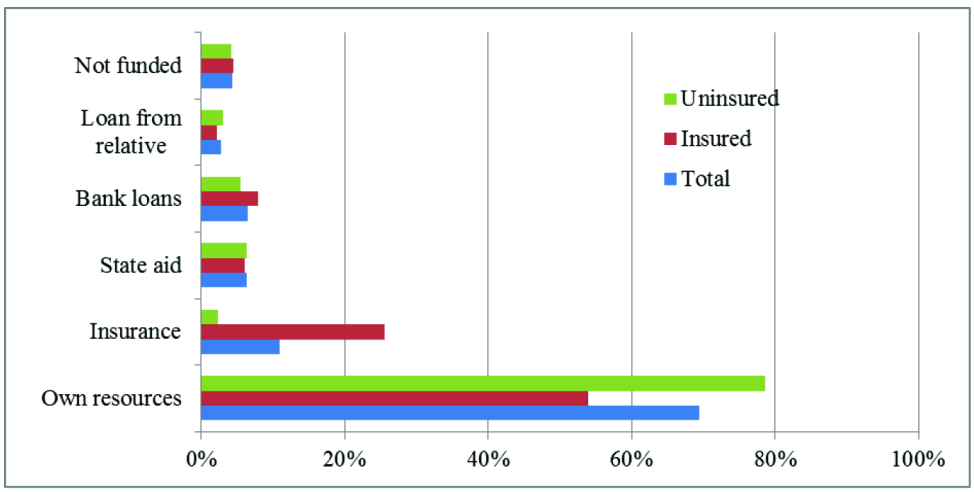

Figure 2. Structure of crop loss funding

Source: own study based on the questionnaires.

In order to establish the relevant differences between the two groups, the chi-square independence test was conducted. Table 1 presents its outcome.

The results point at a significant difference between the funding structures of the two groups. The Insured group often seek loss funding through insurance and rather less often from their own resources than the Uninsured group. In order to investigate possible differences in the funding structure in the case of other sources of finance, once again the independence test was conducted excluding the two funding sources, i.e. insurance and own resources. Its outcome is also presented in Table 1. The findings also indicate that the response structure was different (albeit a little less) between the two groups. The largest differences could be noticed in the case of bank

[1] Each respondent indicated how many types of losses they funded (or co-funded) from a given source, which was a basis for determining the percentage of cases in which a given variant was indicated as a source of loss funding.

loans and loans from relatives. The Insured group funded the losses from a bank loan more often than the Uninsured, and less often from loans from relatives. This may be due to the fact that since 2010 the government aid in the case of losses caused by adverse weather phenomena considered as natural disasters has had to be reduced by 50%[2] if the farmer has not met the obligatory crop insurance requirement of 7 July 2005 act of state subsidies for crop and livestock insurance [Ustawa z 7 lipca 2005].[3] The aid may come in the form of interest reduction for disaster loans (this is what happened after the drought of 2010). This means that the insured farmers have access to cheaper loans or may postpone payment of formerly obtained disaster loans. The insured farmers declared more often than the uninsured ones that they had taken bank loans to finance their loss and relatively more seldom that they had resorted to relatives' help. This may mean that the insured group generally is more likely to turn to specialised financial institutions for assistance.

Table 1. Structure of loss funding and the chi-square test of independence of qualitative features

Source of loss funding	Percentage of cases when losses were to fund		The independence chi-square test results	
			All sources	
	Insured	Uninsured	Chi-sq	507.125
Own resources	53.90	78.65	*p*-value	0.000
Insurance	25.51	2.27	*V*-Cramer coef.	0.373
State aid	6.03	6.39	Without insur. & own resources	
Bank loans	7.94	5.51	Chi-sq	9.833
Loan from relative	2.13	3.06	*p*-value	0.020
Not funded	4.49	4.11	*V*-Cramer coef.	0.0519

Source: own calculations.

The aforementioned obligatory insurance[4] of half of the area where the types of crops covered by the subsidised insurance act are grown against the types of risks

[2] The act is further referred to as subsidised insurance act.

