

THE WIND – CLIMATIC RISK FACTOR FOR THE SUCEAVA COUNTY'S FORESTRY STOCK

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Keywords: wind throw, risk, forestry stock

Abstract. Forests contribute to the formation and protection of our environment; they also need permanent protection from humans, due to the multiple functionalities of the forestry ecosystems, as forest is not only a component of the environment, but also a source of multiple and valuable goods and services essential to human communities. This paper presents aspects concerning the impact of wind on the forests of Susana County. Local conditions are presented and debated upon, as well as an analysis of the risk factors which determine wind throws, emphasizing the major economic, ecologic and negative impact of this disturbing factor. The last big wind throw of 6th- 8th March 2002 is analyzed, the conditions in which it occurred, the damage resulted and the measures that were taken. Further action is necessary, though, in order to diminish the negative impact of the wind on the forests of Suceava County.

Introduction

It is almost impossible to read a newspaper or a magazine or turn on the TV or radio without reading or hearing a report about the lamentable state of the environment. If we had a better understanding of the environment and of how human behavior affects it, we could turn our planet into a more secure and more enjoyable place to live in.

The effects of climate variations, in particular the current global warming, are characterized by a wide range of risks, for both the human society and the natural environment. Some of the consequences have an immediate jeopardizing effect (increasing frequency and intensity of weather phenomena risk, expanding desertification, diminishing water resources), others will be felt more intensely in the distant future (an increase in the mass of the Planetary Ocean, changes in species biodiversity).

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The impact of climate risks on vegetation entails many aspects, in the future a series of changes in the structure and distribution of vegetation - both the natural and cultivated one - being expected. Observations made in northern forests of the Northern Hemisphere show a shift towards greater latitudes, in the current area of the tundra, in the coniferous forests of Finland, Canada, Alaska. At the same time, at the southern limit of the northern forests we can notice a fairly rapid degradation, affecting larger and larger forest areas, which led some researchers to argue that the specific spreading areas for species occupied by the northern forest, representing about 17% of the mainland area, will be reduced in the future by 10-15%.

1. General geographic types

Suceava County is situated in North-Eastern Romania. It is bordered to the North by Ukraine (border state), to the East by Botosani County, to the South-East by Iassy County, to the South by the counties Neamt, Harghita, Mures and to the West, the counties Bistrita-Nasaud, Maramures. It is part of the north-eastern region of Romania, most of it consisting of southern Bucovina. It has an area of 8,553 square kilometres (3.6% of the country surface), being the second largest county in the country.

Administrative organization of Suceava County territory in 2007 included: 5 municipalities: Suceava, Fălticeni, Radauti, Campulung Moldovenesc, Vatra Dornei; 11 towns: Gura Humorului, Siret, Solca, Broșteni, Cajvana, Dolhasca, Frasin, Liteni, Milișăuți, Salcea, Vicovu de Sus; 98 communes; 379 villages. The capital of the county is the city of Suceava.

The hills and mountains are the prevalent forms of relief. The surface of the forest stock represents 53% of the county, being from this point of view the most important example of the kind in the whole country. Referring to the large geographical units of the country, the territory of the Suceava County partly overlaps the Eastern Carpathians and the Suceava Tableland. The mountainous region includes the massives of Suhard and Călimani (with the peak of Pietrosul which is 2100m in altitude), the most stately volcanic mountains in the country, Obcina Mestecăniș, the massives Giupalău-Rarău, Obcina Feredeului, Obcina Mare, Stănișoara Mountains, Dorna Depressions.

The tableland region includes the following piedmont hills: Marginea, the Radauti Depression, the Suceava-Fălticeni Plateau, the Dragomirna Plateau, the Liteni Depression, the piedmont Plain of Baia, the Siret River Valley.

The position of the county determines the cool character of climate, the county having a temperate-continental climate.

Suceava County has a rich hydrographic network represented by rivers (Bistrita, Dorna, Moldova, Siret, Șomuzul Mare, Suceava), brooks, ponds.

