PRESENT ENVIRONMENT AND SUSTAINABLE DEVELOPMENT, NR. 1, 2007

THE NECESSITY AND OPPORTUNITY OF THE PROTECTION FROM HAILSTORMS IN THE DEPARTMENTS OF VRANCEA AND GALATI

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Key words : *departments of Vrancea and Galati, hail*

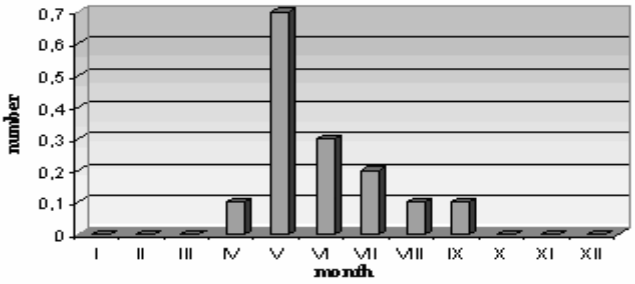
Résumé:*L'étude au sujet mentionné présente un étalage scientifique de la manière selon laquelle se produisent les phénomènes de grêle dans les départements de Vrancea et Galați, les conclusions menant à des prises de décisions, á l'élaboration de quelques stratégies de diminution des effets de tels phénomènes ou même de stoppage de leur déploiement. La chute de grêle est un phénomène météorologique dangereux, qui produit toujours de grands dommages matériaux non seulement aux cultures agricoles et aux plantations arboricoles et viticoles, mais à la population et aux agents économiques aussi. Il est impératif de faire une évaluation agrométéorologique de la nécessité et de l'opportunité de la protection contre la grêle dans les départements de Vrancea et Galați, surtout à cause des grands dommages provoqués à unes des plus importantes branches de l'économie nationale – l'agriculture –. Selon cette étude, ces deux départements possèdent d'importantes surfaces arboricoles et viticoles, dans des planatations bien-formées qui sont affectées anuellement par la grêle, environ 50 % des cas concernant les chutes de grêle enregistrant des pertes significatives; souvent, elles ont provoqué leur déstruction totale. Dans le cas des plantations arboricoles et viticoles, à part les dommages matériaux immédiats, ce phénomène affecte la production pour 2-3 ans encore.*

1. Monthly and yearly medium number of days with hail.

The monthly and yearly medium number of days with hail is stated by a ratio between the monthly or yearly number of days with hail and the number of years from that certain period, the number being decimal one.

From the analysed data, it turned out that at the mentioned stations there have been registered 5-27 hailstorms during the period taken into account. According to the definition from the hereinbefore paragraph, the variation of the monthly and yearly medium number of days with hail is presented below.

A more suggestive expression of this parameter is represented in tab. 1 and picture 1 with direct reference to the variation of the monthly and yearly medium



Picture 1. Monthly medium number of days with hail registered at 6 weather stations during the period of 1985 - 2004

number of days with hail in the season of maximum vegetation, this having the highest values in the months of May and June.

From the same graphic table, we can notice that the monthly medium number of days with hail increases beginning with April towards summer months and decreases towards autumn.

If we analyse comparatively the months with the highest frequency of formation of hail phenomenon, we notice that the highest number is during the period of May – June and then it drops from July.

Tab. 1 Monthly medium number of days with hail registered during the period of 1985-2004

Name of station	Month											
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**	**XII**
Adjud	0,0	0,0	0,0	0,1	0,4	0,4	0,1	0,1	0,0	0,0	0,0	0,0
Focsani	0,0	0,0	0,0	0,2	0,4	0,4	0,2	0,1	0,1	0,0	0,1	0,0
Tecuci	0,0	0,0	0,0	0,2	0,5	0,1	0,2	0,1	0,1	0,0	0,0	0,0
Galaţi	0,0	0,0	0,0	0,2	0,3	0,3	0,2	0,2	0,1	0,0	0,1	0,0
Măicăneşti	0,0	0,0	0,0	0,0	0,6	0,1	0,1	0,0	0,0	0,1	0,0	0,0
Odobeşti	0,0	0,0	0,0	0,0	0,5	0,4	0,2	0,2	0,1	0,0	0,0	0,0
Average	***0,0***	***0,0***	***0,0***	***0,1***	***0,7***	***0,3***	***0,2***	***0,1***	***0,1***	***0,0***	***0,0***	***0,0***