[3] Cf. [European Commission Regulation (EC) No 1857/2006, Art. 11]

[4] According to Art. 4 sect. 4 and Art. 11 sects. 1 and 2 of the 22 May 2003 Act on Obligatory Insurance, Insurance Guarantee Fund and Polish Motor Insurance Bureau [Ustawa z 22 maja 2003] subsidized crop insurance is not obligatory insurance which is subject to provisions of this act (more in: [Orlicki 2011]). This has immense practical implications. To emphasise the fact that subsidized insurance, although it is obligatory in character, it is not compulsory, therefore they are referred to in this article as "enforced insurance" in accordance with Orlicki's terminology.

mentioned in the act was initially introduced by the 2007 amendment and took effect as of July 2008.[5] This obligation comprises all farmers, although insurance premium subsidies are exclusively aimed at entities which meet the EU small and medium-sized business requirements. However, the obligation is not complied with despite sanctions (reduction of government aid in the case of natural disaster, €2 penalty per ha). In 2011 approximately 28% of crops were insured [Rojewski 2012]. At present the number has grown to 30% [Rojewski 2014]. The sanctions seem to be ineffective for a variety of reasons. Therefore it is reasonable to ask what factors increase the probability of farmers' having crop insurance and why.

3.2. Respondents' features and the level of crop insurance use

3.2.1. The features of farmers who insure crops in the light of statistical analysis

In order to determine the relevant factors which define those who insure their crops against those who do not, the independence test was conducted several times. It was focused on rather objective and permanent traits of the farmers who insure their crops and those who do not. The following traits were considered: sex, age, educational background, respondent's farm size, production purpose, sources of income, dominant soil quality class, dominant production and location (whether the farm is placed on a drought-prone area and in which province). Tables 2 and 3 present the cases where it seemed sensible to reject the null hypothesis about the lack of trait interdependence with 5% significance level. Apart from the test results, they also present the percentage of the respondents within a researched trait variety who declared that they had crop insurance.

The findings indicate that there is a strong interdependence in the following cases:

- The size of the farm and the arable area – the larger it is, the higher the percentage of the insured.
- The province where the farm is located – there are provinces where the percentage of insured farmers amounts to more than 50% (e.g. Warmia-Masuria Province, Kujawy-Pomerania Province, Wielkopolska Province) and there also are provinces where this percentage is much lower than the country average (Silesia Province, Podkarpacie Province, Łódź Province). It is only slightly less relevant if the farm is located on a drought-prone area.
- Sources of income – those who solely maintain their households on farming are most likely to have crop insurance.
- Soil quality classes – the better the soils, the more farmers insure their crops.

[5] This is when Art. 10c of the subsidised insurance act was introduced, which regulated the insurance obligation. Formerly the obligation referred to a risk package, at present (since 23 August 2008) it is a selected risk.

- Dominant production – the lowest percentage of crop insurance was noted in those who do not have specialised production.
- Purpose of production – the insured farmers usually market their crops rather than produce for private use, which is also probably connected with the farm size.
- Respondent's age – the lowest percentage of crop insurance was found in the youngest group of farmers.

Table 2. The percentage of the insured set against the objective qualitative traits – statistical analysis results

Feature	Variants	Percentage of insured (total 33%)	Test results	
Age	< 40	21	Chi-sq	12.3970
	40–50	**39**	*p*-value	0.0060
	50–60	31	*V*-Cramer coef.	0.1290
	> 60	**39**		
Farm size	Small (1–7 ha)	15	Chi-sq	123.1559
	Medium (7–20 ha)	35	*p*-value	0.0000
	Large (> 20 ha)	**67**	*V*-Cramer coef.	0.4050
Size of agricultural land	Small (1–7 ha)	18	Chi-sq	116.5789
	Medium (7–20 ha)	41	*p*-value	0.0000
	Large (> 20 ha)	**74**	*V*-Cramer coef.	0.3940
Destination of productions	Own needs only	25	Chi-sq	13.3589
	Own needs and the market	34	*p*-value	0.0013
	On the market	**40**	*V*-Cramer coef.	0.1335
Source of incomes	Only agricultural business	**42**	Chi-sq	23.6842
	Seasonal non-agricultural	38	*p*-value	0.0000
	Permanent non-agricultural.	25	*V*-Cramer coef.	0.1777
Type of soil	Class: 1 & 2	**58**	Chi-sq	19.6437
	Class 3 & 4	38	*p*-value	0.0001
	Class 5 & 6	25	*V*-Cramer coef.	0.1610
Dominant production	Crop production	35	Chi-sq	16.3298
	Milk	34	*p*-value	0.0010
	Porker pigs	**45**	*V*-Cramer coef.	0.1480
	None	23		

Source: own calculations.