Throughout the county there are sources of mineral water and mineralized springs, the most famous springs being those of Șaru Dornei, Poiana Negri and Coșna.

The forest stock occupies 49,9% of the county area (422.455 ha), representing about 7% of the forestry potential of Romania. Most of the vegetation consists of forests, which represent an important natural resource of the county. The hazards produced in this area are frequent, being caused by numerous natural factors, as well as by anthropic ones. Of all the natural factors, the climatic ones and especially wind and snow caused the major damages to the forests of Suceava County, which is why we tried to reconstitute the history of these phenomena since the distant past up to the present, in order to reveal the causes which will determine them in the future. The study of the conditions in which these events occur leads to the understanding of the natural laws that trigger these phenomena, to acquaintance with the relation between forest and environment.

2. Forestry stocks

The forestry stock of our country has reached 6.3 million hectares. After the massive deforestations of the recent years, our country has become a straggle in Europe as far as afforested areas are concerned. No more than a quarter of the country is afforested, a figure that places us on the 13th place in an European classification. According to the estimations made by the specialists of the Ministry of Agriculture, the share of afforested areas, of the total area of Romania, is under the European average and by far below the level that researchers consider to be a possible minimum limit, namely 35%. Over 800,000 hectares of forest were destroyed by 2007, the lack of legislative rigour being, undoubtedly, the main reason, enhanced by a precarious environmental awareness (hence, education) of the population. Therefore, the enlargement of the area occupied by forests and the afforestation of agricultural land, affected by various phenomena of degradation, should be priorities for the forest policy in our country.

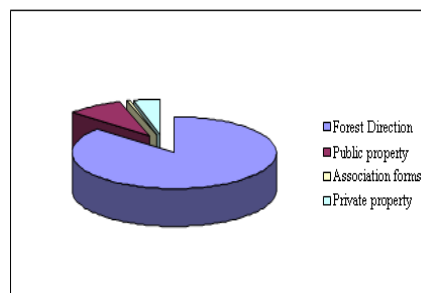


Fig. 1 – Forestry stock of Suceava County

Until 2010, authorities want to increase the amount of green space per head up to 20 square metres, so that - in 2013 - the average should reach up to 26 square metres of green space. Romsilva announced that in 2008, works would be undergone on an area of 15,400 ha, out of which 7,830 hectares will be afforested.

The total area of the forestry stock of Suceava County is of 438.862 ha, as following: 380.317 ha are managed by the Suceava Forest Division, 38.406 ha represent public property of territorial administrative units, 2.666 ha represent private property of legal entities (associative forms), managed by RNP Suceava Forest Division, 18.473 ha belong to private property of natural persons.

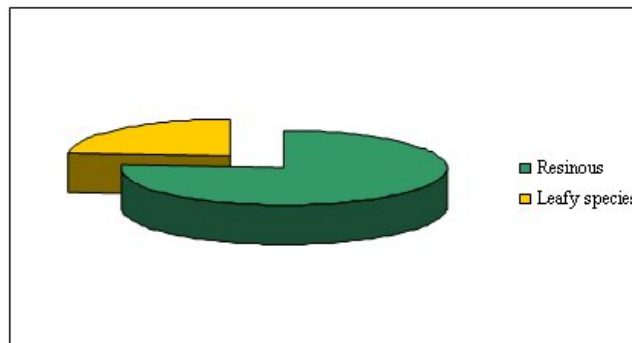


Fig. 2 – Stands composition

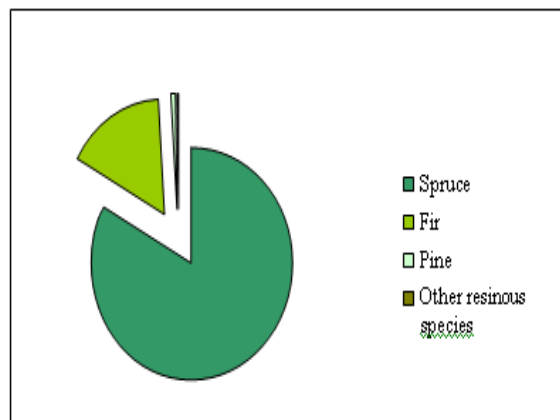


Fig. 3 – Proportion of the main resinous species

The brushes and stands consist of the following species:

- resinous trees - 284.159 ha (76%), of which: 235.817 ha – spruce, 45.406 ha – fir, 4 ha – douglas fir, 665 ha – larch trees, 1.817 ha – pine trees, 450 ha – other resinous trees.

- deciduous trees – 88.393 ha (24%), of which: 62.604 ha – beech, 4.973 ha – oak, 530 ha – acacia, 3.315 ha – sycamore maple, 964 ha – ash, 95 ha – cherry, 11 ha – nut, 11.734 other hard species, 748 ha – lime tree, 592 ha – willow, 1.288 ha – poplar, 1.539 ha – other soft species.

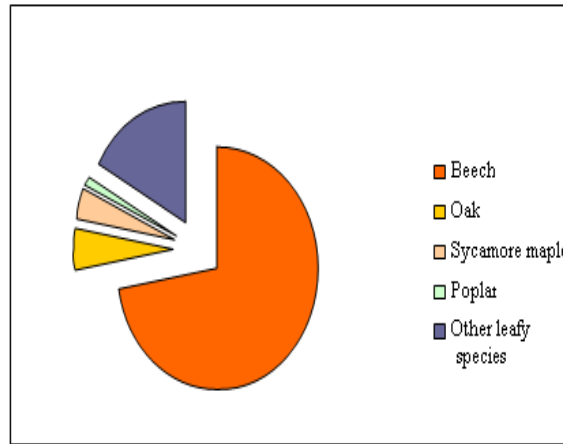


Fig. 4 – Proportion of the main deciduous species

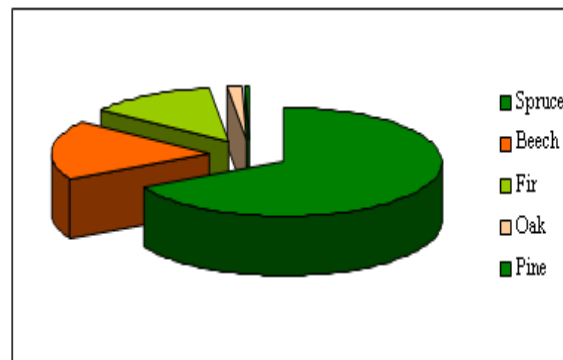


Fig. 5 – Proportion of the main tree species

Making a comparison between the shares of the main species of forest trees in Suceava county, we notice that on the first place there is the spruce with the highest frequency, followed by beech and fir and much behind them there are oak and pine tree.

3. Terminology

Of the environmental factors, climate has the most important role. It represents the main modifying factor of the land crust; it is the main ecological factor based on which vegetal associations, animal packs, human settlements etc. distribute on Earth; it is the main indispensable energy source of life. In all its ways of manifestation, climate is not only a source releasing vital energy, in different forms, but also a risk factor which also discharges other energies, sometimes with catastrophic effect that cause disorder in the geographical systems.

Climatic risks include a wide range of phenomena, from the point of view of the genetic type, of the way of manifestation of variations in time and space, or of manifestation and evolution. In geographical literature, different terms are used in order to measure and quantify the proportion and the material damage caused by dangerous natural phenomena, such as: hazard, risks, records, calamities, disasters, catastrophes (O. Bogdan, 1999).

Climatic hazard represents a random climatic phenomenon vast in scope, which mostly suggests its random genetic condition (while its consequences are easily-understood), something unexplained and therefore, difficult to foresee.