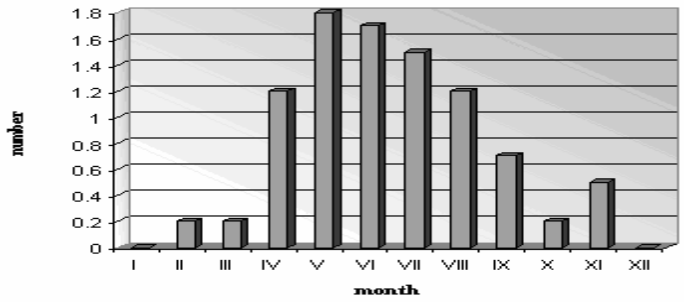
Source: C.M.R. Moldova Iasi

2. The monthly and yearly maximum number of days with hail.

The monthly and yearly maximum number of days with hail represents the highest number of days in a month or a year when hail phenomenon is reported in that particular period.

In the analysed period, hail phenomenon appears frequently in the warm season, especially in the months of May, June and July, when a maximum number of days with hail is also reported.

The appearance of this phenomenon during the months of winter is rare (the



Picture 2. Monthly maximum number of days with hail registered at 6 weather stations during the period of 1985 - 2004

maximum number of days with hail is low) and it forms at a low altitude, where, due to a series of meteorological conditions, air temperatures have been temporarily higher than normal ones.

During the months of spring and especially beginning with the month of May, this maximum monthly number increases up to 1, 8 cases (Picture 2, Tab. 2).

In May, the highest maximum monthly number of days with hail was reported, (3 days in May at Galati 1991, Focsani 1992) due to the fact that western and south western air circulation is intensified, the atmospheric fronts producing large quantities of precipitations with hail.

Starting from the month of September, this maximum number is decreasing gradually, in November being of only one day (Focsani, Galati, Tecuci).

Tab. 2. Monthly and yearly maximum number of days with hail registered during the period of 1985-2004

Station	Month												
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**	**XII**	**Yearly**
Adjud	0	0	0	1	1	2	1	1	0	0	0	0	***2***
Focsani	0	0	0	2	3	2	2	2	1	0	1	0	***3***
Tecuci	0	1	1	2	2	2	2	2	1	0	1	0	***3***
Galaţi	0	0	0	2	3	1	2	1	1	0	1	0	***4***
Măicăneşti	0	0	0	0	1	1	1	0	0	1	0	0	***3***
Odobeşti	0	0	0	0	1	2	1	1	1	0	0	0	***6***
Average	***0,0***	***0,2***	***0,2***	***1,2***	***1,8***	***1,7***	***1,5***	***1,2***	***0,7***	***0,2***	***0,5***	***0,0***	

Source: C.M.R. Moldova Iasi

Out of the 20 years analysed, for each station, it was chosen the maximum number of hail cases from that particular month and the annual maximum number as seen below (Tab. 2).

As regards the annual maximum number, we mention that this has been in all cases 2-3 times higher than the yearly medium number and it didn't manifest itself every year at every station, pointing out local and regional peculiarities of thermo-baric contrasts.

The highest yearly maximum number is of 6 days and it was registered at Odobesti Meteorology Station in 1984, followed by Galati Meteorology Station with 4 days in 1990.

3. Duration of production of hail phenomenon.

The daily interval favourable to hail phenomenon is tied to the warmest time of the day, when excessive heating of the active surface takes place and thermal convection becomes maximum especially between the interval 2-5 p.m., but hail can also fall outside this interval and even at night.

The production of this phenomenon at night and in the morning is extremely rare and is due to some special aero-synoptic conditions. From the measurements, usually, the duration of production of hailstorms is between 5-10 minutes, while the maximum duration was of 14 minutes, at Maicanesti in 1971 and 31 minutes, at Odobesti in 1996. In table 3, the medium durations of hailstorms in Vrancea and Galati counties are presented, from which it results that these frequently exceed 6 -7 minutes.