Table 3. Percentage of the insured against farm location – statistical analysis results

Feature	Variants	Percentage of insured (total 33%)	Test results	
Drought area	Yes	36	Chi-sq	6.3817
	Not	27	*p*-value	0.0115
Location (province)	W1_WEST_POMER	39		
	W2_LUBUSKIE	19		
	W3_LOWER_SIL	48		
	W4_WIELKOPOLSKA	53	Chi-sq	111.896
	W5_POMERANIA	50	*p*-value	0.0000
	W6_OPOLE	63	*V*-Cramer	0.3860
	W7_KUJAWY-POMER	66		
	W8_SILESIA	11		
	W9_ŁÓDŹ	16		
	W10_WARMIA_MASUR	70		
	W11_MALOPOL	19		
	W12_SWIETOKRZYSKIE	22		
	W13_MASOVIA	27		
	W14_PODKARPACIE	11		
	W15_PODLASIE	22		
	W16_LUBLIN	33		

Source: own calculations.

The cases when the independence-hypothesis cannot be rejected is the respondent's sex and education – these features are not correlated with crop insurance (consequently, the results are omitted in tables).

3.2.2. The logit model of crop insurance conditional probability – structure and evaluation of the model

The fact that there is a correlation between the studied qualitative traits gives rise to a possible estimation of conditional probability (on the basis of farmer and their farm's known characteristics) that the farmer insures the crops. It is also possible to categorise respondents accurately as insured or uninsured.[6] In order to estimate this probability a logit model was established. The dependent variable in the model is the

[6] Due to the fact that the survey was aimed at individual farms we assume that the farm user is both the insurer and the insured.

binary variable, which equals 1 when the respondent declared to have crop insurance (any crop against any peril), and 0 if they declared to have no insurance at all. Initially, the respondents were described using the objective and relatively permanent traits analysed above. They were qualitative traits and were introduced into the model by means of a series of 0-1 variables. If a variable (e.g. the farm size) could be counted in *m*-variants, *m*-1 binary variables were introduced into the model. Also, *i*-binary variable equalled 1 if the *i*-variant of a feature occurred and 0 if the opposite occurred. Hence, one of the trait's variants was treated as a base. Accurate categorisation rate (hit ratio) in this case amounted to 77%.

In order to improve the accuracy of categorisation, the set of studied traits was broadened and less objective or more variable features were added. Particularly, information about the following was introduced:

- Opinions about insurance (respondents evaluated their level of acceptance for the following statements: 1. Insurance makes me feel confident about my own future and my family's. 2. I am worried about problems with indemnity payment. 3. Insurance companies offer policies which cover all types of perils. 4. Every farmer should buy crop insurance. 5. Crop insurance guarantees a high indemnity. 6. Crop insurance is too expensive for me; respondents rated their opinion in the scale from 1 to 7 where 1 meant absolute lack of acceptance).
- Perception of perils (respondents evaluated 13 different perils in the scale from 1 to 7 where 1 means that the peril is not dangerous at all: drought, flood, hail, spring frost, winterkill, hurricane, plant diseases and pest, health problems, rising prices of agricultural input, agricultural market volatility, political changes affecting agriculture, property damage, rapid changes in agricultural technology).
- Occurrence of crop damage (respondents stated if in the past 10 years their crop was damaged by plant or animal diseases, drought, hail, spring frost, winterkill, hurricane, fire, other causes; binary variables).
- Source of loss funding (respondents indicated the source from which particular type of crop loss was funded within the past 10 years. There were the following variants: own resources, insurance, government or community aid, other entities' assistance, loans from relatives or neighbours, bank loans, other, loss was not funded; binary variables).
- The crop grown in the past two years (the trait's variants: rape, winter wheat, winter barley, winter triticale, rye, oats, spring barley, maize, sugar beet; binary variables).

Explanatory variables were selected according to backward stepwise regression method, assuming that the only variables which could remain in the model were significant at 95% confidence level. One has to add that some of the variables were deleted because they were co-related (e.g. farm size, sources of income, purpose of production), and not because they had no impact on respondents' insurance behaviour. GRETL and Statistica software were used for the estimations.

