THE IDENTIFICATION AND EVALUATION OF SOME NATURAL RISKS COVERED BY THE INSURANCE IN A RURAL ECOSYSTEM

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REZUMAT.În această perioadă, cu schimbări majore ale climei, problemele economice şi manageriale, în ceea ce priveşte producţiile agro-alimentare, sunt dependente profund de condiţiile de mediu. Precipitaţiile sunt unul dintre efectele cele mai importante, de mare impact în producţia agricolă dar şi pentru calitatea produselor alimentare. Analiza perioadelor de precipitaţii în exces se poate face folosind metoda anomaliei standardizate şi ponderate a precipitaţiilor (SPPA). Percepţia în cazul unor perioade cu surplus pluviometric este cea a unui risc hidrologic major, din cauza modului violent sau progresiv de manifestare, în timp ce seceta este percepută ca fiind fenomen mai puţin dăunător. Studiul de faţă analizează anumite elemente principale de asigurare a ecosistemelor rurale, elementele asigurabile, riscurile asigurate, posibile excluderi şi mecanismul de executare al acestor contracte de asigurare, ca elementele cele mai adecvate şi compatibile, pentru a construi o bază solidă, de la care se poate constitui un sistem integrat de forme de asigurare, precum şi de forme de asigurare obligatorie.

Cuvinte cheie: climat, precipitaţii, anomalii.

ABSTRACT.In this period, with major changes of the climate, the economical and managerial problems concerning agro-food productions are in deep connection with the environmental conditions. The precipitations are one of the most important factors great impacts in the agricultural production and in the quality of the food products. The analysis of the excess rainfall periods can be done using the method of the standardized and ponderate rainfall anomaly (SPPA). The perception in case of periods with pluviometrical surplus is that of a major hydrological risk, due to the violent or progressive way of manifestation, while the droughts are perceived as being less harmful phenomena. The present study analyse certain main elements of the rural ecosystems insurance, namely the insurable items, the insured risks, the possible exclusions and the execution mechanism of these insurance contracts, in order have the most appropriate and compatible elements for building a solid groundwork from which to constitute an integrated system of insurance forms as well as the compulsory insurance forms.

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Key wods: climate,,precipitations, anomaly

1. INTRODUCTION

In the temporal and spatial analysis of the periods with pluviometrical surplus, certain difficulties that have to do with determining the control variables and the threshold values used might occur, difficulties generated by the complexity of the phenomena of interest.

The periods with excess rainfall represent a risk that often has a local spread, unlike the periods with scarce rainfall, when the areal spread is great, and the trigger action and evolution are slow. The perception in case of periods with pluviometrical surplus is that of a major hydrological risk, due to the violent or progressive way of manifestation, while the droughts are perceived as being less harmful phenomena.

The insured risks, which are usually covered by the majority of insurers through optional insurance contracts, are the action-result of natural factors of risk: hailstone; hoar-frost (late spring frost and early autumn frost, respectively); torrential rains; storms, hurricanes, tornadoes; landslides and the collapses of cultivated fields; fire induced by natural electrical discharge (thunderbolt and lightning).

In the case of insurance in the rural ecosystems, where such insurance is directed only towards the production side and the quality increase, the damages which may occur are indemnified only for the quantity and quality type of losses suffered by harvests and only for the base product of the crop (Udrea N. M., 2011). Thus, for stalk crops, damages are granted only for the losses caused to seeds. In case of torrential rain, damages are granted both for losses caused by the direct consequences of the downpour, meaning the washing away of seeds or the soil around the plants, denudation of roots, the silting caused by torrents, uprooting plants with or without the soil around them and so forth, as well as for the indirect consequences like pooling, water overflowing that damages the respective crops, collapses, landslides involving the agricultural crops. In the case of hailstone, the risks of destruction or damages to plants following the mechanical consequences of hailstone or ice formed at the stem base of the plants have to be considered. The

insurance in the rural environment functions as a business oriented condition.

2. METHODOLOGICAL ASPECTS

The analysis of the long range of data provides an overview regarding the succession of the periods with pluviometrical surplus in the Sibiu area. This approach allows the identification of a possible ciclicity of the episodes with flooding and of those with droughts.

For Sibiu we have data concerning the monthly rain quantity for the period 1851-2010. The analysis of the excess rainfall periods can be done using the method of the standardized and ponderate rainfall anomaly (SPPA). For calculating the SPPA it is necessary to determine the standardized rainfall deviation (SPA).

