

## DETERMINANTS OF TAKING OUT INSURANCE AGAINST LOSSES IN AGRICULTURAL PRODUCTION IN POLAND<sup>1</sup>

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Key words: agricultural insurance, risk in agriculture, farmers' risk aversion

*Słowa kluczowe: ubezpieczenia rolnicze, ryzyko w rolnictwie, awersja do ryzyka*

**A b s t r a c t.** Insuring agricultural production is one of the main tools of risk management in agriculture. In Poland it is still not popular, despite subsidies from the state budget. The paper tries to present determinants of farmer's participation in the insurance system. The analysis covered over 400 crop and mixed farms. The research was carried out in 2012 and refers to events that occurred between 2005 and 2011. It was revealed that reasons for taking out insurance are rather complex. The probability of buying insurance rises sharply if the farmer had faced significant loss in the past.

### INTRODUCTION

In all human activities risk factor should be taken into consideration, as it cannot be fully eliminated [Sztumski 1994]. Agricultural production is specific in a sense that it is exposed not only to risks faced by any other type of enterprise, but to weather factors, as well. For instance, crop farms may face catastrophic risks due to extreme weather conditions such as hail, droughts, frosts, floods, etc. [Langeveld et al. 2003 after Ogurtsov 2008], while animal farms are prone to catastrophic risks in forms of epidemics, such as BSE, swine fever, or other large scale livestock losses [Hurine et al. 2003]. Farmers can undertake various risk-coping strategies. Hardaker et. al. [2004] quote, among others, various ways of financing agricultural business, diversification of agricultural production, futures and forward contracts, and – last but not least – insurances.

The basic method of risk transfer is an insurance which can be broadly understood as saving money in case of unexpected loss [Willet 1901]. In a popular sense the term “insurance” means a financial instrument reducing financial consequences of risk for a certain unit (a person, a company or a farm) through „sharing” possible losses with oth-

<sup>1</sup> This research was funded under the project 3916/B/H03/2011/40: *Methods of Risk Measurement and Risk Reduction in Agricultural Production in Poland under Climate and Institutional Changes* supported by National Science Centre, Poland.

ers, who are compensated in some way for taking on the added risk [Vesper 2006], or, in other words, exchanging unsure but serious financial loss for rather low but definite cost (insurance premium) [Chmielowiec-Ronka 2003]. The general idea of insurances is based on the von Neumann's and Morgenstern's theory of expected utility [1953] that develops observations made in the 17<sup>th</sup> century by Daniel Bernoullie [Damadaron 2009]. Basically, it says that a risk-averse actor is willing to reduce his/her expected income in exchange for reducing faced risk to an acceptable level. Such behavior would bring higher expected utility than pure maximizing of income (or in some cases profit). In practice this mechanism can be observed in the case of insurance, where expected income is reduced by the sum paid as insurance premium.

An effective insurance market can operate only when certain conditions are fulfilled [Berg 2008, Green et al. 1981 after Ronka-Chmielowiec 2002]. The most important are the following:

- number and size of the objects should be sufficient to calculate probable losses,
- the occurrence of the loss has to be incidental and should not be intended by the insured one,
- possible occurrences have to be severe in terms of their consequences, and the losses should be measurable.

In agriculture the effectiveness of the insurance system is determined mostly by the types of insured risks and by the state policy supporting the system (the scope of state subsidies) [*Managing risk...* 2011]. One of the biggest problems in the agricultural insurance system is the asymmetry of information which leads to high transaction costs. In the case of systemic risk the possibilities of reducing these costs are quite broad and can be based on indexes (for instance assessing weather conditions influencing the level of yields) [*Managing risk...* 2011].