Table 4 presents the combination of logit model parameters assessment, *p*-values and changes in the levels of probability of having crop insurance resulting from an increase in a given explanatory variable by one unit.[7]

Table 4. Results of logit model estimation describing probability of crop insurance

Variable	Parameter	*p*-value	Marginal eff.
Const	–4.25236	0.0000	
USED_INDEMNITY	2.68608	0.0000	0.5860
LARGE_FARM	1.96866	0.0000	0.4412
MEDIUM_FARM	1.05449	0.0000	0.2179
CLASS_1_2_SOIL	1.33076	0.0271	0.3110
CLASS_3_4_SOIL	0.471715	0.0350	0.0922
W4_WIELKOPOLSKA	1.67975	0.0000	0.3826
W7_KUJAWY-POMER	1.51121	0.0000	0.3501
W3_LOWER_SIL	1.39237	0.0049	0.3254
W10_WARMIA_MASUR	1.73026	0.0352	0.4054
RAPESEED_PRODUCED	0.942338	0.0059	0.2112
HAIL_EXPERIENCED	0.799566	0.0002	0.1605
FLOOD_EXPERIENCED	0.540767	0.0197	0.1105
OPINION_WINTERKILL_IS_DANGER	0.176053	0.007	0.0346
OPINION_HURRICANE_IS_DANGER	–0.157479	0.0083	–0.0310
OPINION_SHOULD_BE_INSURED	0.529606	0.000	0.1042
OPINION_INSURANCE_TOO_EXPENSIVE	–0.361447	0.0009	–0.0711
McFadden *R*-square = 0.3809			
Likelihood-ratio test: Chi-square(16) = 362.032 [0.0000]			

Source: own calculations.

Probability of crop insurance should be estimated on the basis of the following model:

$$\hat{p}_i = \frac{1}{1+\exp[-(-4,25+2,69\cdot USED\_IDEMNITY_i+1,97\cdot LARGE\_FARM_i.+..)]}$$

Before interpreting this model's parameters it is worth noting that the estimated model may be considered to be well adapted. McFadden's coefficient R^2 amounted to approximately 38% while Verber's coefficient pseudo-R^2 (as in [Gruszczyński (ed.)

[7] Details in: [Gruszczyński (ed.) 2012, p. 83].

2012, p. 31]) amounted to 51.4%. On the one hand, it has to be said that the above values mean that the model still does not explain a large part of alterations of the dependent variable. On the other hand though, it has to be remembered that a low McFadden's R^2 is typical for probability models when conditional probabilities of an occurrence are between 0.2 and 0.8. Taking this into consideration, one can say that the above model may in the end result in accurate categorisation of the studied entities (as having or not having crop insurance) and consequently R^2 total (hit ratio) may reach a satisfactory level.

The classification matrix and hit ratios were established on the basis of an assumption that a respondent may be categorised as likely or unlikely to have crop insurance if the probability of having one exceeds 0.5. The results can be seen in Table 5.

Table 5. Classification matrix based on logit model of insurance probability with cut-off ratio of 0.5

Real groups	Classification		Hit ratios (%)
	Uninsured	Insured	
Uninsured	468	35	93
Insured	86	161	65
Hit ratio (total)			84

Source: own calculations.

Table 6. Classification matrix based on logit model of insurance probability with Cramer's cut-off ratio of 0.33

Real groups	Classification		Hit ratios (%)
	Uninsured	Insured	
Uninsured	416	87	83
Insured	50	197	80
Hit ratio (total)			82

Source: own calculations.

The hit ratio amounts to 84%. This is a very good result. Unfortunately, a lot of mistakes were made in categorization of people who tend to be insured against crop losses: as many as 86 out of 247 of those who declared insurance were categorized as uninsured. This must be viewed as undesirable, as from the insurance company standpoint a good insurance probability model should accurately identify people who are likely to buy insurance in the first place. A higher value of the detailed hit ratio in the "uninsured" group can result from the majority of respondents declaring that they have no insurance (ca. 67%). In the case of inequality between the participants of the two groups the so-called Cramer's cut-off point is recommended to be used for

classification, which should improve the quality of categorising entities in the smaller group [Gruszczyński (ed.) 2012, p. 91] The results achieved in this case are shown in Table 6 where 80% of the respondents were categorised accurately.