The standardized rainfall deviation (SPA) represents the difference between the rainfall quantity from a certain time interval and the multiannual average related to the standard deviation. SPA is calculated using the formula:

$$SPA = \frac{x_i - xmed}{\sigma_l} \quad (1)$$

where x_i is the element in the range

x_{med} is the average of the range

σ is the square average deviation

The standardization of the rainfall quantities for different intervals of time can easily be done, this being the main advantage of this method.

Standard deviation is calculated using the formula:

$$\sigma_l = \sqrt{\frac{\sum_{i-1}^{n} (x_i - x_l)^2}{n-1}} \quad (2)$$

and the standardized and ponderate rainfall anomaly (SPPA) is calculated using the formula:

$$SPPA = SPA \times W \quad (3)$$

where: *SPPA* is the standardized and ponderate rainfall anomaly

SPA is the standardized rainfall deviation

W is the fraction of the month from the annual rainfall average

$$W = \frac{x_l}{x_a} \quad (4)$$

The disadvantage of this method comes from the fact that for intervals shorter than or equal to 12 months, the distribution of the values is not a normal one, being confined by the 0 mm rainfall threshold. This has been clearly shown by the comparative study of the excess and scarce rainfall periods.

Evaluating the risk and uncertainty within the ecosystems protection analysis is of great interest with respect to the decision making for the prevention of the negative consequences generated by various risk factors. The appearance of risk4 is reflected by weighing the unfulfillment coefficient of the potential production with the frequency coefficient of the unfavourable years, based upon the following relation:

$$R = \frac{KxF}{100} \quad (5)$$

where: R – represents the risk coefficient;

K – represents the ratio between the sum of the unfulfilled products and the sum of potential products, within a specific time frame, adjusted with the probable productivity increases resulted from the qualitative increase of the crop kind;

F – represents the ratio between the number of unfavorable years and the number of total number of year from the analyzed time frame.

3. RESULTS AND DISCUSSIONS

In the 45 years that have been analyzed in this study from a pluviometrical point of view, there were numerous cases of excess or scarce rainfall, that have often had effects on the environment and the socio-economical life of Sibiu.

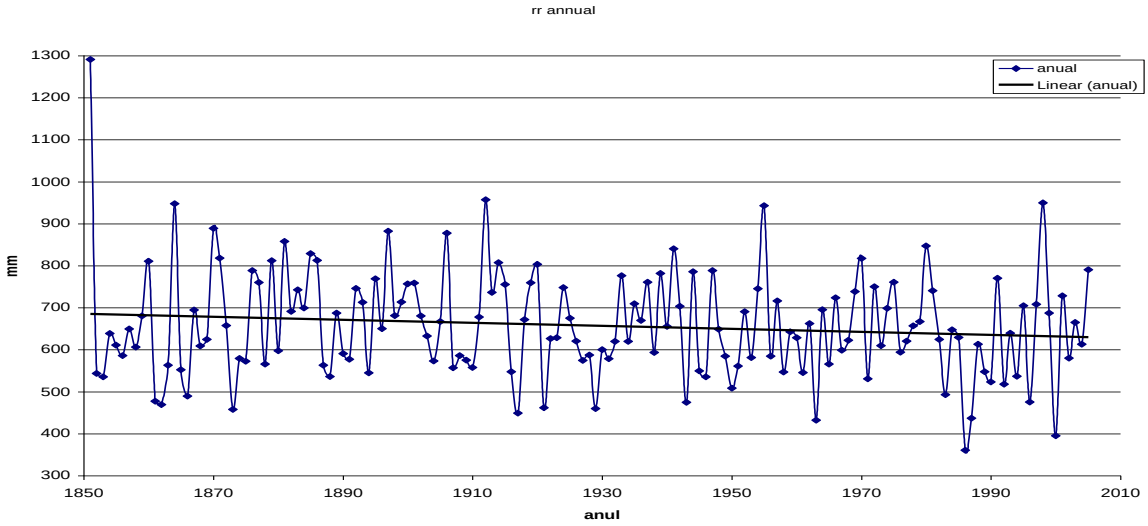

Fig. 1 *The multiyear variation and the trend of the precipitations quantity in Sibiu between 1851 and 2010*

The periods with pluviometrical surplus represent a risk that often has a local spread, unlike the periods with pluviometrical deficit, when the areal spread is great, and the trigger action and evolution are slow. The perception in case of periods with excess rainfall is that of a major hydrological risk, due to the violent or progressive way of manifestation, while the droughts are perceived as being less harmful phenomena (Sorocovschi V., 2002). In order to determine the type of pluviometrical regime, it has been analyzed the rainfall quantity registered in Sibiu in February and June, between the years 1961 and 2010. These months have been chosen because of their extreme pluviometrical characteristics. According to the intensity classification of the standardized deviations from the average, there are:

