STUDY ABOUT THE USAGE OF AGRICULTURAL INSURANCE BASED ON INDEXES IN ROMANIA

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Abstract: *In spite of the development possibilities, the agriculture in Romania is becoming a risky environment, because of the extreme weather events but also because of the lack of organization and the lack of involvement of the authorities in diminishing their effects. We can say that the performance of this sector, as well as its efficiency, depends directly of the competence of the government, the agricultural producers and the insurance agencies to reduce the specific risk for which is necessary a constant level of investment. The most used method in reducing the agricultural risk is multiple insurance, but, this insurance product does not benefit of the attention that it is worthy of, mainly because of the reduced level of income from the rural area as well as the deficient infrastructure. The high level of complexity of harvesting agricultural exploitations, the breeding of animals as well as the conditions in agriculture has made the evolution of activities in this domain to be increasingly harder, reason why there is a search for new options to reduce/eliminate risks at which the agricultural producers are exposed to namely the proposal of implementing insurance based on indexes. The purpose of the study consists of presenting a new tool in view of developing agriculture and agricultural insurance, thus new tools are being added to the ones and they bring two new attractive characteristics namely they eliminate many of the existent problems in traditional insurance of agricultural crops (moral hazard, adverse selection, bigger costs of transaction), making them more viable and less dependent on public subventions, thus being a new and useful instrument which is being added to the instruments that the Romanian government has at its disposal to manage the risks in agriculture better and more efficiently. Insurance based on indexes can help at avoiding the unwanted risks specific to this sector. This, combined with other improved instruments of managing risk, either ex ante (better irrigation systems, better adapted breeds, better plans for flood prevention, better counselling services) or ex post (improvement of offered services from insurance agencies) are powerful instruments for efficient managing of risks in agriculture.*

