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Ecological Conditions and Optimum Use of the Flood Area of the East Slovak Lowland in Czechoslovakia

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The region of the East Slovak Lowland (ESL) was originally a totally flooded area, at present it is only partly flooded. The area is situated in the basin of the Bodrog and Tisza rivers (from 142.7 km to 204.0 km: latitude 48.4°- 48.7°: longitude 21.5°- 22.2°), the latterg a tributary of the Danube river. At present the ESL is sloped downwards from north to south and southwest with small deviations in height (95 108 m, 103 m). The Zemplin Hills, the Chlmec Hills and numerous sandy dunes, ca. 20 m in height, give a variety to the Lowlands landscape.

The territory is characterized by a subcontinental climate with relatively short winters and long summers. The annual average temperature ranges between 8.6 - 9.6° and precipitation from 580 - 700 mm (Fig. 1).

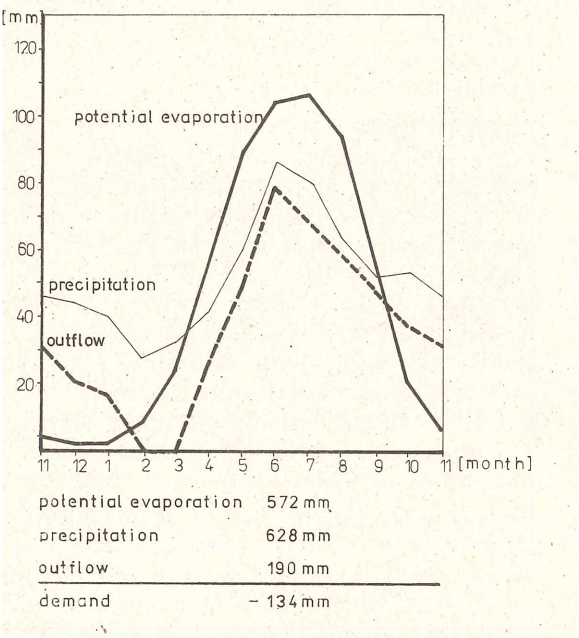

Figure 1

Basic features of hydrological regime

The geology of the territory is still undergoing a change due to complex neotectonic processes. At the beginning of the quaternary period the ESL already showed a marked depression. The rivers of East Slovakia flowed into the land and formed a large fresh water lake which gradually filled up with alluvial material. The conditions for the sedimentation in the rivers often changed and consequently extensions of the individual deposit surfaces are irregular. Quaternary rocks make up the main constituent. Neogean is represented by young tertiary sediments which developed and are of great varying thickness, the depth being about 30 m. In the flood area a heavy clay soil has developed. It forms an impermeable layer for the vertical penetration of underground water. Relatively young soils originated due to the heavy floods. The effect of the underground water made it gluey and the intensive evaporation left it salty.

The ESL region covers an area of about 50 x 50 km, that in the past used to be flooded several times a year, as a consequence on the one hand of the confluence – in a relatively small area – of a large number of rivers with rich catchment areas; and on the other, due to the differences in the slope of the rivers: 0.3 % 2 %. To prevent floods, embankments were built, starting in the 17th century: and only completed in the fifties. Later, relatively large hydromelioration systems were built to lead off the surplus water accumulating in the depressions (areas lying 1-3m under the level of the nearest river bank) which pumped the water from the channels into the rivers. Presently there are some in the ESL region and additional hundreds of kilometers are under development, including the construction of 8 pumping stations. In spite of this, however, there are floods erery year – especially in the spring, when the soil is still partly frozen – on more than 20 % of the depression areas from which gravitational flow is either not possible or highly complicated, necessitating a new management measure for surface draining. Almost the whole area is still tectonically unstable, changing up to 2 mm annually.

The flooded area of the ESL region can be divided into two parts:

- the area between the embankments inundation territory
- the area outside of the embankments territory – land used for farming.