Risk would not exist if it weren't for a natural yet peculiar phenomenon in society: the human being. In the case of climate risk, man puts up with consequences of some unavoidable weather phenomena, uncontrollable, possibly in more or less known conditions. Risk implies the vulnerability degree (of forest in this case), which becomes a risk element.

Vulnerability = the exposure degree of man and his goods in front of different hazards which are potential causes of victims and material goods. It depends on pollution degree, economic development, substructure, types of buildings etc.

The risk that occurs depends on: the hazard's serious manifestation and consequences, vulnerability degree in front of hazard, population number, population's capacity to face the hazard, economic activities etc.

Hazards can be natural and anthropic. Natural hazards: endogenous hazards (earthquakes and volcanic explosions), exogenous hazards (cyclones, storms, blizzards, drought, hails), soil erosion, land slides, floods, icebergs, fires, epidemics, insect and rodent invasion, meteorites fall etc). Anthropic hazards: technological hazards (pollution and radioactivity), social hazards (urbanization, high increase of world population, unemployment, wars).

Disturbing factors of the mountain area: abiotic factors: snow, wind, hoar frost, land slides, avalanches, high floods; biotic factors: defoliators, game, xylophages insects and mushrooms, diseases caused by mushrooms.

The study of any phenomenon requires systematization, classification. In the case of wind throws, a classification is also suggested based on some synthetic criteria, for a better interpretation and elucidation of some terms, which are often used inadequately. By the term "wind throw" we generally mean any mechanical damage caused by wind which affects a tree or a stand as a result of the action of the wind.

The observation of the main aspects regarding the mechanism of mechanical damage that takes place in the forestry ecosystems as a result of the disturbing action of the wind is facilitated by the wind throw classification into two big groups: 1. wind throws with catastrophic effects and 2. endemic wind throws – Classification criteria: force and proportion of phenomenon related to a certain geographical scale.

4. The factors the windthrows depend on

Influence factors – common winds at a speed up to 11m/s, do not generally cause important damage. The intense ones, at a speed between 11m/s and 15m/s cause damage mainly in the stand with moist soil with undeveloped striking roots, with rottenness; storms, winds at a speed between 15m/s and 26m/s respectively, cause mass wind throws and breaches, even in sound forests, the damage being likely to reach a catastrophic level when influenced by other existing factors (even age stand and clean spruce, which moist soils as a result of abundant snows etc). Hurricanes, winds with a speed of more than 29m/s respectively, cause major damage even in the most resistant forests.

By forest planning measures, some of them with long term effects, we can act against winds and storms which, at a speed up to 21m/s, determine the most frequent damages, not only in the spruce stand, but also in other forests (beech forest, fir wood etc).

The damage made by wind depends on:

- Stand composition. Clean stands made of weak resistance species (resinous trees, especially spruce) are the worst and the most frequently affected. Trees stability is higher if more resistant species (beech, larch etc.) exist in the composition of the stand, provided that their proportion be of 30% minimum.
- Vertical structure. Natural stand, the natural uneven nature and relative conditions show individual resistance, as a result of more propitious values of liveness indexes, of the crown shape of trees, specific features of

- striking root system. The trees of the even-aged stand resist wind only in compact mass but they give in to the first interruption of the trees crowing.
- Stand firmness. The stand older than 40 years is extremely exposed to the action of wind, crossed by important sparse vegetation places, without being previously prepared through adequate preparation works. Damage is also produced in the even age stands now being regenerated by the application of successive, gradual cuttings, which are gardened, especially in spruce forests.
 - soil state. The easier, more superficial ones, imbued with water are more favorable to some frequent damage.
 - stand position on the mountainsides. Therefore, on high mountainsides, “in the wind” massive wind throws rarely occur.
 - stands health. Spruce stands with red rottenness at their root and those with trunk rottenness are more frequently affected.
 - stands productivity. Bigger and more frequent damage occur in the stand of superior productivity (pure and even age), especially in the artificial spruce forests of the floor of beech and resinous trees mixture.
 - stands average height. Damage is bigger in the stands with average heights over 20-22m.