In order to make sure whether the logit model could also be of comparable quality beyond the training dataset, it was decided to separate the observations for the training dataset and for the validation set. The rules of tenfold validation were chosen as appropriate. Based on the tenfold validation it can be stated that assumption of cut-off point of 0.33 always led to an increase in the hit ratio within the "insured" group. Not surprisingly, the total hit ratio in the validation sets was a little lower than in the training set (it fluctuated between 70 and 82%) but the drop in quality was not substantial enough to question the stability of model regularities. It is also a positive fact that the set of relevant variables did not change. The above model comprised the relevant variables which were really essential to it. Additionally, other variables appeared as well (albeit usually at one-off rate). Both relevant and positive parameters were reached for the variables connected with traits like the degree of perceived threat of flood, degree of perceived threat of frost, location of the farm on the drought-prone area, recent cultivation of maize, beet, and winter barley and finally expecting that a drop of 11 to 30% in crops may lead to the farm's bankruptcy. Negative parameters were obtained if the variable concerning information about the farm's location in Łódź, Masovia and Podlasie was given. Considering the above results of the analysis of qualitative traits correlation and the fact that the largest percentage of those who insured their crops was among farmers growing rape (68%), sugar beet (60%) maize (58%) and winter barley (52%) one can say that parameter marks are essentially justified.

3.2.3. Interpretation of the results

Due to the fact that the estimated model has proven to be a fairly good classification tool, one may find it useful to determine the particular features of the respondents which influence the probability of insurance and what kind of influence it is. Considering all the above, probability of signing a crop insurance contract increases when:

- the farm size increases;
- the farm is located in Wielkopolska, Kujawy-Pomerania or Warmia-Masuria;
- in the past 10 years insurance was the most or one of the most frequent sources of crop loss funding;
- the level of acceptance increases for the opinion that one should have an insurance policy;
- rape is cultivated;
- increased feeling of threat concerning losses which result from the consequences of winterkill;

- in the last 10 years the farm was hit by a flood or hail;
- class 1-2 and class 3-4 soils are dominant.

Also, the model shows that an increase in the level of acceptance for the statement: "insurance is too expensive" causes a drop in probability of having crop insurance. Similarly, the more dangerous for a given farmer the hurricane is, the lower is the probability that they have insured their crops. This result is quite astonishing, but luckily, the impact of this opinion is not very significant for the final value.

The biggest marginal changes in the probability of having crop insurance are connected with such features of the respondent as: previously receiving crop loss indemnity, right farm size, farm location, soil class and rape cultivation.

4. Conclusions

The hypotheses set at the beginning of the study have been confirmed. It has turned out that the most important risks are: volatility of the prices on the crop markets and agricultural inputs, winterkill and spring frost. The most popular source of financing crop loss is own capital. However, the insured use bank loans definitely more often than the uninsured. There are factors differentiating farmers who insure their crops and who don't insure their crops and as a consequence it is possible to construct practically applicable tool to identify individuals with a greater propensity for insurance.

The level of probability of signing a crop insurance contract is significantly affected by the farm's location in one of the following provinces: Wielkopolska, Kujawy-Pomerania, Lower Silesia or Warmia-Masuria. They are characterised by a high percentage of agricultural areas, including arable land [Głębocki (ed.) 2014]. The first three provinces are the ones with the largest area of rape and turnip rape cultivation [GUS 2011; Głębocki (ed.) 2014] where, consequently, rape cultivation is an important explanatory variable. There are two reasons for this: firstly, it is a capital-intensive crop. When first subsidised crop insurance came into being, it was mainly rape and turnip rape that were insured. In 2006 this crop insurance accounted for 60% of all insured areas (all types of crops) [Kaczała, Łyskawa 2010]. This situation changed in 2011 (one year before this research was conducted) – the insured rape amounted to only 30% of all insured crops within subsidised crop insurance, which was mainly caused by an increase in popularity of cereal insurance. Secondly, rape crops in the years immediately before this research (i.e. 2011 and 2012) were heavily damaged by adverse effects of winterkill and spring frost. According to CSO assessment, in 2012 as much as 61% of the rape and turnip rape land could potentially be ploughed, 47% in Wielkopolska, while Lódź incurred the highest level of damage – more than 90% of rape and turnip rape had to be ploughed [GUS 2011, 2012].