Tab. 3 Average duration of hail phenomena at Vrancea and Galati meteorological stations.

Station	Average duration(minutes)
Galati	8
Tecuci	7
Focsani	9
Adjud	9
Maicanesti	6
Odobesti	6

Source: C.M.R. Moldova Iasi

4. Dimension of hailstones.

The dimensions of hailstones are very different. Usually, the inhabitants of the affected areas exaggerate the size of hailstones and assign them different sizes, like those of nuts, of bird eggs or even oranges. Still, it is known that the duration of hailstorms is inversely proportional to the size of hailstones: the shorter the duration of hailstorms, the bigger the size of hailstones, not to mention the exerted

mechanical influence. Generally, the size of hailstones is smaller than 10 mm. The researches carried out highlighted the fact that, during the seasons of spring and autumn, the diameters are more reduced (under 5 mm) comparatively to summer, when these can reach exceptional sizes of 20 up to 30 cm. In the table below, we reproduce the medium sizes of hailstones at the 6 meteorological stations in the interval 1985-2004 and whose diameter was of 3 - 4 mm.

Tab 4. The medium size hailstones at Vrancea and Galaţi meteorological stations.

Station	Medium size (mm)
Galati	1
Tecuci	2
Focsani	3
Adjud	4
Maicanesti	3
Odobesti	4

Source: C.M.R. Moldova Iasi

Tab 5. Maximum sizes of hailstones measured in the years when hail phenomenon was registered at 4 meteorological stations in Galati and Vrancea Counties

Galati		Tecuci		Focsani		Adjud	
Year	**(mm)**	**Year**	**(mm)**	**Year**	**(mm)**	**Year**	**(mm)**
1985	6	**1985**	20	**1986**	10	**1990**	5
1986	6	**1981**	5	**1989**	12	**1993**	7
1991	6	**1992**	10	**1991**	4	**2003**	25
1992	5	**1993**	6	**1992**	5	**2004**	22
1993	5	**2000**	27	**1993**	15		
1994	5	**2001**	5	**1995**	8		
2000	4			**1999**	5		
2001	4			**2000**	7		
2003	5			**2003**	8		

Source: C.M.R. Moldova Iasi

The dimensions of hailstones measured at the meteorological stations in the interval 1985-2004 oscillated between 5 - 27 mm at Tecuci, 5 - 25 mm at Adjud, 4 - 15 mm at Focsani and 4 - 6 mm at Galati (table 5). We must mention the fact that these values were exceeded outside the meteorological stations, as it happened on the 23rd of May 1993 in Tulucesti, department of Galati.

These dimensions determine the risk extent caused by hailstorms, with fatal consequences on human activity and environment.

5. Distribution of hail phenomenon.

The distribution of hail phenomenon is influenced by aero-synoptic processes generating hail, these processes being more intense in mountain areas.

The data base regarding hail during the period of 1985-2004 (Tab. 6) has allowed me to bring about a distribution of the space of the two Counties (Picture 3) and to distinguish the following areas:

1. Odobesti, Panciu, Focsani, Grivita, Branistea area, with a number of 20 to 27 cases of hail ;
2. Central area of Vrancea and Galati Counties (10 to 15 cases);

Tab. 6 Number of hail cases registered at meteorological stations in Galați and Vrancea .Counties

VRANCEACOUNTY		***GALATI COUNTY***			
Station	**No. cases**	**Station**	**No. cases**	**Station**	**No. cases**
Focsani	15	**Galati**	12	**Tg. Bujor**	6
Adjud	6	**Tecuci**	8	**Baleni**	9
Soveja	16	**Cavadinesti**	6	**Branistea**	17
Panciu	27	**Draguseni**	6	**Vladesti**	10
Țifesti	16	**Grivita**	24	**Cuca**	11
Suraia	11	**Nicoresti**	5	**Balabanesti**	6
Poiana Cristi	6	**Piscu**	6	**Frumusita**	4
Timboiesti	5	**Schela**	6	**Ghidigeni**	7