In Poland, in the times of centrally planned economy, insuring agricultural production was obligatory – that is the decision concerning financing the losses was shifted from the level of the farm to the state level. Since 1990, only insuring the buildings and liability insurance of farmers are mandatory. Consequently, insurance of movable property, crops, grasslands, cattle, and other animals became optional, causing withdrawal of the farmers from the insurance market [Klimkowski 2002]. As a result, at the beginning of this century only about 3% of area under crops and 4% of cattle was insured in Poland. However, farmers did not carry the whole risk, as a large amount of production risk was transferred to taxpayers; every large natural catastrophe was followed by a government post-disaster aid programme. This post-disaster aid soon became an important element of budgetary expenses, especially after floods in 1997 and 2001 and after drought in 2000 and 2003 [Kemény et al. 2014]. In 2005 a new legal act was introduced, putting on farmers obligation to insure at least half of the area under crops; at the same time the rules of subsidising premiums from the state budget were set [*Ustawa z dnia 7 lipca 2005 r. o ubezpieczeniach upraw rolnych i zwierząt gospodarskich*]. However, this legal act did not cause massive taking out insurances by Polish farmers. In 2013 there were only about 151 thousands of contracts concerning crop insurance in work, and about 307 thousands concerning animal insurances. Only about 3.4 mln ha of area under crops was insured [Szelągowska 2014], while total area under crops in Poland was as high as 10.3 mln [*Rolnictwo w 2013 r...* 2014].

The data clearly shows that the system of insuring agricultural production is not widely used in Poland. In such circumstances it seems important to find out the main factors determining undertaking (or not) insurance by the farmers. Such issues were not analysed in the context of agriculture in Poland, but they were discussed by scholars dealing with

agriculture in other countries. Among others, Ogurtsov [2008] analysed expenses on insurance premiums depending on the characteristics of Dutch farms specializing in crop or animal production. According to his findings, participation in the insurance system depended on the size of the farm (in this case operationalised as balance sheet value), geographical localisation, indebtedness, and the age of the farmer, while financial result of the farm was significant only in some cases. Researches carried out by Goodwin et al. [2004] and Sherrick et al. [2004 after Ogurtsov 2008] revealed, that the larger the farm is, the more prone to buy insurance its owner is. Moreover, Sherrick et al. [2004] found out, that farmers that rent more land are more willing to insure their crops. There were also other scientists that were looking for factors determining decision concerning buying an insurance. According to Mishra and Goodwin [2003] and Smith and Goodwin [1996 after Ogurtsov 2008] taking out insurance seems to be negatively correlated with the farm income. Except from features of the farm itself, some authors analysed characteristics of the farmer. Mishra et al. [2005] and Sherrick et al. [2004] found out that on average older farmers are more willing to buy insurance. The “age” as a potential determinant of insurance’ decision was a result of study by Ginder and Spaulding [2006] as well. According to these authors a level of risk aversion also determine decision whether to purchase insurance. In another research Shaik, Coble and Knight [2005] observed that farmers who faced greater risk in the past (yield or price risk) were more likely to buy revenue insurance. It is worth to emphasise that the literature doesn’t give any straight and universal answers concerning determinants of farmers’ insurance decisions. This issue seems still to be “undiscovered” part of the risk problem in agriculture, although a huge effort has been made. Probably the problem with clear identification of insurance decisions’ determinants is connected with different circumstances in which farmers living in different regions and countries operate. Therefore there is a need for research related to this issue in various parts of the world.

The purpose of this paper was an attempt to identify the determinants of farmers’ participation in agricultural insurance scheme in Poland. In other words, the authors of this paper will try to examine why Polish farmers are unwilling to insure their crops, basing on a research carried out in 2012 on a representative sample (described in more detail in the next subchapter).

## DATA

The study is based on data collected as a part of project supported by National Science Centre. Original sample consisted of almost 600 farms participating in polish FADN system. In order to assure representativeness of the sample, method of stratified sampling has been used. Sampling of the objects has been conducted in groups of farms specified by type of production and economic size of the farm. Taking into account concentration on the crops insurance issue, only farms in types connected with commercial crop production has been taken into consideration in this study, which made 405 farms: 75 crop farms (19%), 283 mixed farms (70%), and 47 vegetable and orchard farms (12%). Most of the respondents had professional or secondary education (about 40% each), while almost 14% higher, and 7% primary education. Their age varied from 22 to 71, with average 46, and a half of the sample between 40 and 53 years old. The questionnaire consisted of a set of questions concerning the farm itself, farmer’s characteristics, insurance practices, losses, and propensity to risk.