4. The windthrow of 6-8th march 2002

Wind throws represent the main disturbing factor in the forestry ecosystems of the mountain area.

The first wind throw mentioned in records was the one in 1828 which took place in Sinaia followed by the one from the forests of Bukovina from December 1843.

Since then until 2002 a number of about 40 ample windthrows have rushed upon the forests of Bucovina, among which the biggest were in 1947-1948, 1964, 1969, 1975, 1982, 1995 and 2002.

On 6th-8th March 2002, because of some storms which affected especially the upper basin of Moldavia River, Moldovita basin and mainly Upper Suceava basin, there were wind throws and breaks of 4.000.000mc., affecting the forest administrative units of O.S.Brodina with about 545.000mc, O.S. Falcau with about 450.000mc, O.S.Pojorata with over 507.000mc, O.S.Stulpicani with about 355.000mc, O.S Dorna Candrenilor with over 292.300mc, O.S. Vama with about 255.100mc, O.S.Iacobenii with about 206820mc etc.

The weather phenomenon produced is very rare in this area. It was characterized by wind with very high speed and rainfall absence. This strong storm lasted less than 24 hours and caused huge damage to the ecosystems from that area.

The storm was formed when the warm air masses came into contact with the cold air masses and this happened due to the air overheating and to its ascent in the higher and cold layers of atmosphere. A specific feature of this storm is the rainfall absence and its localization only on the mountainsides, affecting the households of the valley to a lower extent.

The storm started around 4 a.m., having at the beginning a more reduced intensity which shortly achieved very high speed. This strong wind lasted all day long, ending around 1a.m. the next day. The effect: destruction of wide afforested areas.

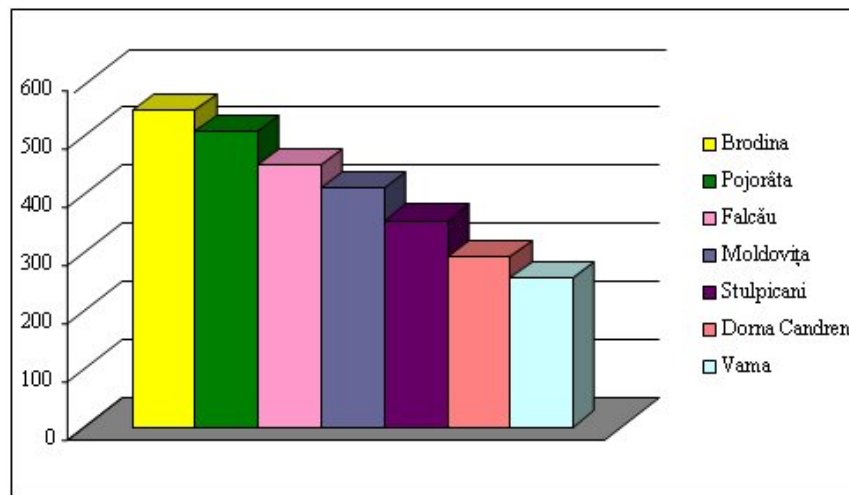


Fig. 6. Windthrows damages (thousand mc) at the forestry units in Suceava County

The main cause which led to this disaster is the irrational exploitation of forests on huge surfaces, exploitation which led to the formation of some holes, some passages within the forest, which therefore became vulnerable to a wind action of greater intensity. Furthermore, thaw, which is specific to spring, when soil is more rarefied and imbued with plenty of water, added to this. About 62.500ha have been destroyed (which represents a huge loss for our country). Because of the lack of exploitation of the fallen trees in a short period of time, a year minimum, these have begun to putrefy, thus huge amounts of wood being wasted every year. In order to reach to the trees that were broken by the force of the wind, new forestry roads have been created which required time and for the sake of which part of the healthy trees had to be cut.

