

WINDBREAKS AS AN IMPORTANT ECO-STABILISING AND SOIL-PROTECTIVE ELEMENTS IN THE LANDSCAPE OF SOUTH MORAVIA

Josef Kučera^{1,2}, Jana Podhrázská^{1,2}, Michal Pochop^{1,2}, Petr Karásek¹

¹ *Research Institute for Soil and Water Conservation, Department for Land Use Planning Brno, Lidická 25/27, 602 00 Brno, Czechia*

² *Department of Applied and Landscape Ecology, Faculty of AgriSciences of Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czechia*

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Abstract

South Moravia is one of the most popular and frequently visited areas for tourism and recreation. Cyclists can take advantage of the dense network of cycling paths of local, regional as well as European importance, which connect interesting localities in the area. Various landscape elements also contribute to the attractiveness of the landscape, among which vegetation linear elements have an irreplaceable function. Historically, windbreaks have been planted in the landscape of southern Moravia as protection against the adverse effects of wind. Their importance is growing, especially in view of the adverse effects of climate change. However, the health of many of the elements is often no longer satisfactory, which can cause serious problems. This is illustrated by the extreme weather event of 24 June 2021, when the area between Breclav and Hodonín was hit by a tornado, which caused enormous damage to the property and health of the inhabitants of the municipalities but also had significant destructive effects on the countryside. At the same time, a number of hiking and cycling routes pass through the area affected by the tornado.

The present paper deals with the assessment of the condition of linear vegetation elements in the affected area. A total of 10 cadastral areas that were directly affected by the tornado were analysed. The analysis of the area will be useful for further proposals for the restoration or implementation of new windbreaks to mitigate the risk of wind erosion and other climatic extremes in this area, to increase the permeability and attractiveness of the landscape, and to support the construction of a new network of field roads, bicycle paths, and walk trails.

Key words: climatic change; erosion; cycling; tourism; linear vegetation

Introduction

The impacts of climate change are not only manifested in extremes of temperature and annual precipitation, but also trigger extreme weather events, often associated with severe wind erosion, soil erosion, air pollution and property damage (Fallon and Betts 2010, (Střešník et al. 2014).

The occurrence of wind erosion is mostly observed in dry and warm areas, intensively farmed and predominantly flat (Fryrear, D.W. et al. 2000, Doležal et al. 2017, Borrelli et al. 2014., Podhrázská et al. Such an area is also the region of southeastern Moravia, which was hit by a strong tornado in 2021. This event caused enormous damage to property, health and lives of the inhabitants of the communities in the tornado belt. The impact of this extreme event can still be seen today, not only on buildings but also in the open countryside, where permanent vegetation, especially linear vegetation, has been damaged. These features perform an irreplaceable function in the landscape, counteracting wind erosion and other weathering, improving the microclimate (Cleugh 1998) and helping to increase the recreational and tourist appeal of the area. They are landmarks along which link and access paths, used in many places as cycle routes, are routed. This is also the case in the study area, which is criss-crossed with cycle routes of local and international importance. This area has suffered greatly from the devastation caused by the tornado and it is necessary to work with experts to restore greenery not only to the intramural areas of the damaged villages but also to the open countryside. A study is currently being carried out to analyse the linear elements in the tornado belt with a view to proposing appropriate methods for their reconstruction and recommending the planting of new elements so as to gradually create an optimal network of windbreaks, which historically belong to this landscape.

Materials and methods

The area of interest is located in the districts of Breclav and Hodonín and includes 19 cadastral areas (c.a.) viz Fig. 1. The overview map of the area of interest also shows the categories of potential vulnerability of the area to wind erosion.

