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# Classification and analyze of non forest woody vegetation in agricultural landscape

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**Abstract.** Proportion of non forest woody vegetation in agricultural landscape of Slovakia has rapidly decreased during the last 50 years. There is about 2-3 % of non forest woody vegetation in lowland landscape and 5-6 % of it in upland landscape. Renovation of non forest woody vegetation is one of the priorities of the landscape planning, land arrangement or projecting a territorial system of ecological stability (ecological network). The first step is to mapping, analyzing and classifying the vegetation. The paper presents the classifying and analyzing of non forest woody vegetation in agricultural landscape on the model area of Vráble cadastre. The map of non forest woody vegetation was made according to aerial photos, and was actualized by terrain research. There was used a GIS software for analyzing and classifying. There were analyzed following characteristics of non forest woody vegetation: count, area, length, shape index, density, connectivity index, and accompanying percentage of non forest woody vegetation. The non forest woody vegetation elements were classified according to area categorizing, the formation process and factor, and functional importance.
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***Key words:*** woody vegetation in agricultural landscape, ecological network, agricultural landscape

## Methods

In the paper the concept of non forest woody vegetation is used in accordance to Supuka (1999) as woody vegetation out of urban areas, which is not part of the forest.
The map of non forest woody vegetation (fig. 1) was made from orthophotos with resolution of 1 m and was actualized by terrain research. The vegetation formations were classified according to area categorizing, the formation process and factor, and according to its function in the landscape. The area categorizing was made in accordance to Supuka (1999, 2000). The point elements were classified as groups of 1 – 3 woody species or solitaire. As the line units were classified line formations, when the ratio between wide and longiness is at least 1:5, and the patches were classified as all non-linear growths with more than 3 woody species.
Non forest woody vegetation growths have been created by the formation process, which is related with the formation factor. The classification in relation with the formation process was done according to Forman, Godron (1986) to these categories: disturbance patches, remnants, and planted patches. The evaluation of formation process and factors was based on species composition, environmental conditions, age and covering of the growths.
Many published works were devoted to categorization of function vegetation in landscape with different approaches. Many of those works are contently and structurally very close, differences are in approaches and

particularity level (Supuka 2000). The evaluation of the growths function was based on species composition, environmental conditions, age, covering, layering health conditions, size and shape of the growths. The functional categorizing was done according to Sláviková (1987) to these categories: soil conservation, hydric, climatic, biological, landscape-creative, hygienic, nature conservation, productional and recreational function.