1. Floodlands inside of the embanked territories

All the large rivers in the plains are embanked, some are above the level of surrounding plains. The total surface of the inundation territory is more than 8000 ha. The structure of the land has changed considerably. After the initial disappearance of the forests, natural and artificial afforestation have been taking place. The succession processes tend to create conditions favorable for the development of the original riverine forests. The shortening of the length of the riverbed has caused increased turbidity due to the unsuitable conditions for the accumulation of the sediments. Biological research projects have been only at the inventory level. Considerable attention has been paid to the area of the river Latorica since the variability of the flow is extraordinarily large. Special attention has been paid to the original function of the inundation territory to accumulate and drain foreign waters by the bio-technical manipulation of forest plants to increase the discharge surface of the inundation territory of the Latorica. The total area of the forests in the district of the Latorica flooded area is about 1000 ha. The following types of forests occur there:

1. Salicito-Alnetum 0.93 %
2. Querceto-Fraxinetum Ulmeto-Fraxinetum 70.45 %
3. Ulmo-Fraxinetum Carpinetum 28.62 %

The present composition of the forests that favors bottomland hardwood species (77,7 %) to willow/poplar woods (Weichholzaue) 29,3 % does not comply with the required hydrological function. Thus, it is necessary to increase the proportion of cultivated poplars to 63 % and decrease the proportion of hardwoods to 37 % (CIFRA and KOHAN, S. 1985).

Originally extensive riverine hardwood forests lay along the territory of the main rivers. Due to the embankment of the rivers the frequency of flooding increased, producing favourable conditions for riverine softwood forests. Besides the district along the Latorica, original willow/poplar forests occur along almost every river in narrow strips with larger or smaller interruptions. Comparatively large surfaces tending to develop climax communities, i.e. hardwood forests, yield from time to time floodlands, so-called polders, which serve as retention areas during floods.

In the district of the flooded area of the Latorica there are 3 reservations. The aim is to protect the natural character of the forest communities and to observe the changes brought about by the hydrological regulations.

In the Latorica district complex ecological studies of the avifauna, Mammalia, herpetofauna and also of the hypo- and epigeic fauna were carried out. The results show quite clearly that the narrow strips of forests along the river banks are of great importance from the point of view of the gene bank protection and their positive effect on the surrounding agricultural land. They are a component of biocenters and biocorridors in the local system of ecological stability (sensu LÖW J. 1985). The hydrobiological and ichthyological research of the so-calles ming pits showed suitable nutrients for fish and favourable conditions for their reproduction and development. With the floods come several species of freshwater organisms: *Haringia eucopa, Lecane ohioensis, Stizostedion volgense.* It is interesting to note the absence of typical steppe and forest-steppe elements, e. g. *Calandrella brachydactyla hungarica, Glareola pratincola* and also the subterranean species, *Spalex hungaricus,* in the observed territory even if they occur in the southern part of the Potiska plain. The numerous colonies of *Ardea purpurea, Chlidonias nigra* and *Anthus campestris* indicate good conditions for nesting. In the territory under observation *Pelecanus onocranatus* has been seen again in recent years. In earlier times they were often seen in the inundation areas. Very precious also from the viewpoint of nature and landscape preservation are *Lacerta vivipara,* from the glacial period and the endemically occurring *Emys orbicularis,* furthermore some protected plants, such as *Trapa natans, Nympha alba, Nuphar lutea, Stratiodes aloides, Aldrovanda vesiculosa, Marselia quadrifolia, Becmania euruciformis.* At present an act is being drawn up to protect landscape elements of „considerable capability to conduct favourable water management", i. e. riverine forests and open water surface for the improvement of the structure of the area (TEREK, MATAS 1983).

2. Floodlands outside of the embanked territories

Much attention has been paid by scientific workers and experts in recent years to the embankment territory to develop fertile agricultural area. Why? Because the investments made on improvement processes did not meet expectations. The improvement measures (applied up til now) tending to level up the ecological conditions, have disturbed – to a greater or lesser degree – the natural structure of the landscape by decreasing the proportion of the meadows and pastures, eliminating the tree belt and by desiccating the natural water reservoirs which were often the only source of humidity in the summer months.

Ecologists come to help the matter, harmonizing nature with human activity. Optimum use of the area starts with ecological analyses, synthesis, interpretation and evaluation, finally giving the optimal measures elaborated on the basis of the LANDEP (Landscape ecology planning) method (RUZICKA, MIKLOS 1982). There is much information available, e.g. in zoology about 1300, in botany 900. The basis for the optimal utilization of the area is to know its features and to have them coincide with the demands of human activities. The useful features and their suitability to different activities of the society can be interpreted from the existing state and dynamic of the landscape.