Keywords*: agricultural insurance; insurance based on indexes; agriculture.*

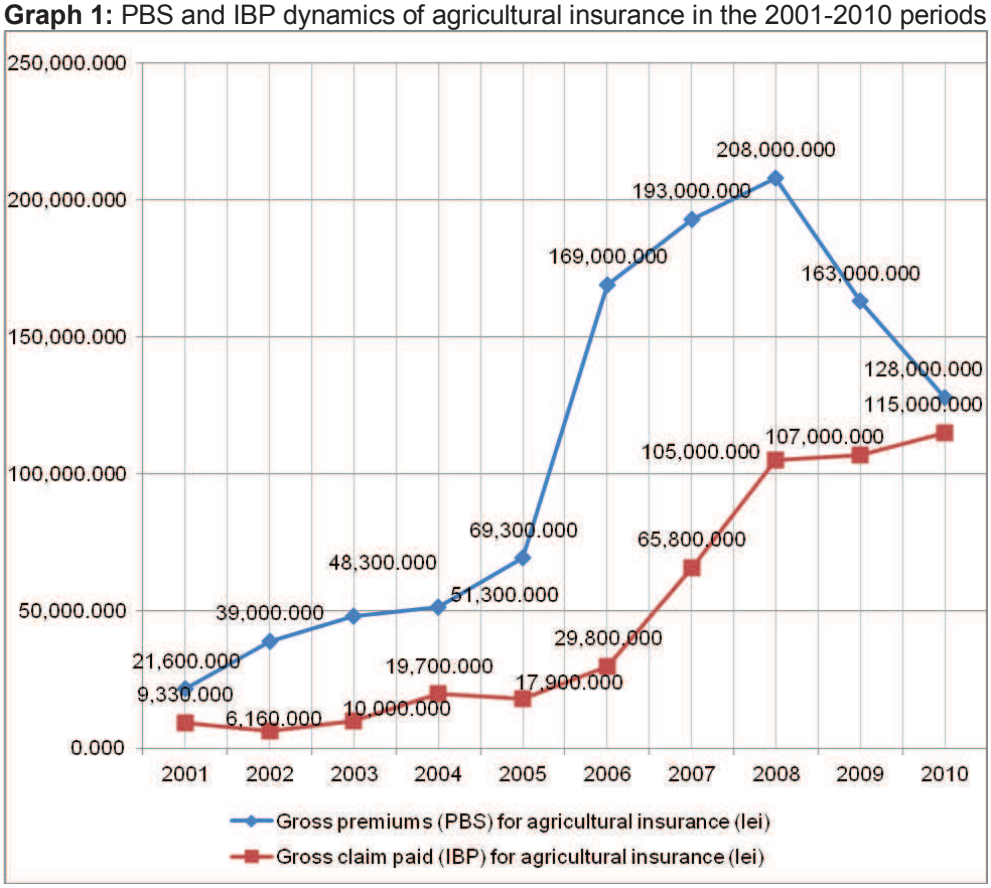
JEL classification: *G10; G22; Q14.*

1. Introduction - The Necessity of Finding new Development Alternatives for Agricultural Insurance

The most popular managing tools of agricultural risks are agricultural insurances which implies the transformation of a big expense, uncertain and in the future (pay) into an anticipated expense, certain and much diminished (insurance bonus). (Booth et all, 1999) Agricultural insurances are seen as one of the best strategies for approaching agricultural risks and to encourage farmers to embrace modern

practices of production with a big potential for better efficiency and better quality. (Olubyo SO et al., 2009) One of the main benefits of insurance is the fact that it allows the balancing of the incomes of the insured as many times as an adverse event happens. (Arrow 1971; Rothschild and Stiglitz, 1976). With all the obvious benefits of traditional agricultural insurance for agricultural producers, their development is inhibited by moral hazard (Goodwin & Glauber 1997) and the lack of long term data about agricultural production to be able to compute with precision a correct insurance bonus (Ozaki A., 2009).
Thus, in theory, agricultural insurance is efficient, but, while applying them we can see a contradiction, according with Graph 1.

Graph 1: PBS and IBP dynamics of agricultural insurance in the 2001-2010 periods



Source: Author processing

As we can see, traditional agricultural insurance is ineffective because they are expensive for the government which bears the considerable costs by granting insurance to stimulate farmers to eliminate/diminish the risks at which agricultural exploitations/ animal effectives are subject to as well as for the insurance agencies after the fact that the collected gross bonuses are much smaller than the allowance paid (according to Graph 1), the damage rate being constantly going up which

transcribes to a considerable loss on this segment, facts from which results that traditional agricultural insurances are not efficient.
In this context, new alternatives have to be found for transferring meteorological risks to insurance agencies by appealing to new agricultural insurance techniques which will revive this insurance segment, aiming in this purpose, insurance based on indexes.

2. Empiric Study About the Efficiency of Implementing Insurance Based on Indexes in the South of Romania for Harvesting Wheat.

The World Bank introduced insurance based on indexes in several countries under development, including Morocco, Mexico, and Ukraine, Mongolia (Skees, Varangis and Larson). The objective of this article is to prove that if the implementing of them would be or not efficient in managing the risks for wheat harvesting by the agricultural producers from the south of Romania.
In this sense, we followed in a systematic mode, the following aspects:

2.1. Reasoning the object pick for the contract of insurance based on indexes, as well as the selected analysed region

In view of determining the most important cereal cultures from Romania, in table 1 we presented the evolution of the production of agricultural cereals from the 2007-2011e periods (2011e - approximate date for the year 2011)

Table 1. Agricultural productions of cereals from Romania (mil. Euros), in the 2007-2011e periods

Components	2007	2008	2009	2010	2011
Wheat	549,2	1.278,6	559,3	775	1438,3
Rye	4	5,6	3,7	4,7	6,1
Barley	102,2	258	153,4	177,7	294,7
Oat	56,6	103,6	47,8	57	93,8
Corn	894,4	2.141,4	1256,4	1517,2	2752,2
Rice	9,7	13,4	11,9	12,3	22,8
Other cereals	12,3	18,6	10,3	15	28,5
Cereals (mil. euro)	1.628,3	3819,2	2042,6	2558,9	4636,3

Source: Eurostat, Economic accounts for Agriculture (values at current producer prices), Updated: November 2010 (for the dates from 2007, 2008) and November 2010 (for the dates from 2009-2011e)

