OPPORTUNITIES TO IDENTIFY SUITABLE SITES FOR THE IMPLEMENTATION OF SMALL WATER BODIES ON DRAINED AREAS

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Abstract
The main purpose of drainage, as one of the traditional amelioration measures, was to adjust the water and air regime of agricultural soils, i.e. to optimise the moisture and aeration of soils in terms of plant needs, soil workability and its carrying capacity for agricultural machinery. Due to changes in the economic conditions, progressive erosion of the land, unprofessional or rather neglected maintenance, ageing of structural elements, etc., quantitative and qualitative changes in the water regime of entire river basins have been occurring for a long time. The possible existence of drainage structures enters into the design of virtually all types of water management measures on small watercourses and in agricultural catchment areas and should be taken into account and used appropriately in these measures. Drainage water can subsidise small reservoirs, pools and wetlands, but only if the applicable standards are met, the technical design is appropriate, and the required water quality is maintained.
The selection of the area for the implementation of small water bodies must be carefully considered with regard to the hydrological, morphological and soil conditions of the environment, the limits and possibilities of the area, especially with regard to the downstream processes in the area (management of the surrounding land, connection to the hydrographic network, etc.). In the present study, a procedure for the design and construction of small water bodies on drained land is presented using the outputs of a multi-criteria analysis based on the search for an optimal solution through the selected factors.

Keywords: drainage, pools, wetlands, agriculture, multicriteria analysis

Introduction
Wetlands and pools are biotopes specific to organisms that require a permanent surface water or at least a very high water table to exist and thrive. They form a transition between terrestrial and aquatic ecosystems. They represent a natural water reservoir in the landscape and have a significant retention capacity in the event of excessive rainfall. They provide suitable conditions for the existence of specific wetland organisms and are the natural habitat of a wide range of plants and animals adapted to life in wetlands. By wetland we can imagine a permanently, or only for a certain period of the year, flooded area or an area with soil that is permanently saturated with groundwater. These are areas that form a kind of transition between terrestrial and aquatic ecosystems. These ecosystems take many forms that are always different from the others. For example, there are marshes, pools, peat bogs, floodplains and forests. Unlike a pond, a wetland may be completely waterless for a temporary period during a drought, but once the water comes, life will resume. In the context of water management revitalisation, a wetland can be described as a waterlogged area of land, often with irregular shapes and an unclear interface between water and land, where water depths of about 0.6 m prevail. Parts of the wetland have developed open water and are partially covered with emergent plants. An artificial wetland can be created by shallow flooding of the terrain by excavation, or a combination of both. Pools and wetlands are of great ecological importance in the landscape as they are very rich and diverse and have a large biomass production. Their water and climate importance is mainly due to the fact that they hold significant amounts of surface and shallow groundwater. These water reserves are predominantly active within the catchment, as they are able to help balance conditions in times of rought.

Materials and methods
The aim of the study was to identify, through a multi-criteria analysis, locations suitable for the implementation of small water areas in the selected area. Multicriteria analysis is a method used when deciding between several alternatives, whereby multiple resulting alternatives are not allowed simultaneously and only one alternative should always be the conclusion of the analysis. A

prerequisite for using multicriteria analysis is a larger number of quantifiable criteria to include in the decision-making process. In practice, multicriteria analysis is implemented through GIS tools as a so-called raster analysis of suitability, in our case the suitability of implementing the MVP in a given area. The layers entered into the multicriteria analysis were the floodplain soils layer, hydrological soil groups, critical point watersheds, concentrated runoff pathways, trans-regional UES, remote sensing, historic ponds, and slope. After editing and converting to raster data, map algebra was used to obtain a weighted average of all layers in the form of a final raster map.
To test the applicability of MKA in a specific environment, the 4th order watershed No. 2-01-01-0810-0-00 in the foothill area of the Jeseníky Mountains, including the selected cadastral area of Větřkovice, was selected (Fig. 1).
The area falls within the geomorphological unit of the Low Jeseník, geomorphological subunit Vítkovská vrchovina. The central part of the Vítkovská vrchovina (Vítkovská vrchovina) is the Heřmanická vrchovina (Heřmanická vrchovina), its relief is very rugged, with large plateaus of an aligned character and valleys of watercourses sunken to varying degrees. For this catchment area, a section of the MKA layers was selected for the analysis of sites potentially suitable for the implementation of water bodies. The analysis of the identified sites in the area was further focused on the survey of the presence of drainage structures, their possible presence and the condition of the land indicating the limited functionality of the possible drainage and thus the suitability of the land for change of use.