Environmental effects: rottenness of the fallen wood which also affects the healthy standing wood; the physical-chemical features of the soil have been modified, water characteristics, and last but not least flora and fauna of the forest; the largest part of forestry vegetation has been destroyed; animal and bird shelters have been destroyed, too. Ecosystems formed during long periods of time have been badly affected, their renewal and regeneration being difficult.

Psychological effects: many owners of afforested lands have lost them entirely; land slides that can occur as a result of tree scarcity; soil erosion; aesthetic aspect resulted in degradation of the affected areas.

Also, we have to specify that the disaster has affected not only the forests nearby Sadova but also the forests of the entire county, as well as the forests of the neighboring counties (Neamt, Maramures, Bistrita-Nasaud).

Another effect is represented by the shutting off of some lines of communication, but only for a short period of time, due to the urgent measures that have been taken:

- Quick and rational exploitation of fallen trees is, therefore, recommended.

For this purpose, a new legislation has been created; there has been brought forest staff from the counties where the wood is insufficient, as well as economic agents who have invested huge amounts of money.

- the trees put to the ground by the wind have started to putrefy, thus becoming an infection hotbed for the healthy ones;
- reforestation of the affected areas, measure which continues in the present;
- settling the sore aspects regarding the wind throws and the snow throws in every cut before planting (places with excess of humidity, ravines, gradients, edges and skirts exposed to the wind as well as the areas with rottenness behind gnarls);
- introducing more resistant species and adequate to the environment factors in this point;
- treatments will be promoted with longer natural regeneration and on small cuts ;
- the maintenance works will be done correctly and on time (forest cleanings, sparse vegetation etc.). The biggest problem that requires urgent solving is represented by the stands of the first two age categories, which have the highest instability degree.

Conclusions

Undoubtedly, the spruce due to the exceptional features of its wood, as well as to eco-protective value – when it is promoted in its natural area, remains one of

the most valuable forestry species of the Carpathian forests and of the forests of Suceava County.

No matter how valuable, the spruce becomes vulnerable when there are unfavorable conditions for its fundamental biological necessities.

The man's greed and rashness has always pushed things over the tolerance limit. The main factors which have created huge economic disturbance on wide surfaces and long standing are: the amount of grubbing concentrated on hydrographic basins, replacing the mixed uneven age beech stands with the resinous ones, creating thick, pure, even age and genetically homogenized cultures of spruce – left without the corresponding care – the damage brought in the exploitation process, the resin extraction process, grazing and other unwise human interventions. The consequences of this lack of poise are the great instability of the forests to unfavorable natural factors. Consequently, massive spruce wind throws and snow throws occur as well as sparse vegetation places. Damage strikes harder in areas with more intensely raised artificial spruce areas prevalence, especially in those areas where there are 40 – 80 year old cultures, which reached the critical ages regarding their vulnerability to adversities.

Pure, unspoiled plantations of spruce are instable, vulnerable to adversities and environment-unbalancing factors; hence they cannot be offer as long term solution, at least not taken separately. Spruce put in direct and intimate combination with beech, which would be advisable if we hinted at enhancing their resistance, are not environmentally stable. This can lead to pure beech forest (in areas where beech is really popular and thriving) or pure spruce-fir. This hybrid can be maintained only with human, financial and energetic effort which for the time being and as far as immediate future enables us to predict, is not generally possible or easy to achieve. Without such efforts, plantations will be compromised, triggering considerable and consistent damage.

After the study of risk climate factors and of their impact on the forests of Suceava County, we are able to conclude that wind throws are the main factor to interfere with and influence the economy of our mountainous systems, having negative effects both ecologically, by structural modifications that immediately follow and economically, by the repeated losses of valuable wood quantities and by changes determined in the careful applying of proper forestry management plan. Wind throws have constituted an urgent issue of forestry research, but this phenomenon should also be studied by other specialists (teachers, educators, climate researchers, biologists etc.).

Only by approaching these risk factors interdisciplinarily can we develop solutions in order to diminish the negative impact that they have on the forest and, implicitly, on the geographical spectrum as a whole.

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