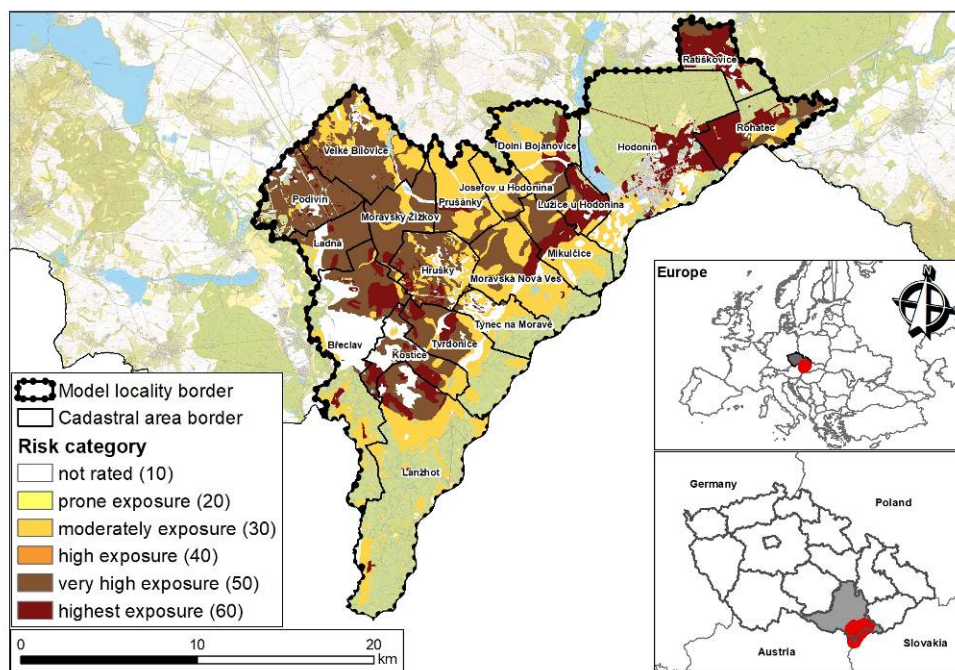


Fig. 1: Overview map of the area of interest, including categories of potential wind erosion risk

For the assessment of the risk of wind erosion in the area of interest, the valid methodological guidelines (Doležal et al., 2017, Podhrázká et al. 2021). According to the valid methodological procedures, a map of Potential Vulnerability of Agricultural Land to Wind Erosion was created, taking into account the effectiveness of protective vegetation barriers (Podhrázká et al. 2021). The map expresses the potential vulnerability of agricultural land to wind erosion according to soil and climatic characteristics. Among soil characteristics, it takes into account the vulnerability of both light and heavy soils. In terms of climatic characteristics, the map takes into account the influence of the soil surface (subsidence), wind conditions (frequency of winds above 10 m.s-1) and unfavourable winter conditions affecting the vulnerability of heavy soils (alternating temperatures above and below freezing). The map also includes an assessment of the permissible lengths of the assessed plots (Tab. 1), in the direction of the prevailing erosive winds. Data from the Czech Hydrometeorological Institute on the prevailing wind directions were used to determine the tolerable plot length.

Tab. 1: Tolerated land lengths (threat to land by wind erosion due to existence of wind barrier)

Risk category	Tolerated length of land
1 – 4	< 850
5	< 600
6	< 350

The map also takes into account the effectiveness of permanent vegetation barriers (Tab. 2). To take into account the effectiveness of these barriers, the methodology of Podhrázká et al. (2008) defining a buffer zone for windbreaks with a fixed value of 300 m for the buffer zone on the leeward side and 100 m on the windward side was used. The buffer zone for other vegetation barriers has a value of 150 m for the buffer zone on the leeward side and 50 m on the windward side.

The assessment was carried out on the detail of agricultural land blocks (PB) from the LPIS database. The PBs are clearly separated from the surrounding terrain features. This means that between adjacent PBs there is, for example, a landscape feature, a forest, a built-up area, a road (with a tree line), a watercourse or a water body (with riparian vegetation). These are features that can have a significant effect on the occurrence and progression of wind erosion. For all PBs, a maximum length in the direction of the prevailing erosion hazard winds was determined. According to the prevailing potential hazard and Table 1, the maximum tolerated length is determined. By comparing the maximum length of a parcel to the maximum tolerated length, parcels are identified where the length limit has been exceeded and are therefore more susceptible to wind erosion. For plots with an

exceeded tolerated length, a value of 1 was added to the rating at the last position of the code (Tab. 2). Thus, in the resulting layer of overall farmland vulnerability to wind erosion, the code designation of the vulnerability category is used to identify which factors are causing the parcel to be vulnerable. For clarity, the results of the analysis have been detailed to the cadastral areas of interest.

Tab. 2: Vulnerability categories of the resulting map of the overall vulnerability of agricultural land to wind erosion

Threat category without consideration of tolerated length	Threat category with consideration of tolerated length - Not exceeded	Threat category with consideration of tolerated length - Exceeded
1	10	11
2	20	21
3	30	31
4	40	41
5	50	51
6	60	61

Results and Discussion

The wind erosion risk assessment included 19 c.a. with an area of 40 thousand ha. The assessment was carried out on 19 thousand ha of agricultural land. Over 2 thousand PB were assessed in this area. The tolerated length was exceeded in 237 PB. These are the blocks with code designation 11, 31, 51 and 61 see Table 3. The assessed PBs with exceeded tolerated plot length cover 55.4% of the assessed area. This represents a majority of the total area assessed. The most represented category with exceeded tolerable length was the threat category - soils at high risk (28.2%). This rating indicates the need for implementation of additional stable vegetation features (e.g., windbreaks) in the area of interest.