## RESULTS

In 2005-2011 almost all the respondents (97%) bought insurance for their buildings and liability insurance (or at least they claim so, because these insurances are obligatory), and about 3/4 decided to pay for insurance against accidents. At the same time above 65% of the respondents did not buy insurance for their crop production. Those who did so, chose mostly insurance against hail (50% of contracts), spring frosts (14%), drought and poor overwintering (10% each). At the analysed time, 35% of insured crops did not suffer from bad weather, so they were not eligible for claims. The remaining 65% of farmers applied for the compensation, but 17% were refused (that makes 1/4 of those who applied for it). In such circumstances it seems understandable that the farmers are reluctant to spend their money for insurance, if big share of the claims were rejected, however it is difficult to state what was the real reason of refusal and whether all conditions were fulfilled, as the farmers claim<sup>2</sup>.

The farmers that had not insured their crops said that the main reasons for that were too high premiums (46% of answers), problems with receiving compensation (17%) or both (such double answer was not included in the questionnaire, but during the interviews 9% of the respondents insisted on including both of them), and finally lack of risk factors that could be insured in their area (11%). For others reasons indicated 16% of farmers.

There is a statistically significant (test chi-square) but weak correlation between facing losses in 2005-2011 due to bad weather and insuring the crops in the same period (0,2 measured with the difference in fractions). Even though we have no hard data on the sequence of the events, we might assume that at least part of the farmers decided to buy insurance as a result of losses due to weather conditions. As for other factors determining undertaking insurance, the level of education seems to be insignificant, similarly as previous facing crisis situations not connected with agricultural production. Average age of farmers that took out insurance did not differ from those who did not (46 years old), and the distributions of age in these two groups did not differ one from another. Having children is statistically significant – those who have children tend to be less interested in insuring their crops than those who do not have. One of probable explanations is that those who have children have more short- and long term credits (78 thousand PLN, while childless about 65 thousand PLN on average) – either connected with the children's needs or with the stage of the life cycle of the farm. Differences in average indebtedness between farmers having children and those who do not is statistically significant. This issue should be addressed more deeply – either there is some hidden relation (for example organizational or psychological), or the correlation is just accidental. Surprisingly, further analysis revealed that average credits are much higher in the group that insured their crops than in the group that did not (on average 140 thousand PLN compared to 40 thousand PLN, respectively). To explain this issue, farmers' declarations concerning their relation to various types of risk were analysed (Tab. 1.).

It is clearly visible that the farmers who avoid taking credits at the same time tend to not insure their crops. At the first glance this seems counterintuitive, if we treat avoiding credits and taking out insurance as realizations of risk aversion. However, this kind of behaviour could be a deliberately chosen strategy: if one decides to take credit, he

<sup>2</sup> This issue needs further research and clarification. One of the possibilities is that some of the farmers did not fully understand the conditions of the insurance contract (these are usually written with specific, quite complex language), thus they were not aware of the fact that the claim was not eligible for the payment. In consequence, they were disappointed with the cooperation with insurance companies and could be reluctant to use such services in the future. Another possible answer is difficulty with exact assessment of the level of losses. There could be also an issue of unfair insurance companies.

Table 1. Relation between farmers' declared propensity to risk and taking out crop insurance in Poland. in years 2005-2011

Self-characteristics of the farmer	Average scores*		Standard deviation		Significance level for test of equal means
	crops not insured	crops insured	crops not insured	crops insured	
Generally likes to take risk	3.95	4.00	2.484	2.796	0.86
Is willing to risk while managing the farm	4.02	4.31	2.175	2.350	0.23
Keeps cash reserves just in case	6.16	6.22	2.804	2.974	0.86
Avoids taking credits	5.99	4.85	3.043	3.073	0.00
Avoids high specialisation on the farm	5.71	5.45	2.777	2.803	0.39
Introduces technological innovations	4.19	5.08	2.650	2.913	0.00

\* self-assessment of importance of specified statements in scale 0-10

Source: own research.