- moderately droughty periods (SPA between -1,0…-1,49)
- very droughty periods (SPA between -1,5…-1,99)
- extremely droughty periods (ASP between -2,0…-2,5)
- exceptionally droughty periods (ASP < 2,5)

In order to determine the intensity of the periods with pluviometrical surplus, the identification criteria are:

- almost normal periods (ASP between -0,99…+0,99)
- moderately wet periods (ASP between +1,0…+1,49)
- very wet periods (ASP between +1,5…+1,99)
- extremely wet periods (ASP between 2,0…2,5)
- exceptionally wet periods (ASP > 2,5)

In the interval between 1961 and 2010, in June 2001 there can be noticed in Sibiu values of the SPA that drop under -1.5 thus being characteristic for a very droughty regime. Otherwise, the index varies in between the values of a rainy regime (+1,5) and those of a droughty one (-1,5).

Out of the 50 years from which the months of June have been analyzed from a pluviometrical point of view, 12 months are characterized by a normal regime, in 14 of the cases there have been reported rainy months of June and in 19 of the cases the months have been droughty. The quantity of precipitations in Sibiu area has also been analysed (Spânu Simona, 2007) with the help of the standard anomaly and the standardized and ponderate precipitations anomaly (SPPA), a method that is widely spread because of the significant results it generates and that is recommended by the World Meteorological Organization in the study of droughts and periods with pluviometric surplus (Table1).

Table 1. *Thresholds, qualificatives and associated types of risk according to the values of the standardized anomalies in Sibiu area for the interval 1961-2010*

SPA value	Qualificative	Frequency			Associated type of risk
		Sibiu	Păltiniş	Agnita	
<- 2,5	Very dry intervals	-	-	2%	Major risk
-2,5...-1,51	Dry intervals	-	-	4%	Medium risk
-1,5...-0,51	Slightly dry intervals	9%	24%	16%	Low risk
-0,5...0,5	Normal intervals	82%	47%	58%	No risk
0,51...1,5	Slightly rainy intervals	9%	11%	20%	Low risk
1,51...2,5	Rainy intervals	-	7%	-	Medium risk
>2,5	Very rainy intervals	-	11%	-	Major risk

In the 50 years that have been analyzed, the frequency with which the precipitations have been recorded according to different risk classes denotes that in Sibiu only a low risk through deficit and surplus is manifested, in Agnita the extreme values with medium and major risk are of deficitary nature, and in Păltiniş the extremes with medium and major risk are characteristic to the surplus quantities (Table 2).

Table 2. *Frequency of pluviometric qualificatives based on the ASPP value for the interval 1961-2010 in Sibiu, Păltiniş and Agnita*

SPPA value	Class symbol	Sibiu %	Păltiniş %	Agnita %	Qualificative of pluviometric class	Pluviometric domain	Group of pluviometric risk
≥ 3,00	P4	-	-	-	Extremely rainy	rainy	Pluviometric risk through surplus
2,00...2,99	P3	-	2.2	-	Very rainy		
1,00...1,99	P2	8.9	4.4	-	Moderatly rainy		
0,51...0,99	P1	4.4	11.1	13.3	Slightly rainy	normal	No pluviometric risk
-0,5...+0,5	N	77.8	69.0	80.0	Normal		
-0,51...-0,99	S1	8.9	13.3	6.7	Slightly dry		
-1,00...-1,99	S2	-	-	-	Moderatly dry	droughty	Pluviometric risk through deficit
-2,00...-2,99	S3	-	-	-	Very dry		
≤ -3,00	S4	-	-	-	Extremly dry		

Through the synthetic description of pluviometric anomalies (magnitude) the periods with surplus, respectively those with pluviometric deficit could be gradated. Thus it is noticed that the greatest positive magnitudes characterize the mountain region, while the lowest negative magnitudes are recorded in the plateau region (Table 3).

Table 3. *Frequency of cases (%) based on the SPPA magnitude for the interval 1961-2010 in Sibiu, Păltiniş and Agnita*

Magnitude value/Station	Positive magnitude			Negative magnitude		
	Sibiu	Păltiniş	Agnita	Sibiu	Păltiniş	Agnita
below 4,99	31,1	20,0	28,9	2,2	2,2	2,2
between 5,0-9,99	62,2	71,1	60,0	77,8	82,2	82,2
over 10,0	6,7	8,9	11,1	20,0	15,6	15,6

The greater frequency of the negative magnitudes with high values denotes once again the general decrease tendency of the quantity of precipitations. The events with major pluviometric surplus, added to the average ones, barely manage to reach the frequency of the ones with average negative magnitude. Instead, the cases with average negative magnitude, added to the ones with high magnitude represent 98% of the total of analyzed values in the interval 1961-2010 (Spânu Simona, 2008).