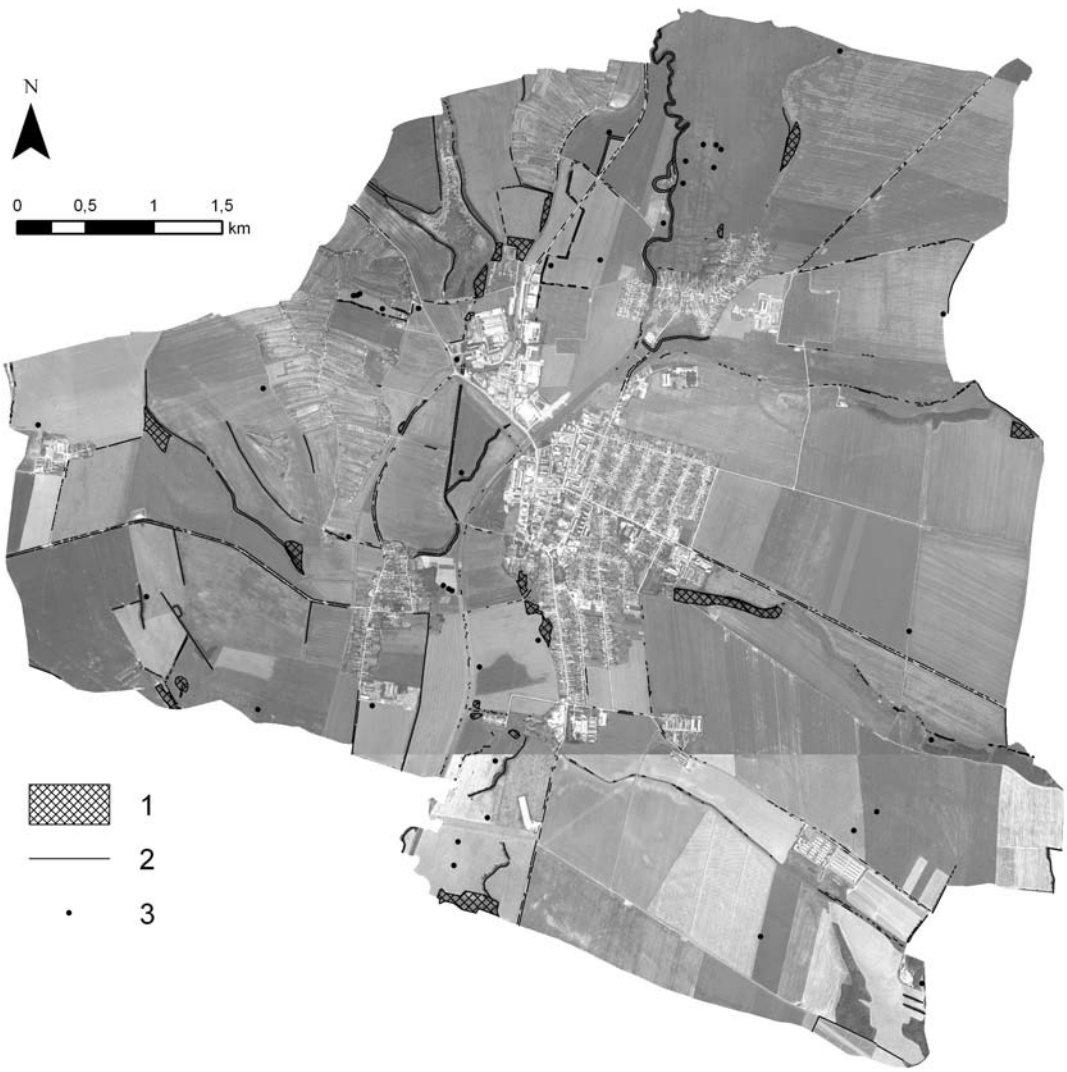


Fig.1. The map of the non forest woody vegetation in Vráble cadastral area (1 - patches, 2 – linear elements, 3 – point elements)

## Area categorizing

There were found 143 elements of non forest woody vegetation in Vráble cadastral area. The elements were classified as patches, linear and point elements. The area and a proportion index were counted for all the elements (table 1).

The proportion index quantifies area proportion of the rural area that is occupied by non forest woody vegetation. The Pi values are estimated by dividing the area of cover type by the total area of the entire rural area:

$$P_i = \frac{Cover\ type\ area}{Area\ of\ entire\ landscape}$$

Table1. Count, area and proportion of non forest woody vegetation elements

| elements | count | area (ha) | proportion index (Pi ) |
|---|---|---|---|
| patches | 26 | 28,333 | 0,0088 |
| linear elements | 77 | 63,121 | 0,0195 |
| point elements | 40 | 0,30 | 0,0001 |
| total | 143 | 91,754 | 0,0284 |

## Formation factor and process

Non forest woody vegetation patches in agricultural landscape stay mainly on areas, which are not accessible for agricultural utilization. It is strongly determinated by georelief. 8 patches are on the high-slope sides, 9 on wet areas with high level of groundwater. Another formation factor for non forest woody vegetation patches is good accessibility for the people, which live in the country (9 patches). These patches are mainly utilized for fruit production (orchards), wood production (groves), or are the tree growths on meadows. Special types of patches, which are next to urban areas, are the patches, which have not been ploughed-up, because of the plan for next development of the built-up area.

There are 3 main processes, which affect the origin of the non forest woody vegetation patches. First is disturbance of surrounding matrix (tillage), which leads to origin of the remnants (13 patches). Second is a disturbance. The patches had been ploughed-up but later, they have been abandoned (5 patches). Third process is the colonization of the woods, which has been planted as the orchards (6 patches) or as the groves (2 patches).

The linear elements of non forest woody vegetation exist along the roads or watercourse, on the fields boundaries, or been planted as an anti-erosion protection. All the road sides (28), 8 balks, 11 anti-erosion hedgerows and 4 waterside stands have been planted. Main disturbance process for the linear elements was the regulation of the rivers and streams. 13 stands were particularly or fully disturbed by the regulation. The remnants of the stream sides (8 stands) are ecologically most valuable corridors, 5 balks has also originated as the remnants.

The point formations of non forest woody vegetation are remnants or originated by the colonization.

## Functional classification

The non forest woody vegetation realizes primary 1 – 3 functions in the country. Beside that, it carries out secondary functions, which are not negligible.