In the years before the research there were numerous extreme weather phenomena, the most spectacular of them being the 2006 and 2008 drought, winterkill and spring frost in 2011 and 2012 in particular (the research was actually conducted in March 2012 when most winterkill claims were settled). In 2012 approximately PLN 650 million worth of crop claims were paid out, with PLN 590 million for winterkill alone [Rojewski 2012]. In the light of the above it is not surprising that there is a significant correlation between the risk awareness of winterkill and the probability of using crop insurance. The fact that crops (especially cereals) were usually insured against hail for many years [Janc 2012] did not result from very frequent occurrence of this phenomenon (although it does constitute a relevant variable). Cereals (especially) were most often insured against hail in order to meet the compulsory obligation at a lowest cost (hail being the cheapest insured occurrence). Doubtlessly, experiencing former claims affects the probability of having crop insurance. In this context it is also surprising that drought is not considered a meaningful phenomenon, although it occurs every 2-3 years in some of the regions (Wielkopolska, Kujawy-Pomerania) [Doroszewski 2014] and is one of the most significant perils. It might be explained by the fact that in Poland draught had not been insured at all (with the exception of a short transitory period in 1960s). The situation changed only after the subsidised insurance act had come into effect. However, when the act was amended and risk packages were abolished (in 2008), drought insurance premiums were up to 20%, especially for poor quality soils. As a result, in 2011 the actual number of signed crop insurance deals which covered adverse effects of drought amounted to 600 (!) [Janc 2012]. Hence, the farmers seem to be aware of the possibility to insure their crops against drought (85% of the respondents have heard about this kind of insurance), but due to the price level they remain practically unaffected by this information when deciding about their crop insurance.

If the farmer had experienced a loss and more or less often had received compensation (i.e. it was at least partially funded by indemnity) this led to a significant growth in probability of signing a crop insurance contract. Probability of signing an insurance deal is twice as much linked with financing the loss by indemnity than solely with the occurrence of a given phenomenon (e.g. hail or flood). It is worth mentioning here that acceptance level for the opinion "I am worried about the payment of indemnity" did not have much influence on probability of signing an insurance contract.

The use of crop insurance tends to grow along with the farm size; probably due to the fact that small supplementary farms are not the main source of the household income. At present, the share of small and medium-sized farms is falling [Głębocki (ed.) 2014] Moreover, the better the soils are in the area, the higher the probability of concluding an insurance deal.

It is logical to point at the inverse relation between the probability of having crop insurance and the degree of acceptance of the opinion: "crop insurance is too expensive for me". This correlation is confirmed by the growth in the number of crop insurance contracts concluded after 2005 when the crop insurance subsidy act took effect, which enabled partial state subsidies of crop insurance premium.[8] In 2005 approximately 36 000 contracts were concluded, in 2006, when first subsidies were available, 49 000 contracts were signed, 11 000 of subsidised ones among them, and in 2007 when the subsidy was increased, as many as 90 000 contracts were signed, including approximately 28 000 subsidised ones [Kaczała, Łyskawa 2010].

It is not surprising that the level of probability of obtaining crop insurance rises with the increase in acceptance of the opinion that "every farmer should insure their crops". It is, however, rather astonishing in the context of two obligatory types of agricultural insurance (agricultural holding civil liability insurance and insurance of all the buildings included in the farm against fire and other unforeseeable circumstances) and one enforced (crop insurance) that only half of the respondents accept or rather accept the above statement. It is a really serious challenge for the legislators due to the obvious problem with acceptance of a legal insurance obligation. It is also a challenge for insurance companies because of the aforementioned correlation between the opinion and probability of having crop insurance. It has to be said that the marginal changes in probability of having crop insurance are bigger in the case of differing acceptance for the statement "each farmer should insure their crops" rather than a differing opinion about "crop insurance is too expensive for me." This means that in order to promote the idea of crop insurance it is almost as important to increase insurance awareness as to carry out actions aimed at price stability. This is especially valid in the light of the already introduced and planned changes in legal regulations concerning subsidised crop insurance. So far they have been focussed on lowering the insurance costs (abolishing risk packages, introduction of state reinsurance in the case of drought insurance) and increasing maximum rates allowing for applying for subsidies. Awareness-building action was mainly left to voluntary activities of marketing departments of insurance companies.