The direct effect of precipitations on crops is determined by the nature and quantity of precipitations (Moise Cristina, 2011). Mainly, precipitations have an effect on the seeds germination, process that is directly affected, in a negative manner, if the precipitations are in excess or are not abundant enough. For the crops, the maximum yield is given by the precipitations that fall during the phenophases that are critical for their growth, phases in which the water intake is high. If the necessary water limits are exceeded, plants are exposed to a hydric stress which affects the quantity and quality of the harvest. There also are processes that cannot take place in the absence of water in the soil, or in a situation with water surplus, as in the case of the germination.

During the plants' florescence period, precipitations can be harmful, because they interfere in the process of fecundation, by washing away the pollen. Downpours also exert a mechanical action on the plants, leading to the rootedness weakening or the uprootal of plants, especially if the precipitations are accompanied by wind intensifications. If the rain drops have a great diameter, they can shake down flowers, fruits, and seeds before their ripening and can cause the covering up with earth of small plants, thus stopping their growth. An abnormally great quantity of precipitations can lead to floods, which cause the suffocation of plants, the decrease in the quantity of dry matter in the plant, also reducing the capacity of the plants to resist to the attack of diseases and pests (Bogdan A. T., 2010). If the precipitations are not in a sufficient quantity or are not at all present during the period in which the vegetation absolutely needs them, the plants stop growing, fade, get dry and die.

The snow layer has a great importance in the growth and development of plants, by acting during the winter as a thermic insulator for the autumn cultures. In spring, through the snow melting, the water supply in the soil is ameliorated. The temperature variations of a soil that is covered in snow are much smaller than the ones of a soil lacking a snow layer. The sudden snow melt generates large quantities of water both at the surface of the soil, and deeper, which often leads to the flooding of cultivated areas (Iagăru Pompilica, 2010). If the snow falls on a frozen soil, and the culture has a rich foliar mass, the lack of oxygen occurs, which creates unfavourable wintering conditions, as it happens in the case of the autumn wheat. Precipitations in the form of hail are very harmful for the vegetation, because they break the aerial part of the plant, causing lesions which affect the plant and where diseases can get installed. The damages caused to crops are directly proportional with the diameter of the ice particles, and with the intensity and duration of the hail. Hail is more frequent in Sibiu Depression, as compared to the higher regions of Sibiu area, this being an effect of the area's high level of habitation.

In rural ecosystems, determining the risk zones and the economically certain areas for a particular crop is made depending on the average values of the incomes, expenditures and profit. The production and risk variation, within a particular area, also imposes the consideration of the standard deviation, which characterizes the differences between deviations (plus or minus) from the average levels of the analysed indicators.

4. CONCLUSIONS

The effects of the precipitations surplus, but even more those of the precipitations deficit, are especially felt by the agriculture, the working sector that is most sensitive to climatic conditions. With respect to the insurance period, for rural ecosystems the insurance contracts can be concluded anytime during the agricultural season, within the timeframe of that particular business year.

The insurance period is the strict concern of the insurance companies, the actual time between the entering into effect, commencement of liability and the termination of liability (Udrea N. M., 2011). Concerning the commencement of insurer’s liability,

the exact date differs from company to company, starting from a certain number of hours or days, counted from the end of the day in which the contract was concluded and the insurance premiums were paid. Also, this starting date differs depending on the risks insured and type of crops insured, for example: for seeded agricultural crops, liability starts as soon as the plants have sprouted (for the damages caused by hails, storms and fire) and liability also starts from the moment of seeding (for the direct or indirect damages from torrential rain, collapse of soils or landslides). In the case of grapevine fruit and hop crops, the insurer's liability starts for all the insured risks from the moment of flowering or, depending on the case, from the appearance of the plants' inflorescence.

The liability of the insurer will terminate from the moment of harvesting. For the crops that necessitate threshing, the fire risk liability will terminate at the end of the threshing process. The main obligation of the insured party is to maintain the crops in good condition, in accordance with agrotechnical requirements, to take measures for preventing damages or losses to crops, plantations, as well as measures to limit the damages to crops and salvage them after the occurrence of an insured event (Udrea N. M., 2011). In the case of the urban ecosystems insurance, certain nuances emerge, tied to the fact that in a particular perimeter, a variety of plants may be present and the measures to protect and sustain them have to be taken in accordance with the requirements of each species of plant. These measures have to be sustained for the whole respective insured year (Cistelcan L., 2002).

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