Results

Based on the analysis of the area according to the MKA outputs, areas suitable for the implementation of small water areas were identified. The colour range of the legend is divided into 6 categories, according to the same interval. The higher the value of the interval (maximum value of the interval = 1), the more suitable the site is evaluated for the implementation of SSSIs. In the area of interest Větřkovice, the MKA reaches a maximum value of 0.39 and an average value of 0.12. (Fig.1)

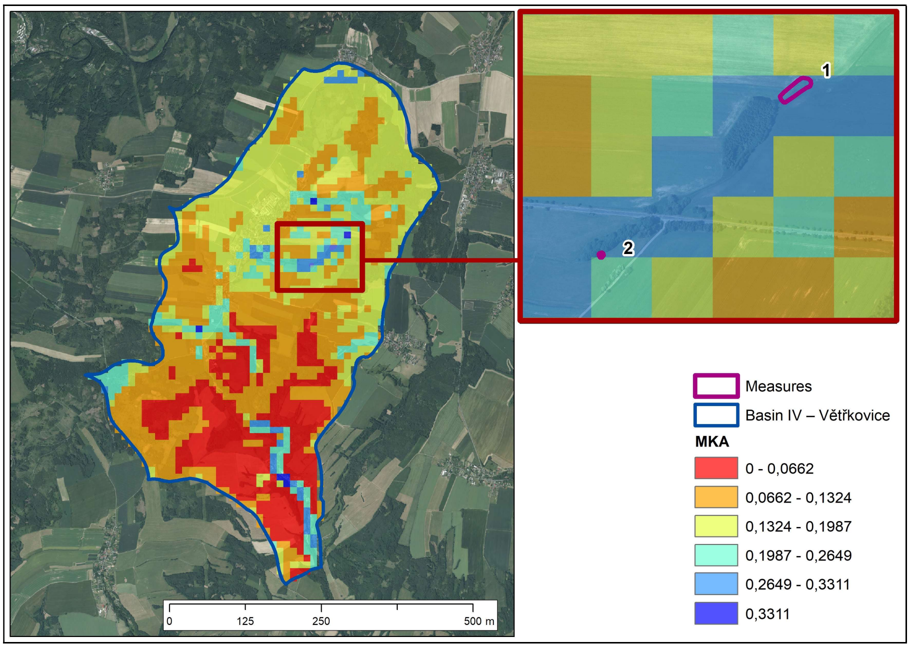

Fig.1: Area of interest

For the analysis of the existence of drainage structures, the LPIS.https://eagri.cz/public/portal/mze/puda/aplikace-mapove-podklady/uzitecne-aplikace database was used in the first phase. From many experiences it can be concluded that the digitized polygons of drainage structures may not fully correspond to the project documentation of the implemented structures. Moreover, they do not contain information on the location of detailed drainage facilities (drains).

Based on a detailed survey of the area and an analysis of the limits and possibilities for the implementation of the structures regarding the ownership relations in the area, in consultation with the landowners, land owned by the municipality in the immediate vicinity of the watercourse was selected.

These lands have not been used by the municipality for a long time due to their unfavourable hydrological regime. They were also not used by ZD Slezská Dubina because the waterlogged area could not be managed. The MKA value in the selected site is 0.29. In cooperation with ZD Slezská Dubina, project documentation for the selected site was subsequently traced. Figure 2 presents the proposed location of the water reservoirs on the basis of the drainage construction project.

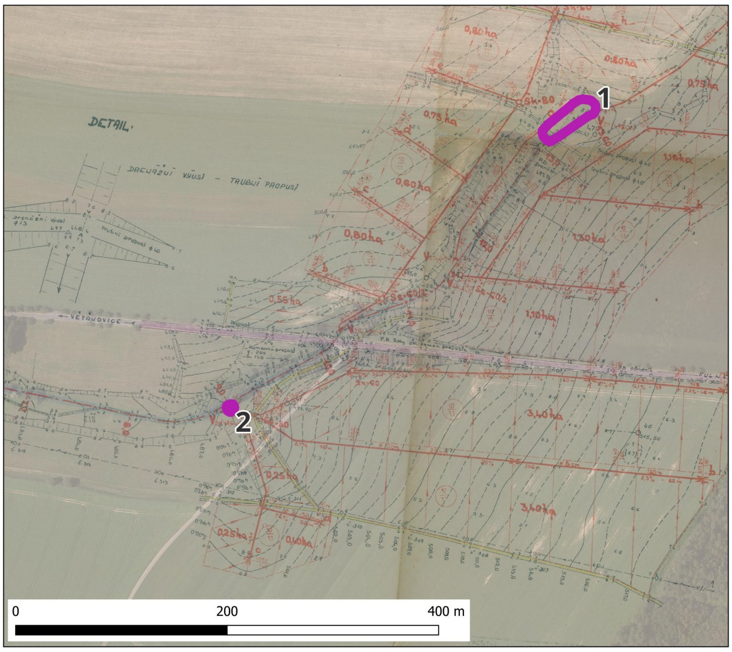

Fig. 2: Proposal for the location of water reservoirs on the basis of the drainage construction project.