References

Coble K.H., Knight T.O., Pope R.D., Williams J.R., 1996, *Modeling Farm-Level Crop Insurance Demand with Panel Data*, American Journal of Agricultural Economics, vol. 78, no. 2, p. 439–447.

[8] Initially the subsidy amounted to 40% of the premium for 1 ha of cereals, maize, rape or turnip rape and 35% of the premium for 1 ha of potato or sugar beet [Rozporządzenie Rady Ministrów z 21 marca 2006] and since 2007 it has been 50% per 1 ha ([Rozporządzenie Rady Ministrów z 29 maja 2007] and annual regulations on the level of premium subsidies).

Doroszewski A.., 2014, *Monitoring drought in Poland. The methodology and results*, Polish Re Agro Seminar. 6th International Seminar on Crop Insurance, Toruń 23–25.06. 2014.

Garrido A., Zilberman D., 2008, *Revisiting the Demand for Agricultural Insurance: The Case of Spain*, Agricultural Finance Review, vol. 68, no. 1, p. 43–66.

Głębocki B. (ed.), 2014, *Zróżnicowanie przestrzenne rolnictwa. Powszechny spis rolny 2010*, GUS, Warszawa.

Goodwin B.K., Vandeveer M.L., Deal J.L., 2004, *An Empirical Analysis of Acreage Effects of Participation in Federal Crop Insurance Program*, American Journal of Agricultural Economics, vol. 86, no. 4, p. 1058–1077.

Gruszczyński M. (ed.), 2012, *Mikroekonometria. Modele i metody analizy danych indywidualnych*, Wolters Kluwer, Warszawa.

GUS, 2011, *Wynikowy szacunek głównych ziemiopłodów rolnych i ogrodniczych w 2011 r.*, Warszawa.

GUS, 2012, *Wstępna ocena przezimowania upraw ozimych w 2012 r.*, Warszawa.

Janc A., 2012, *Difficulties in the Functioning of Crop and Livestock Insurances in Poland in the Years 2006–2012*, Polish Insurance Association Seminar: Trends in Agricultural Insurance in Europe. Drought Insurance in Poland, Warsaw 5 Nov 2012.

Kaczała M., Łyskawa K., 2008, *Ubezpieczenia z dopłatami z budżetu państwa jako instrument ochrony gospodarstw rolnych przed skutkami ryzyka*, Gospodarka i Finanse, Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu, Poznań, p. 123–145.

Kaczała M., Łyskawa K., 2010, *Ubezpieczenia przedsiębiorstw/gospodarstw rolnych*, [in:] L. Gąsiorkiewicz, J. Monkiewicz (eds.), *Ubezpieczenia w zarządzaniu ryzykiem przedsiębiorstwa*, t. 2: *Zastosowania*, Poltext, Warszawa, p. 155–184.

Kasten E., 2014, *Agriculture Insurance. Recommended Sales Solutions, Polish Re Agro Seminar*, 6th International Seminar on Crop Insurance, Toruń 23–25.06. 2014.

Mishra A.K., Goodwin B.K., 2003, *Adoption of Crop Insurance versus Revenue Insurance: A FarmLevel Analysis*, Agricultural Finance Review, vol. 63, no. 22, p. 144–155.

OECD, 2011, *Managing Risk in Agriculture: Policy Assessment and Design*, OECD Publishing, http://dx.doi.org/10.1787/9789264116146-en (retrieved:12.08.2012).

Ogurtsov V.A., Van Asseldonk M.A., Huirne R.B., 2009, *Purchase of Catastrophe Insurance by Dutch Dairy and Arable Farmers*, Applied Economic Perspectives and Policy, vol. 31, p 143–162.

Orlicki M., 2011, *Ubezpieczenia obowiązkowe*, Wolters Kluwer Polska, Warszawa 2011.

Rojewski K., 2012, *The History and Current State of Agricultural Insurance in Poland*, Polish Insurance Association Seminar: Trends in Agricultural Insurance in Europe. Drought Insurance in Poland, Warsaw 5 Nov 2012.