We can easily observe that the cereal production is dominated by corn, wheat and barley. From the estimated data for the 2011 year, we can find that corn counts as 59.36% from the cereal total, wheat for 31.02% and barley for 6.36%, in total counting for 96.74% from the market of cereal production.
The main cereal cultures from Romania are those of corn and wheat, being cultivated on extended areas but in the same time registering important losses, reason why, in our study we opted for wheat as a reference culture in the view of analysing the efficiency of implementing insurance based on indexes in Romania because it is one of the most important plants harvested having a great weight in the food industry, and at the same time it is an important economical factor; because of its toughness

against less favourable environmental factors, the culture area of wheat being bigger than the corns.
As well, we picked the South-Muntenia and South-East Region of Romania, because as we can see in table 2 the harvested quantity of wheat is much bigger compared to the other regions and at the same time its production effectiveness is smaller in the Vest Region (with 16.2% smaller than the South-Muntenia and with 20.4% than the South-East), which means a bigger rate of loss that being another argument in favour of picking this region in the analysing of the implementation of insurance based on indexes in Romania.

Table 2. The harvested quantity and the harvested wheat productivity (1995-2009 average)

Region	Quantity harvested (1000 t)	Productivity (100 kg/ha)
Nord-West	457,5	27,5
Centre	347,5	27,6
Nord-East	471,2	23,7
South-East	1008,6	24,1
South-Muntenia	1474,1	25,4
Bucharest	56,4	24,2
South-Vest	965,5	23,5
Vest	751,7	30,3

Source: http://epp.eurostat.ec.europa.eu

2.2. The analysis of the relation between everyday temperatures and annual productions of wheat

In our study we will analyse the most harvested species of wheat from Romania which is the autumn wheat (Triticum aestivum), this being distinguished by a vegetation period of 9 months (270-290 days), in this interval the plants going through phenology fazes. The elaboration of insurance based on indexes contracts needs to have in view the particularities of the insured harvest to be able to reduce the probability of bad classification, mainly because of moral hazards or/and adverse selection. Thus, we analyse the relation between daily temperatures and annual wheat production.
An important aspect of insurance based on indexes is area risk. More specifically, the efficiency of using insurance based on indexes is followed based on registered temperatures on a referential station on an extended area. In consequence, as the surface on which the same type of insurance is applied gets bigger, the costs are smaller and the profitability is bigger, being conditioned by a correct classification of allowances.

2.3.The evaluation of historic time series and the placement locations of meteorological stations

In our study, we pick as a reference the meteorological station from Bucharest and as auxiliary meteorological stations the ones from Rosiorii de Vede (100km from Bucharest), Craiova (220km from Bucharest) and Drobeta Turnu Severin (354km from Bucharest) from which we collected daily dates from the 1971-2010 period and which we classified on the time interval to which wheat production cycles they

correspond (10.10.N – 10.07.N+1), the aim of the study being that of analysing the area differences between the reference location and the locations where we implemented the insurance based on indexes product.
In this case, the data's are collected by INMH, the analysed period being 1971-2010 with daily date from the October 10 – July 10 interval, summing up to 39 years of production. The corresponding time series for Cravoia contained missing data for the year 1972 for May, which were replaced by the average collected data registered at Bucharest and Rosiorii de Vede, on the same time period. We are considering that the quality of the analysis is not affected by short the undocumented period (31 days from a total of 10.969 days).

2.4. Establishing, presenting utilised static methods and data processing
The trigger event of insurance allowance on the insurance based on indexes case, is being represented by the passing of a strike level (bar, it represents that value of the specific coefficients from which the contract is executed and the pay is being made) looking at the average daily temperatures according to the calculus relation number (1). The strike level is agreed based on the phenology phases of wheat cultures, presented in table 3. The minimum and maximum temperatures are registered at the reference and auxiliary meteorological stations.

$$Allowance = \begin{bmatrix} 0, if X < strike \\ 1, if X \geq strike \end{bmatrix}, \quad (1)$$

Where the strike level is agreed in the insurance contract,

$$\bar{T}_i = \frac{T_i^{max} - T_i^{min}}{2} \quad (2)$$

where,
$\bar{T}_i$ – the arithmetic mean between the maximum temperature (T_i^{max}) and the minimum temperature (T_i^{min}) of the day "i"

Table 3. The strike levels on time intervals

Phenology phases	Time interval	Optimum interval of temperature (Co)	Strike level (Co)
Sprouting-Rising	10/10 – 15/11	12-20	21
Twinning	16/11 – 25/12	8-12	13
Hardening	26/12 – 10/02	5	6
Idle period	11/02 – 20/03	8-10	11
Stuffed	21/03 – 30/04	15	16
Earing	01/05 – 15/06	16-18	19
Blooming	16/06 – 10/07	18-20	21

Source: Author processing according to date gathered from specialty literature

For a more profound analysing of implementing insurance based on indexes in the South of Romania for wheat cultures, we took into consideration the Pearson correlation coefficient which will be presented in detail next.