We devoted the most attention to the hydrological regime which should solve the problem of native water ressources. The evaluation of the spatial relations of the geosystems and their interpretation from the viewpoint of the water regime (conditions of waterflow) helped to understand the water flow dynamics in the territory. We analyzed the synergic properties on the basis of the determination of the absolute and relative heights, the determination of the relief slope angles, the determination of the boundaries of the gravitation directions, the delimitation of the gravitationally homogeneous surfaces, the determination of the direction of the surface flow in a microbasin respecting the physical properties of the soil and the surface cover (MIKLOS, HRNCIAROVÁ, KOZOVÁ 1987). By the analysis

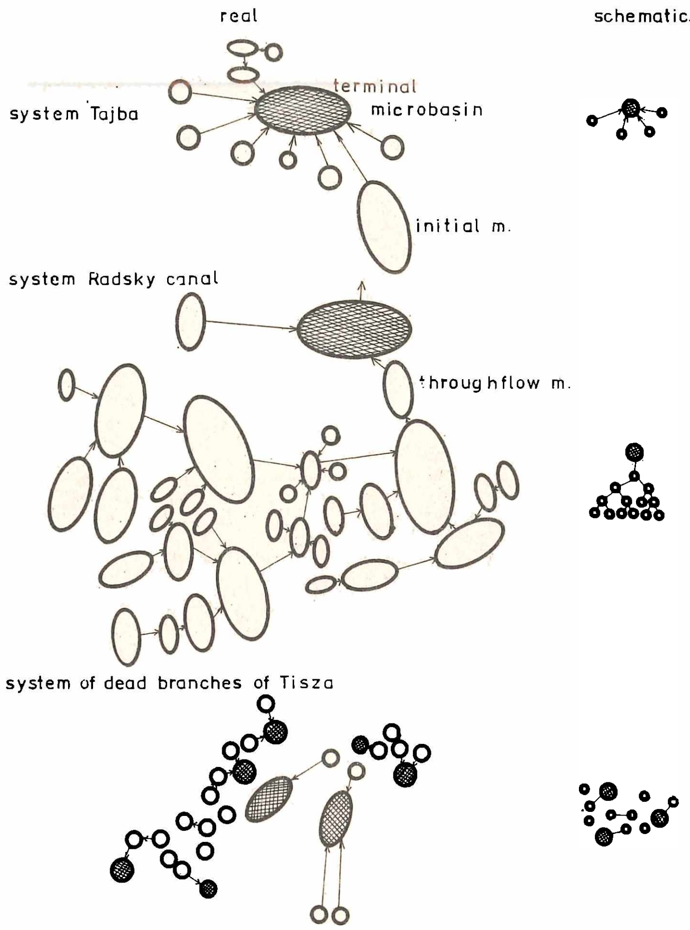

Figure 2

Different shape of the hydrological system patterns

of the synchoric properties of the system the individual microbasins were differentiated: they are either gravitational, i.e. along the riverbeds, channels simply spreading by the declivity of the ground, or are structural, i.e. they have common boundaries, but neither matter nor energy join them. A further step in the evaluation is the position of the microbasins (Fig. 2). It is necessary to determine the spatial relation of every micro-basin to the neighboring surfaces in the direction of gravitation. By the mutual comparison of the neighbouring surfaces we were able to determine whether the microbasin is:

- initial, from which there is only water outflow
- through-flow in which there is inflow and outflow
- terminal, where only inflow exists.

By synthesis we formed homogeneous units with exactly defined properties enabling us to make a theoretical scheme of evaluation for the selected aspects of the spatial structure of the hydrological systems (Fig. 2). The spatial arrangement of the basins with the directions of the flow marked is the starting point for further improvement measures, especially for the leading off of surface water from the agricultural soil and the building of retention areas. When proposing the optimal solution for water economy measures, the information on the water demand and the total balance of the precipitation-outflow relations have been initially considered. Considering that the annual mean precipitation is 682 mm (STASTNY 1985 (Fig. 1)) and that the annual mean evotranspiration and outflow are 572 and 190 mm, there is water deficit in the territory, consequently it is necessary to accumulate water in the district, especially in the soil. At present it is technically to demand to increase the accumulation of water in the soil. The accumulation of water in small reservoirs seems to be a possible realization contributing to improve the land, besides, they relieve the channel system at flood time. The distribution of water surfaces does not make a great demand on the localization from the hydrological point of view. It may be solved by gravitation or by emplying pumping stations (Fig. 3). There is about 5000 ha not used for agricultural purposes that could be turned into water bodies. The ecological criteria for the localization of the water surfaces have been elaborated (TEREK 1986).