Subsequently, project documentation was prepared for the construction of two pools in site 1 (measures 1) and a wetland in site 2 (measure 2) (Vysoudil, J., 2022). The construction of the pools (measure 1) was started in June 2023. During the excavation works, a drain running along the stream was uncovered. this drain was therefore discharged into the pools, its outlet part was blinded in order not to drain the pools under construction. In the case of the wetland construction (measure 2), the drainage drain was uncovered during construction, a new manhole was constructed, and the drainage was connected to the wetland. The pre-construction situation and the current status are documented in Figures 3 and 4.

Fig. 3: Site of interest before and after implementation of the pools

Fig. 4: Site of interest before and after implementation of the wetland

Conclusion

The proposed measures can be characterised as measures to improve water conditions in the area, which will have a positive effect on optimising the water conditions in the area. The proposed buildings are designed to improve the water conditions in the area. (GEON, Ltd,2022) The pools create another element of ecological stability, the primary purpose will be to create a wetland and aquatic environment for the preservation and restoration of aquatic habitat. The facilities have been complemented by the planting of landscape greenery.

The possible existence of drainage structures enters the design of virtually all types of water management measures on small watercourses and in agricultural catchments and should be considered and appropriately used in these measures (Kulhavy, Z. et al.2013).

It is suggested to differentiate the management of drained areas to the original drainage function where it is necessary to farm and ensure agricultural production. Or, on the contrary, to direct the drained areas to the non-productive function by implementing appropriate water management measures on drainage structures (e.g. creation and restoration of water features in the landscape with eco-stabilisation function such as pools, wetlands, blind arms and small water reservoirs, revitalisation, and renaturation of drainage water recipients, etc.). Of course, in such a way as to avoid undesirable degradation of the drained land. (Tlapáková, L. et al., 2021).

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Souhrn

Hlavním účelem odvodnění jako jednoho z tradičních melioračních opatření bylo upravit vodní a vzdušný režim zemědělských půd, tj. optimalizovat vlhkost a provzdušnění půd z hlediska potřeb rostlin, zpracovatelnosti půdy a její únosnosti pro zemědělské stroje. V důsledku změn hospodářských podmínek, postupující eroze půdy, neodborné nebo spíše zanedbané údržby, stárnutí stavebních prvků apod. dochází již delší dobu ke kvantitativním i kvalitativním změnám vodního režimu celých

povodí. Drenážní vody mohou dotovat malé vodní nádrže, tůně a mokřady, ale pouze za předpokladu, že jsou dodrženy platné normy, technické řešení je vhodné a je zachována požadovaná kvalita vody. Na základě výsledků multikriteriální analýzy vybraného území byly vytipovány lokality vhodné k realizaci malých vodních ploch. Byl následně proveden podrobný terenní průzkum, konzultace s vlastníky pozemků a hospodařícím subjektem a na těchto podkladech lokalizovány plochy pro výstavbu tůní a mokřadu na pozemcích se stavbami odvodnění, které již omezeně plnily svoji funkci. Následně byla vypracována projektová dokumentace a provedeny stavby tůní a mokřadu. Tyto objekty jsou dotovány drenážními vodami. Došlo k odkrytí drénů, jejich zaústěním do vodního útvaru a zaslepením výtokových drénů tak aby byla zachována funkce odvodnění pod stavbami. Výběr území pro realizaci malých vodních nádrží je třeba pečlivě zvážit s ohledem na hydrologické, morfologické a půdní podmínky prostředí, limity a možnosti území, zejména s ohledem na navazující procesy v území (obhospodařování okolních pozemků, napojení na hydrografickou síť apod.). V předkládané studii je uveden postup návrhu a výstavby malých vodních nádrží na odvodněných pozemcích s využitím výstupů multikriteriální analýzy založené na hledání optimálního řešení prostřednictvím vybraných faktorů.

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