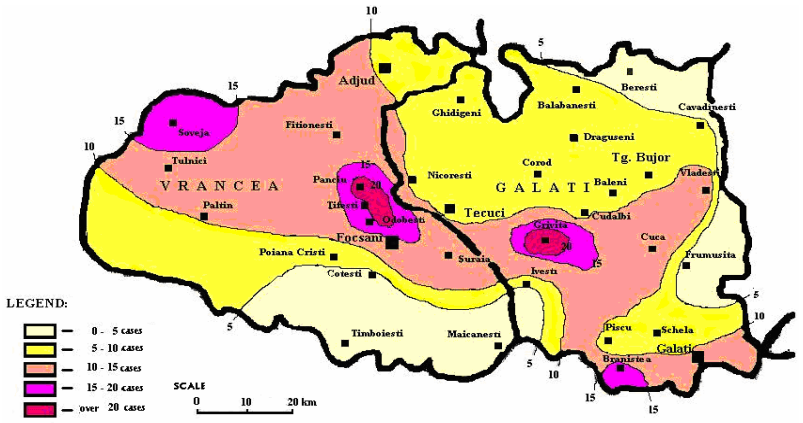
Source: C.M.R. Moldova Iasi

3. Northern area of the Galati County and South-western area of the Vrancea County (5 - 10 cases).
4. South-eastern area of the Vrancea Countiy and Eastern area of the Galati County (until 5 cases)

5.

We must mention the fact that the data from the Eastern area of the Galati County, regarding the number of days with hail phenomena produced at the ground, have been negatively influenced (fewer from a numerical point of view) as a consequence of the efficiency of the Anti-hail System from the Republic of Moldavia, recognized by the natives from the Prut area in Romania.

6. Agrometeorological evaluations generated by hail phenomenon



Picture 3. Distribution of the number of hail cases in the Counties of Vrancea and Galati (1985 – 2004)

6.1 The structure of land fund in Galati and Vrancea Counties

Tab. 7 Structure of land fund according to the use in Galati and Vrancea Counties in the year 2001

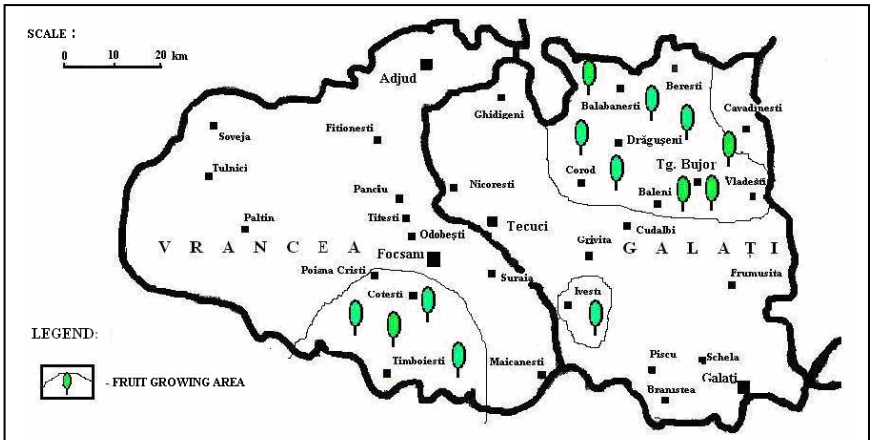
County	Total surface	Agricultural surface	Out of which:					
			Arable	Pasture	Hay fields	Vineyards and orchards	Forests	Other surfaces
Vrancea	485.703	255.454	147.562	42.970	33.045	31.877	181.564	48.685
Galati	446.632	358.754	292.229	43.580	598	22.347	36.273	51.605
Total	**932.335**	**614.208**	**439.791**	**86.550**	**33.643**	**54.224**	**217.837**	**100.290**

Source: D.A.F.I. Vrancea and Galati

The total surface of Galati and Vrancea Countiesis of 932.335 ha. 66 % of this surface is used in agriculture, respectively 614.208 ha, which is distributed in this way: arable field-439.791 ha, pastures and hay fields-120.193 ha, vineyards and orchards-54.224 ha, forests-217.837 ha and other surfaces-100.290 ha (Tab. 7).

6.2 Distribution of the areas with fruit and vine-growing plantations.

The diversity of landforms and their disposal in treads, the climate with a great variety of nuances, determined by the complexity and fragmentation of the relief and the quite ample hydrographic network have been propitious to the expansion of fruit trees. These trees can be seen everywhere, but with some exceptions: in high, rough and uneven areas and with acid soils in the department of Vrancea.