The rules of water movement in relation to the physico-chemical properties of little permeable soil humidified atmospherically present conditions for surface outflow. The agricultural lands connected with the channel system by gravitation have no problem with the surplus water during floods. The catch-drain net system should be led in the lowest places of the microbasins (KRAVCIK 1987).

Joining the draining channel to the water surface and the pumping station yields conditions for:

1. Solving water economy problems (improve the protection of farmland against floods, improving

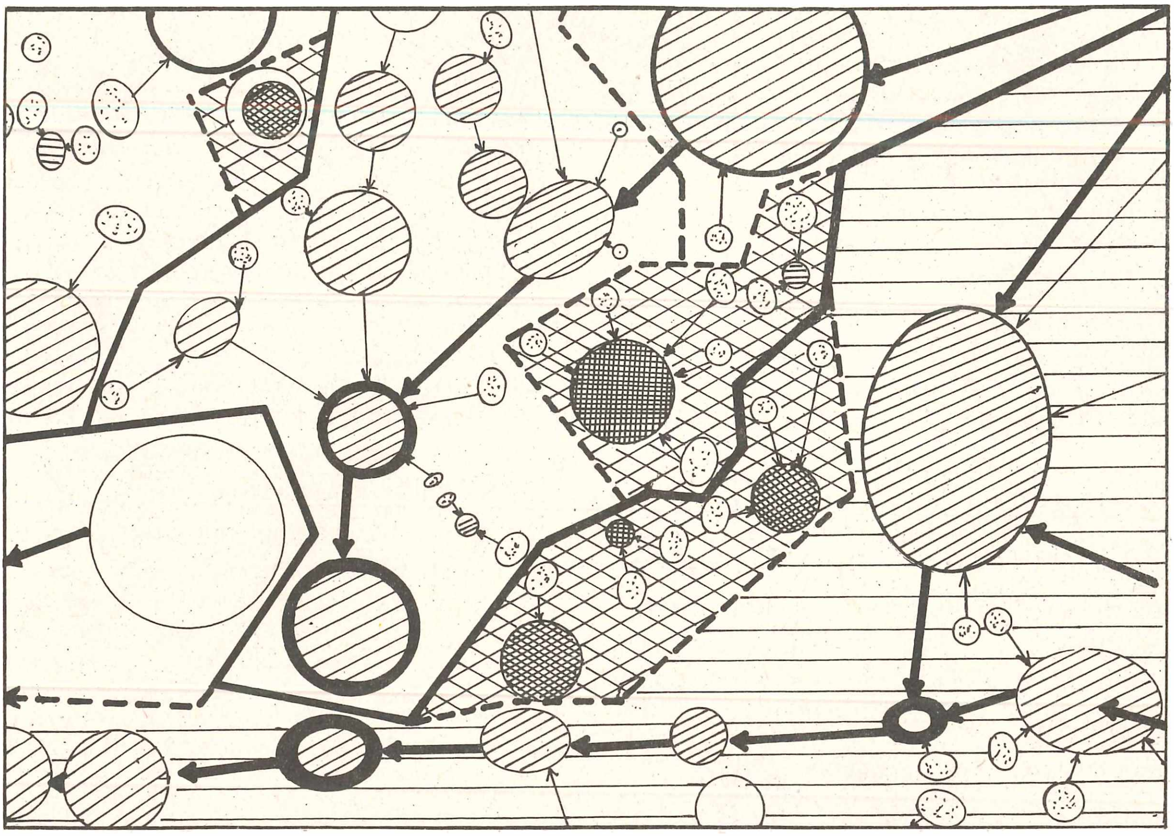

Figure 3

General graphic model of hydrological systems and their chosen problems
(cut -out-southern part of East Slovakian Lowland)

Basis elements of the model and interconnection of microbasins
- microbasins of different size
- interconnection of microbasins by channels
- interconnection of microbasins without channels