Rojewski K., 2014, *Agricultural insurances in Poland*, Polish Re Agro Seminar. 6th International Seminar on Crop Insurance, Toruń 23–25.06.2014.

Sherrick B.J., Barry P.J., Ellinger P.N., Schnitkey G.D., 2004, *Factors Influencing Farmers' Crop Insurance Decisions*, American Journal of Agricultural Economics, vol. 86, no. 1, p. 103–114.

Legal acts

European Commission Regulation (EC) No 1857/2006 on the application of Articles 87 and 88 of the Treaty to State aid to small and medium-sized enterprises active in the production of agricultural products and amending Regulation (EC) No 70/2001, Official Journal of the UE L 358 of 16 December 2006.

EP and Council Regulation No 1305/2013 of 17 Dec 2013 on support of rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation No 1698/2005, Official Journal of the UE L 347 of 20.12.2013.

Rozporządzenie Rady Ministrów z dnia 29 maja 2007 r. zmieniające rozporządzenie w sprawie wysokości dopłat do składek z tytułu ubezpieczenia upraw rolnych i zwierząt gospodarskich w 2007 r., Dz.U. 2007, nr 98, poz. 649.
Rozporządzenie Rady Ministrów z dnia 21 marca 2006 r. w sprawie wysokości dopłat do składek z tytułu ubezpieczenia upraw rolnych i zwierząt gospodarskich w 2006 r., Dz.U. 2006, nr 52, poz, 381.
Ustawa z dnia 22 maja 2003 r. o ubezpieczeniach obowiązkowych, Ubezpieczeniowym Funduszu Gwarancyjnym i Polskim Biurze Ubezpieczycieli Komunikacyjnych, Dz.U. 2003 nr 124 poz. 1152 z późn. zm.
Ustawa z dnia 7 lipca 2005 r. o dopłatach do ubezpieczeń upraw rolnych i zwierząt gospodarskich, Dz.U. 2005 nr 150, poz. 1249 z późn. zm.

ZAGROŻENIA W GOSPODARSTWACH ROLNYCH W POLSCE I FINANSOWANIE ICH SKUTKÓW – WYNIKI BADAŃ

Streszczenie: W ramach wspólnej polityki rolnej na lata 2014–2020, której priorytetem jest zarządzanie ryzykiem w gospodarstwie rolnym, wskazuje się na trzy instrumenty finansowania ryzyka. Kombinacja tych instrumentów zależy od wielu czynników makro- i mikroekonomicznych danego państwa. Do tych ostatnich należą m.in. postrzeganie zagrożeń przez rolników oraz ich skłonność do korzystania z ubezpieczenia. W niniejszym artykule zadano następujące pytania: które z zagrożeń są w opinii rolników najważniejsze? Jak są one finansowane? Co wpływa na prawdopodobieństwo posiadania dedykowanego źródła finansowania strat w uprawach, tj. ubezpieczenia dotowanego upraw? Odpowiedzi udzielono na podstawie analizy statystycznej (testów niezależności) i ekonometrycznej (modelu logitowego) wyników reprezentatywnego badania przeprowadzonego w marcu 2012 r. metodą CATI na próbie 750 osób. Najważniejszymi zagrożeniami okazały się niekorzystne zmiany cen na rynku płodów rolnych oraz środków produkcji, a także ujemne skutki przezimowania i przymrozki wiosenne. Najczęściej wymienianym sposobem finasowania strat są środki własne. Najbardziej istotnymi czynnikami wpływającymi na poziom prawdopodobieństwa zawarcia umowy ubezpieczenia upraw są: położenie i wielkość gospodarstwa, uprawa rzepaku, posiadanie gleb bardzo dobrych lub dobrych, dotychczasowe finansowanie strat w uprawach z odszkodowania ubezpieczeniowego, występowanie w przeszłości strat z tytułu powodzi lub gradu, poczucie zagrożenia stratami związanymi z ujemnymi skutkami przezimowania. Istotną zmienną okazała się również zmienna reprezentująca opinię respondentów na temat konieczności i kosztowności ubezpieczania upraw.

Słowa kluczowe: ubezpieczenia rolne, zagrożenia w gospodarstwie rolnym, zarządzanie ryzykiem, model prawdopodobieństwa ubezpieczenia upraw.