Picture 4. Map of fruit- growing areas which need to be protected in Vrancea and Galati Counties

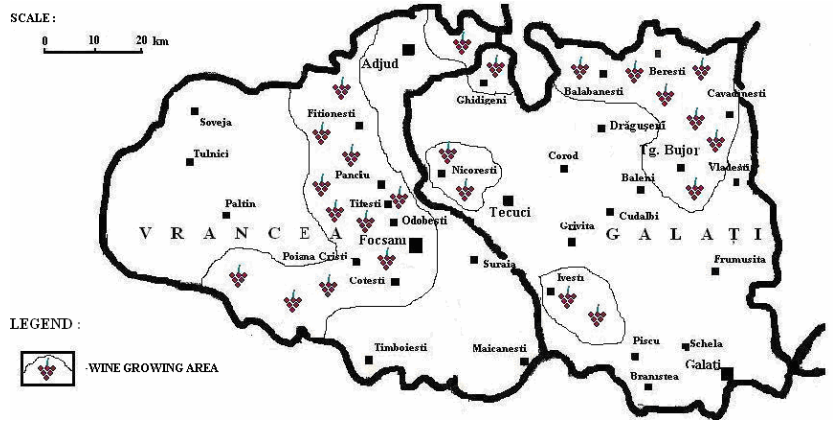
The specific natural conditions (relief, climate, soil etc.) and the economic ones (the creation of centers of fruit valorization, the distance between consuming towns) of *Vrancea department*, acting unequally, have given the possibility of individualization of certain fruit-growing areas (Picture 4), with proper characteristics: Rimnic – Rimna area (having a majority of plum trees, then apple trees, nut trees, pear trees, sweet cherry trees, cherry trees, apricot trees), Putna area (plum trees, apple trees, nut trees, pear trees, cherry trees, sweet cherry trees), Susita area (plum trees, nut trees, apple trees, apricot trees, pear trees etc).

In regards to the geographic distribution of fruit-growing trees plantations in *Galati County*, larger surfaces can be found in the Northeastern area of the department, in the localities of Virlezi, Balabanesti, Corni, Beresti, Tirgu Bujor, Vladesti, then in the South-East in Firtatesti and then in the West at Ivesti. In the structure of orchards the plum tree is predominant, followed by apple tree, then sweet cherry tree, cherry tree, apricot tree, pear tree, etc (Picture 4).

Due to natural conditions extremely propitious of piedmont area, vine has a very old tradition in *Vrancea County* (Picture 5), being cultivated here from ancient times.

According to the characteristic features of the natural environment, which condition the spreading of vine, the quality and quantity of products, as well as the economic factors which have determined certain orientations in the development of this branch, a few vineyards can be delimited, each having proper characteristics:

- Panciu vineyard - localities: Panciu, Tifesti, Movilita, Fitionesti; etc;
- Odobesti vineyard – localities: Odobesti, Jaristea, Virtejoiu, Brosteni, Gagesti;



Picture 5. Map of wine-growing areas which need to be protected in Vrancea and Galati Counties

- Cotesti vineyard – localities: Cotesti, Cirligele, Urechesti, Dumbraveni etc.

The geographical distribution of wine-growing perimeters in G*alati County* (Picture 5), has discontinuous areas, differing from the characteristics of Putna vineyard in Vrancea. In general, there are four main perimeters, namely:

- Nicoresti – Poiana vineyard: one of the renowned vineyards of the department in between Siret valley and Berheci valley. It spreads between Poiana, Cosmesti, Tecuci, Priponesti;
- Ivesti-Hanu Conachi vineyard is situated in the western part of the department, on sandy soils and is overlay between Tecuci, Fundeni and Pechea;
- Dealurile Bujorului vineyard is situated in the eastern part of the department, approximately in the hydrographic area of Chineja;
- Beresti vineyard is situated in the northern part of the county, including the wine-producing centers Beresti, Beresti – Meria, Cavadinesti, Balabanesti, Certesti.