Tab. 3 Percentage representation of the vulnerability category code in the area of interest

Hazard category code	Description of the code designation of the categories of vulnerability	Percentage of vulnerability category codes [%]
10	Unthreatened or protected by a wind barrier	12,8
11	Unthreatened, unprotected and too long	7,0
30	Land block slightly threatened, unprotected but within limit	19,6
31	Land block slightly threatened, unprotected and too long	10,1
50	Land block severely threatened, unprotected but within limit	10,0
51	Land block severely threatened, unprotected and too long	28,2
60	Land block most at risk, unprotected but within limit	2,0
61	Land block most at risk, unprotected and too long	10,1

The following assessment focused on the detail of the assessed k.u. in the area of interest. The following Table 4 shows the percentage of the hazard category code (exceeded/not exceeded tolerance length) per k.u. The highest representation of PB with exceeded tolerated length was in c.a. Hrušky (4.8%), the next most significant were Moravská Nová Ves (4.8%) and Lanžhot (4.7%).

Tab. 4: Percentage representation of the hazard category code (exceeded/not exceeded tolerable length) for the c.a. in the area of interest

Evaluated c.a.	Percentage of vulnerability category codes – not exceeded [%]	Percentage of vulnerability category codes – exceeded [%]	Total sum [%]
Hrušky	2,3	4,9	7,2
Moravská Nová Ves	3,1	4,8	7,9

Lanžhot	1,9	4,7	6,6
Břeclav	3,0	4,5	7,5
Moravský Žižkov	1,6	4,5	6,1
Velké Bílovice	6,0	3,7	9,7
Hodonín	1,9	3,2	5,1
Dolní Bojanovice	2,2	3,0	5,2
Podivín	3,0	2,8	5,9
Tvrdonice	2,5	2,8	5,3
Mikulčice	2,4	2,6	5,0
Kostice	2,3	2,6	4,9
Ladná	1,3	2,5	3,8
Rohatec	1,9	1,8	3,7
Ratíškovice	0,7	1,8	2,5
Týnec na Moravě	0,6	1,7	2,3
Lužice u Hodonína	0,5	1,5	2,0
Prušánky	4,8	1,3	6,0
Josefov u Hodonína	2,7	0,6	3,3
Total sum	44,6	55,4	100,0

Conclusion

The paper shows an assessment of the wind erosion problem on the example of a recreationally and tourist important area in the Czech Republic. At the same time, it is the area affected by the tornado of 24.6.2021, which caused significant damage to the property of persons, municipalities, and current vegetation barriers, including windbreaks, in the area of interest. An assessment of the potential vulnerability of the area to wind erosion, considering an assessment of the tolerated length of the land (soil blocks), confirmed the high potential susceptibility of the area to wind erosion. The assessment was prepared for 19 land areas. The results of the assessment indicate the need for further implementation of vegetation barriers (especially windbreaks). The proposed elements should appropriately divide soil blocks with high potential vulnerability to wind erosion. The reduction of extended soil blocks will also have additional ecological significance. Extensive hiking and biking trails in the area can be used for design and further implementation of vegetative barriers. The analysis of the area will be useful for further proposals for the restoration or implementation of new vegetation features to mitigate the risk of wind erosion and other climatic extremes in this area, to increase the permeability and attractiveness of the landscape, and to enable the construction of new networks of dirt roads, cycle paths and walking routes. The newly proposed measures will help to increase the recreational and tourist potential of the area.

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Souhrn

Příspěvek ukazuje hodnocení problematiky větrné eroze na příkladu rekreačně a turisticky významného území v ČR. Současně se jedná o území zasažení tornádem 24.6.2021, které v zájmovém území způsobilo výrazné škody na majetku osob, obcí a současných vegetačních bariér, včetně větrolamů. Hodnocení potenciální ohroženosti území větrnou erozí s přihlédnutím na hodnocení tolerované délky pozemků (půdní bloků) potvrdilo vysoký potenciál náchylnost území k větrné erozi. Hodnocení bylo zpracováno pro 19 k.ú.. Z výstupů hodnocení vyplívá potřeba další realizace vegetačních bariér (zejména větrolamů). Navrhované prvky by měli vhodně rozdělit půdní bloky s vysokou potenciální ohrožeností větrnou erozí. Zmenšení půdních bloků budou mít i další ekologický význam. Pro návrhy a další realizace vegetačních bariér je v tomto území možné využít rozsáhlé turistické trasy a cykloturistických tras. Analýza území bude přínosná pro další návrhy na obnovu či realizaci nových vegetačních prvků pro zmírnění rizika vzniku větrné eroze a dalších klimatických extrémů na tomto území, zvýšení prostupnosti a atraktivity krajiny, umožní budovat nové sítě polních cest, cyklostezek a pěších tras.

Contact:

Ing. Josef Kučera

E-mail: kucera.josef.jr@vumop.cz

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