should at least insure his crops, otherwise the farm is exposed to extremely high risk of financial instability. „The risk that the existence of the firm will come to an end is of an entirely different type than the chance of making additional profit” [Carlo et al. 2001], so it requires special attention. On the other hand, we could just face two types of farmers in more psychological (or behavioural) sense: one group taking part in official financial market (credits, insurances), and the other one avoiding such activities. Similarly, those who insured their crops declared to introduce technological innovations – probably they are more open for external world and for new challenges than the other group. Those who do not insure their crops seem to be more traditional, less willing to try out new methods of farming, and to contact with financial institutions. Correlation analysis revealed, that those who are reluctant to take any credits usually try to keep cash reserves just in case (0,6). At the same time they avoid high specialization on the farm (0,7) and declare willingness to introduce technological innovations, even if their results were still unsure (0,7). Keeping cash reserves and avoiding high specialisation seem to be their ways of risk management (more traditional than participating in financial market).

The second stage of the research contained the use of logistic regression. Generally, this method is used if the dependent variable is binary. In such a case its values show the probability of a certain situation as a result of an influence of several explanatory variables [Stanisz 2007]. In this paper the authors have chosen the fact of undertaking insurance as the dichotomous dependent variable, while the independent variables will be possible determinants of such decision, including farmers' and farms' characteristics. The following variables were included in the analysis: soil quality, farm acreage, assets value, liabilities, intensity of production measured by expenses on fertilizers, pesticides, herbicides etc., farm income per hectare, farmer's age, number of years of being an independent farm manager, gender, level of education, having children, self-description of risk propensity, losses in plant production during previous 6 years. According to Wald's chi-squared test, only 5 variables came out to be statistically significant, thus later only they were included in the model:

- soil quality (SOIL\_QUALITY),
- facing loss in crops in years 2005-2011 (LOSS),
- farmer's attitude towards undertaking credit (measured on an 11-point scale) (CREDIT),

- having children (CHILDREN),
- fact of testing the quality of the soil (S\_TEST).

The final model was as follows:

$$P(Y) = \frac{e^{-1,54+0,61 * S\_QUALITY + 1,17 * LOSS - 0,95 * CREDIT - 089 * CHILDREN + 0,67 * S\_TEST}}{1 + e^{-1,54+0,61 * S\_QUALITY + 1,17 * LOSS - 0,95 * CREDIT - 089 * CHILDREN + 0,67 * S\_TEST}}$$

Detailed results of modelling can be found in Table 2. The model is statistically significant, because chi-squared statistic for the difference between this model and the model consisting only of intercept is significant at all levels ( $p = 0.0000$ ). The significance of the model is assessed by „-2\*log” statistics. The „-2\*log” value for this model equals 467.1 while a model consisting only of intercept equals 522. This suggests that the model is quite properly built [Stanisz 2008], even though the goodness-of fit is moderate (the differences between the two above mentioned models are rather small). Probably there are some other important determinants of undertaking insurance, that have not been identified in this model.

The coefficients situated by the variables cannot be explained in a straightforward manner. However, the signs (positive or negative) found before the coefficients undergo some interpretations:

1. The higher the quality of the soil on the farm is, the higher the probability of insuring the crops is. At the first glance this seems illogical, as soils of lower quality can face more risks such as drought, because of smaller ability to absorb water. In this respect it would be logical to insure crops on worse soils. In second thoughts, the yield on better soil is usually higher, so possible absolute losses are higher, as well. This could explain why farmers operating on better soils are more willing to insure their crops.
2. Facing losses during several years before the interview (variable „LOSS”) makes undertaking insurance more probable. This relation seems obvious, as farmers who had faced financial losses perceive future risks as more probable. Consequently, they are more willing to pay for the insurance of their crops, than those who see the risk as something abstract.
3. The higher the level of agreement with statement „I avoid taking any credits”, the lower probability of buying insurance. This relation has been analyzed before, while discussing correlations. Generally, there should be some latent variable concerning some type of passiveness on the financial/insurance market.
4. Having children makes buying insurance less probable. This relation has been discussed before as well, and no clear explanation was found.
5. Farmers who test the quality of the soil (S\_TEST) insure their crops more often than those who do not. Similarly as in the case of undertaking credit, we could explain it through higher activeness of the farmers; those who test their soils usually prefer more modern ways of managing their farms, while traditionalists are less willing to pay for the insurance.