Types of microbasin positions
- dunes (initial microbasins on sand dunes)
- lowland initial microbasins
- through-flow microbasins
- terminal elements of relatively independant depressions
- relatively independent inter-dune depressions (terminal microbasins)

Territorial classification of the hydrologic systems
- boundaries of the systems
- boundaries of subsystems of different order

Determination of the type of structure of hydrologic systems
- cascade system
- morphological system
- controlled system

Categorization of key surface problems
- the smallest expected problems resulting from high water volume
- ⇓
- the greatest expected problems

the effectivity of pumping stations, decreasing the changeability of inflow into the channel system),

2. Solving agricultural problems (developing conditions for the regulation of the water regime in heavy soils, decreasing water deficience, increasing the stability of crops and establishing conditions for developing irrigation),

3. Solving ecological functions in the territory (confirming the ecological stability of the territory, increasing retention capacity, utilizing agricultural nutrients),

4. Solving energetic problems (decreasing energetic investments into agricultural lands, decreasing management demands of the water economy system, decreasing and making more effective investments, decreasing the technological demands in producing water surfaces instead of pumping stations,

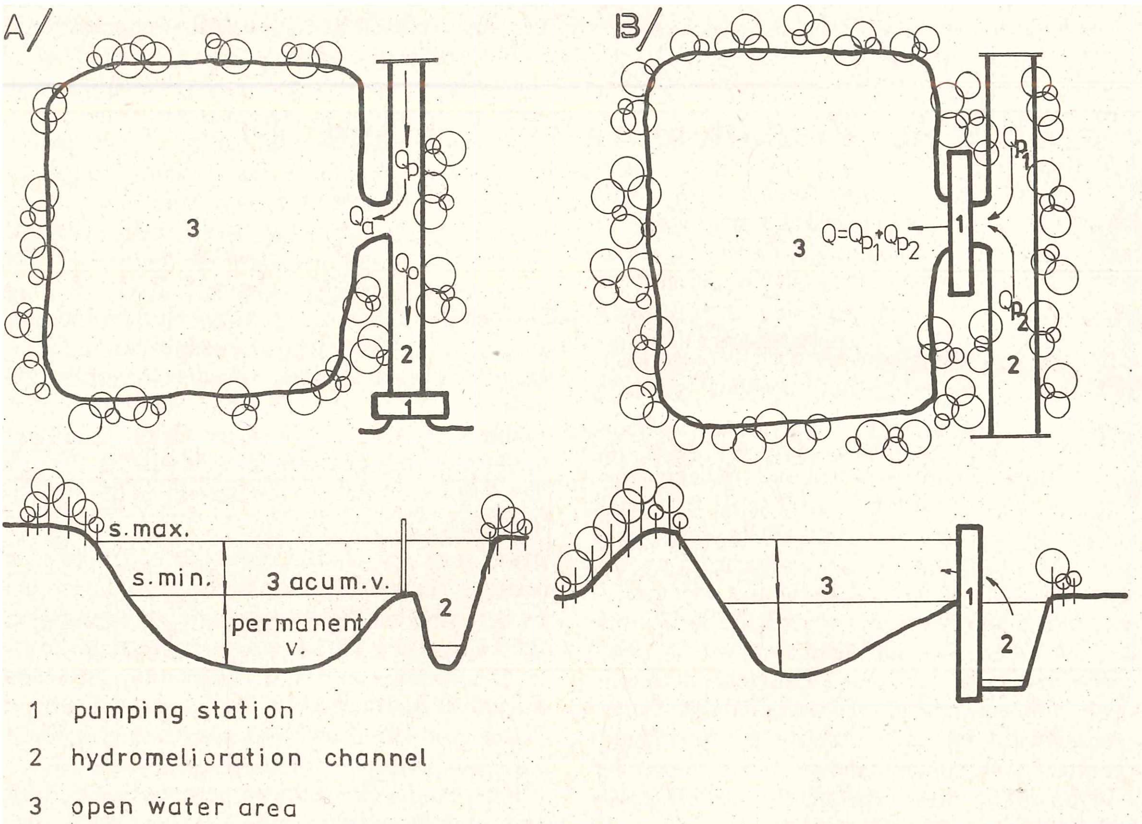

Figure 4

Ways of joining water bodies with channel

5. Other functions (sport fishing, semi-intensive fish production).

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