Pearson's correlation coefficient

This coefficient gives a measure of linear dependability intensity between two variables and has the next calculus relation:

$$r(X,Y)=\frac{\operatorname{cov}(X,Y)}{\sigma_x\sigma_y}=\frac{M(XY)-M(X)M(Y)}{\sigma_x\sigma_y}\in[-1;1] \quad (3)$$

The coefficient gives the direction and intensity relation between quantity analysed variables. A negative coefficient proves a reverse association while a positive one proves a direct association. The signification tests for this coefficient accept or reject the following null hypothesis: the discovered relation is incidental.

In table 4 we will analyse the meteorological correlation between the considered location, at a temperature level from which we can find that there are strong considerable ties between registered temperatures measured at the mentioned locations, but, the correlation coefficient between Bucharest and the other towns drops as the distance gets bigger (Roșiorii de Vede .990**, Craiova .982**, Drobeta Turnu Severin .979**).

Table 4. Pearson correlation coefficients between the location considered in the study, at a temperature level

		Bucharest	Craiova	Roşiorii de Vede	Drobeta Turnu Severin
Bucharest	Pearson Correlation	1			
	Sig. (2-tailed)				
Craiova	Pearson Correlation	.982**	1		
	Sig. (2-tailed)	.000			
Rosiorii de Vede	Pearson Correlation	.988**	.990**	1	
	Sig. (2-tailed)	.000	.000		
Drobeta Turnu Severin	Pearson Correlation	.972**	.989**	.979**	1
	Sig. (2-tailed)	.000	.000	.000	
**. Correlation is significant at the 0.01 level (2-tailed).					

Source: Author processing after the obtained data from INMH

The corresponding Sig. value equal to 0.000 shows that a significant correlation coefficient has been obtained at 0.01 thus there are smaller than 1% chances of making a mistake when we say that between the analysed locations, at a temperature level, there is a significant correlation. We can conclude that the analysed locations are correlated from a registered temperature point of view.

The obtained results of Pearson's correlation coefficient highlights the viability of insurance based on meteorological coefficient products, proving that their use is justified because of the high correlation coefficients, but, an analysis about the risk area needs to be made to evaluate the efficiency of this type of insurance.

Conclusions

A country's agriculture may be in danger from bad weather which can't be controlled but in a small matter while they can have major impacts on the realised production. The present risks in agriculture represent a challenge, especially for small farmers that don't have an insurance culture. (Johnson 1993:35-51) showed that lots of farmers estimate badly their probable losses, not being able to approximate correctly if an insurance contract is right for them or not.

Based on the data analysed above we can confidently say that the area risk is an essential component which needs to be considered while creating insurance based on indexes contracts. A high level of area risks can reduce the appeal of the insurance products in areas affected by adverse meteorological effects.

The performed analysis also proves the flexibility of contracts based on indexes, (which opens new research directions) for example they can change the reference location so that the area risks can be reduced and the insurance product can be no longer profitable. Contracts can be made by introducing a minimum period of passing the strike level, for example the pay of the allowance could be triggered just after 5 days have passed of passing the strike level agreed in the contract. Another advantage of these types of insurances is that they can be combined in more insurance products for covering more meteorological risks like excessive rain or highly diminished level of precipitations in the winter, fact which in the case of wheat can influence the production by affecting the toughening process.

Despite the importance and necessity of implementing agricultural insurance based on coefficients, as an alternative of development of agriculture and agricultural insurance, I consider that the realisation of them will be delayed because of the lack of implication from the insurance societies and reglementation authorities from the area (The supervising committee of Agriculture and the Department of Agriculture)

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