The soil conservation function is realized by most of the formations. It is one of the most important functions in agricultural landscape according to sustainable development. Waterside-conservation function is carried out by the riparian stands. It's an important function especially by the streams, which were not regulated. The function effectivity depends on the connectivity and the species composition of the stands. Most effective are connected stands, composed by willows (Salix sp.) and alders (Alnus sp.). The riparian stands in Vráble cadastral area are scattered and not connected. The willows and the alder's growths are threatened by invasive species Negundo Aceroides.

Water-erosion protection function is carried out by the patches on the high-slopes sides, and by the anti-erosion hedgerows. The anti-erosion hedgerows are most effective in the protection, because of disconnecting a rain flow, which cause the water erosion. That effectivity depends on the wideness, species composition, and the deviation from angel of the contours. Most effective are the anti-erosion hedgerows in combination with a bank or a trench. Most of the hedgerows have been ploughed-out since the last 50 years, and now there are 17.73 % of the agricultural fields threatened by the water erosion (Lieskovský 2006).

Wind-erosion protection function is realized by wind-breakers, which are located only in the western part of the cadastre. The wind-breakers don't realize its function in the country properly. Acacia's growths are not toll enough, and poplar's growths are old and not connected. There is also a need to plant the wind-breakers in the eastern part of the cadastre. The best way is to plant them near the field roads (just 1% of the road edges are covered by the trees). By this way the occupation of the agricultural land can be minimized.
The hydric function is realized out by riparian stands, anti-erosion hedgerows, and by patches on the slopes and wet areas. It is realized by transformation of rain flow to underground flow. That causes a rise of underground water level, decrease of the water erosion and elimination of a flood risk. There was a huge slump of underground water level for the last 25 years. That is connected with the regulation of the streams, and liquidation of non forest woody vegetation in the 80's years.
The climatic function is carried out by all non forest woody vegetation, which reduces transpiration from the ground, increases relative air humidity, and reduces temperatures fluctuations. The most important function have wind-breakers, which reduce the wind speed, and that support moisture condensation, and reducing of temperature fluctuations near the wind-breakers. A microclimatic function is carried out by the point formations, which shadow could be a place for rest for the people or animals.
The biological function is significant for all the vegetation. The importance of this function is given by the absence of this function in agricultural landscape. The highest biodiversity have riparian stands of non-regulated rivers and remnants of meadow forest. The anti-erosion hedgerows seated in horizontal concaves are also interesting. These hedgerows lays on the boundaries between dry fields and wet concaves, so a lot of species ranging from xerophytes to hydrophytes could be found there.. The lowest biodiversity have the acacias growths. The components of non forest woody vegetation in Vráble cadastral area are isolated, and they are not connected to the ecological network. The connectivity of the network could be improved by renovation of the riparian growths (only 42% of stream sides are covered by the vegetation), which would be connected with wind-breakers, anti-erosion hedgerows and near-road vegetation.
The landscape-creative function is carried out by all the non forest woody vegetation. There is a need to improve this function by enlarging the proportion of the vegetation, especially on the stream-sides and road-sides (just 34% of main roads and 1% of byroads are covered by the vegetation.)
The hygienic function is realized by all the vegetation, the most important is the vegetation near the roads and urban areas.
In the study area there is not nature protected area, so the vegetation does not realize nature conservation function.
The production function shouldn't be a primary function for the non forest woody vegetation in agricultural landscape. The old orchards (6 formations) produce apples and plums. Nut-trees (Juglans regia), plums (Prunus domestica) and sloes (Rubus sp.) are presented in lot of non forest woody vegetation formations. From medicinal herbs, there are presented elders (Sambucus nigra) and roses (Rosa canina). Honey-production function is mostly carried out by false acacias trees (Robinia pseudoacacia). Some of the growths are also utilized for wood production.
The growths near the urban area are often used for the recreation, although there are no sidewalks or benches.

## Conclusion

The proportion of non forest woody vegetation in Vráble is 2,84 % of entire rural area, which is deficient. Non forest woody vegetation patches in agricultural landscape stay mainly on areas, which are not accessible for agricultural utilization. Disturbance of surrounding matrix (tillage) is the main formation process for the patches. The linear elements exists along the roads or watersides, on the fields boundaries, or have been planted as an anti-erosion protection. Most of them have been planted. The point formations have been planted or they are remnants. The highest biodiversity have riparian stands of non-regulated rivers and remnants of meadow forest. The lowest biodiversity have acacias growths.
Every formation of the non forest woody vegetation realizes many functions in agricultural landscape. The

most important is the anti-erosion function. A lot of the vegetation has been ploughed-up since last 50 years. The growths are isolated, the are not connected to the ecological network; the species composition is also not optimal, therefore the vegetation does not realize its functions in the country sufficiently.

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