6.3 Evaluation of the damages caused by hail

The evaluation of the damages caused by hail was done based on the information obtained from the Department for Agriculture and Food Industry from

the two counties. Since this year, precisely on the 21st of May 2006, rain and hailstorms have again swerved this area, the presentation in this paper of the devastating effects caused by the two phenomena will point out even more the need to diminish the risk of hailstorms and pouring rains.

The evaluation of agriculture of Galati and Vrancea counties, based on the data drawn up by the Department for Agriculture and Food Industry (tab. 8), with special references to the damages provoked by hailstorms, has pointed out the following aspects:

- hail represents a phenomenon encountered with a frequency which affects annually over 2 % of the agricultural surface of the two counties;
- the fruit and wine-producing patrimony is affected on average in proportion of 3,3 %. It is noticed the fact that there are years when the fruit and wine-producing surfaces of the two departments can be compromised in proportion of 80 %;
- the damages caused through calamity on the average of over 7000 ha, out of which 1500 ha of fruit and wine growing plantations, can reach about 110 billion lei annually;
- usually, hailstorms are associated with storms and pouring rains, which worsen the destructive effect of hail;
- critical situations are produced in the years when severe draught periods follow hail periods, especially in the months of July-August, agriculture being thus compromised in high proportions.

On May 21st 2006, in the interval 5 p.m. -6 p.m, rain and hail have violently hit areas from the county of Vrancea, causing great damages in Cirligele, Golesti, Virtesoiu, Brosteni and Cimpineanca (photo 1). According to the first evaluations made by local authorities, hail and rains have caused damages of about 121 billion lei (ROL) to the Vrancea farmers. Almost 3.718 hectares of crop field have been affected by hail, out of which 2.910 hectares have been destroyed over 50%.

In this period of time, devastating meteorological phenomena (hail with a diameter of 3-4 cm, pouring rain, strong wind – which here and there had the aspect of gale) have destroyed people's gardens and vineyards, have pulled out roof tops, have uprooted trees and flooded many houses.

In *the locality of Cirligele* hail and pouring rain has destroyed over 1.575 ha of vineyards and orchards, as well as 700 ha of crops (photo 2.), vegetable gardens etc. The crops on these fields have been destroyed in proportion of over 95%, while the trees on the side of the road had their branches "spread" all over the road, which on some parts was covered with mud.

Tab. 8 Damages caused by hailstorms according to the reports of D.A.F.I. Vrancea and Galați D.A.F.I. (1992 – 2001)

Department	Specification	Crops		Vineyards and orchards		Total damages (billion lei)
		Affected surface	Estimated damages	Affected surface	Estimated damages	
Vrancea	Total department (ha)	147.562		31.877		57.1
	Calamity-stricken surface average on 10 years (ha)	1045		1358		
	Average damages on ha (kg)		3157		3700	
	Calamity-stricken surface (%)	0.7		4.3		
Galati	Total department (ha)	292.229		22.347		52.6
	Calamity-stricken surface average on 10 years(ha))	4522		440		
	Average damages on ha(kg)		2158		3204	
	Calamity-stricken surface (%)	1.5		2.0		
TOTAL Vrancea and Galati departments	Total departments (ha)	***439.791***		***54.224***		***109.7***
	Calamity-stricken surface average on 10 years (ha)	***5567***		***1798***		
	Average damages on ha(kg)		***5315***		***6904***	
	Calamity-stricken surface (%)	***1.3***		***3.3***		

Photo 1. Aspect of hailstorms which have devastated some localities in Vrancea

Photo 2. The bags of hail laid on the ground late in the night

Photo 3. Destroyed vine plantation in the locality of Virtesoiu

Photo 4
. Demaged car by freshet of Pituleasa Valey

A short pouring rain flooded the road between *Goleşti* and Cirligele. The clogged channels on the side of the road which leads to Cirligele made the water pour over the road, fences and crops.

The situation in *the locality of Virtesoiu* has been much worse, seeing that 150 ha of vineyard were destroyed (photo 3), because of the hail which has beaten strongly for an hour. According to some evaluations made by local authorities, the freshet generated by the pouring rain has flooded even 10 houses, destroyed bridges, and almost 10 km of roads.