Once the regression coefficients are interpreted, it is important to assess odds ratios (presented in Table 2), that is the quotient of the probability that certain situation will come true and the probability it would not, according to the following formula:

$$S(A) = P(A) / (1 - P(A))$$

where:  $P(A)$  stands for the probability that situation A will come true.

Table 2. Results of logistic regression

	intercept	S_QUALITY	LOSS	CREDIT	CHILDREN	S_TEST
Number of zeros (no insurance): 260 (64.7%)						
Number of ones (insurance): 142 (35.3%)						
Endogenous variable: INSURANCE						
-2*log(likelihood ): for this model=467.1 for model consisting only of intercept = 522.1						
Model's significance: Chi-squared. = 54.99 df = 5 p = .0000						
Estimation	-1.5397	0.6148	1.1799	-0.9497	-0.890	0.6685
Standard error	0.6337	0.3012	0.3494	0.3701	0.3321	0.2313
p-level (parameters' significance)	0.015	0.041	0.000	0.010	0.007	0.004
Wald's Chi-squared	5.90	4.165	11.40	6.58	7.18	8.35
p-level	0.0151	0.041	0.0007	0.010	0.007	0.003
Odds ratio	0.2144	1.8493	3.2543	0.3868	0.4105	1.951

Source: own research.

Theoretically, if the index of soil quality rises by one unit, the probability of buying insurance should rise by 1.8 (other variables constant). Those who had faced losses are over three times more probable to undertake insurance, than those that had not. If a farmer's aversion towards undertaking credit rises by one point, the probability of paying premium should be declining by 38%. Having children makes buying insurance less probable by 41%, while testing soil quality rises it by 195%.

## CONCLUSIONS

The determinants of undertaking insurance by Polish farmers are rather complex. Only one reason is obvious – those who had faced losses due to bad weather conditions are more willing undertake this form of risk management. Higher propensity to insure crops observed among those who have better soils could be explained by potentially higher losses in case of a disaster. Moreover, high rate of rejecting claims by insurance companies can be also an important factor discouraging farmers from signing insurance contracts. The farmers themselves stake the problems with receiving compensations and - in their opinion – too high premiums.

The other factors are not so clear. Some variables that came out to be significantly connected with the issue (taking credits, testing soil quality) can be seen as proxies for some characteristics of the farmers' attitudes, that is openness for cooperation with financial market or more modern way of farming. Surprisingly, there is no statistically significant relation between farmer's self-description of risk propensity and the fact of production insurance use. There can be two theoretical explanation of the fact. One is potentially misleading farmers' declarations about their real attitudes towards risk – it cannot be excluded that they are less risk averse than they claim (either because their self-perception is different than the reality, or that for some reasons they were not fully open with the interviewer). Another reason, particularly in the context of significance such variables like "CREDIT" (taking credits) and "S\_TEST" (soil testing), can be general farmer's attitude toward his

profession and farm. The results suggest, that crop insurance use is rather one of active farmer's features than the indicator of his (at least declarative) risk aversion level. However this needs much more detailed sociological research.

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*CZYNNIKI DETERMINUJĄCE KORZYSTANIE Z UBEZPIECZEŃ PRODUKCJI ROLNICZEJ  
W POLSCE*

*Streszczenie*

*Ubezpieczenia produkcji rolniczej stanowią jedno z głównych narzędzi zarządzania ryzykiem w rolnictwie. Zakres ich stosowania w Polsce pozostaje ciągle niewielki, pomimo wsparcia systemu ubezpieczeniowego z budżetu państwa. W artykule podjęto próbę identyfikacji czynników mogących determinować fakt uczestnictwa rolników w systemie ubezpieczeń. Badania przeprowadzono w 2012 roku, a zebrany materiał dotyczył sytuacji z lat 2005-2011. Badaniami objęto zbiorowość ponad 400 gospodarstw prowadzących produkcję roślinną i mieszaną. Przeprowadzone analizy sugerują dużą złożoność uwarunkowań stosowania ubezpieczeń produkcyjnych. Bezdiskusyjnym czynnikiem zwiększającym prawdopodobieństwo korzystania przez rolników z ubezpieczeń okazało się poniesienie straty w przeszłości.*

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