In *the locality of Broşteni,* raining has made river Pituleasa Valey swell, which also caused havoc in the month of July 2005. Still, the waters did not cause damages and didn't flood the gardens, but caused panic among the natives, just because they had confronted themselves with problems related to this river. The formed freshet destroyed a car (photo 4).

7. The necessity and opportunity of the protection against hailstorms in Vrancea and Galati Counties

As it is known, hail causes important losses to crops. In the case of fruit and wine growing plantations, this phenomenon affects them for a period of 2-3 years. The two departments have important fruit and wine growing surfaces in well-constituted, traditional plantations which are affected annually by hailstorms.

Also, present climate changes have led to the intensification of the magnitude and frequency of hail.

Nowadays, all the neighbouring countries have controlling systems for hail and in the Prut area, the lack of a Romanian system perturbs the capacity of control of the system in the Republic of Moldavia.

Through the nature of its attributions, civil protection annually reports great damages caused by this disaster to the goods of the population.

8. Social and economic effects of controlling hail in the departments of Vrancea and Galati

8.1 Social effects

Implementing an anti-hail system represents the greatest project ever promoted in the rural space of the two departments:

- the supported area will protect 11 % out of the total surface of the two departments;
- the project promotes a space of high technology, available now even to social structures;
- social structures and objectives are protected;

- it leads to the increase of the cohesion factor and of unitary action of the members of rural communities ;
- it leads to the increase of social security and to the diminishing of damage risks of personal goods (house, outhouses, animals);
- on the whole, the project can represent a serious reason of modernising the rural space in Moldova.

8.2 Economic effects

By setting up a regional antihail center, all the important vineyards from the two counties will be protected: Nicoresti, Panciu, Odobesti, Cotesti in Vrancea department and Tirgu Bujor in Galati, totalizing 13.000 ha (Tab. 9).

In the case of calamities caused by hail on fruit and vine growing plantations, according to the intensity of the phenomenon, the productive potential of the following year is compromised by 30– 70%. Thus, by setting up this antihail system, the losses in vegetal production will be significantly reduced.

Other favourable economic effects:

- diminishing death rate at animals, reducing morbidity and protecting the increase factor as a direct influence on the protection of fodder;
- investment funds are dislocated to other agricultural sectors;
- it increases the degree of security of businesses in agriculture;
- it creates pre-requisites for a rural durable development in the protected areas.

Tab. 9 Structure of land fund on the areas of protected vineyards of Vrancea and Galati counties

County	Specification	Total surface	Agricultural field		Non-agricultural field
			Total	Vineyards and orchards	
Vrancea	Total county (ha)	485.703	255.454	31.877	230.249
	Protected area (ha)	65.000	58.000	10.000	7.000
	Degree of coverage (%)	13.4	22.7	31.3	3.0
Galați	Total county(ha)	446.632	358.754	22.347	87.878
	Protected area (ha)	35.000	31.000	3.000	4.000
	Degree of coverage (%)	7.8	8.6	13.5	4.6
Total	**Total countiesVn+Gl(ha)**	**932.335**	**614.208**	**53.224**	**318.127**
	Protected area (ha)	**100.000**	**89.000**	**13.000**	**11.000**
	Degree of coverage (%)	**10.7**	**14.5**	**24.4**	**3.5**

Source: D.A.F.I. Vrancea and Galati

9. Conclusions

The analysed data from meteorological stations and precipitation stations for 20 years (an interval of time which has "registered" the frequency and duration of producing of such a devastating phenomenon as hail) have facilitated the composing material for this paper through computer – assisted processing and the pointing out of the following conclusions and suggestions:

✓ hail, as a spatial aleatory phenomenon, is present in the whole studied area, its highest frequency being in the season of summer when vegetation is at its fullest. Territorially it overlaps the agricultural - land fund, representing over 60% of the arable surfaces cultivated with cereals, vineyards and orchards, dominant in the two departments;

✓ damages caused by this phenomenon exceed about 10 billion lei annually;

✓ the tables, graphics, but especially the maps with the distribution of the analysed phenomenon can represent scientifically – underlied sources in order to support the promotion of a project regarding the necessity and opportunity of implementing an antihail system in Vrancea and Galați counties.

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