

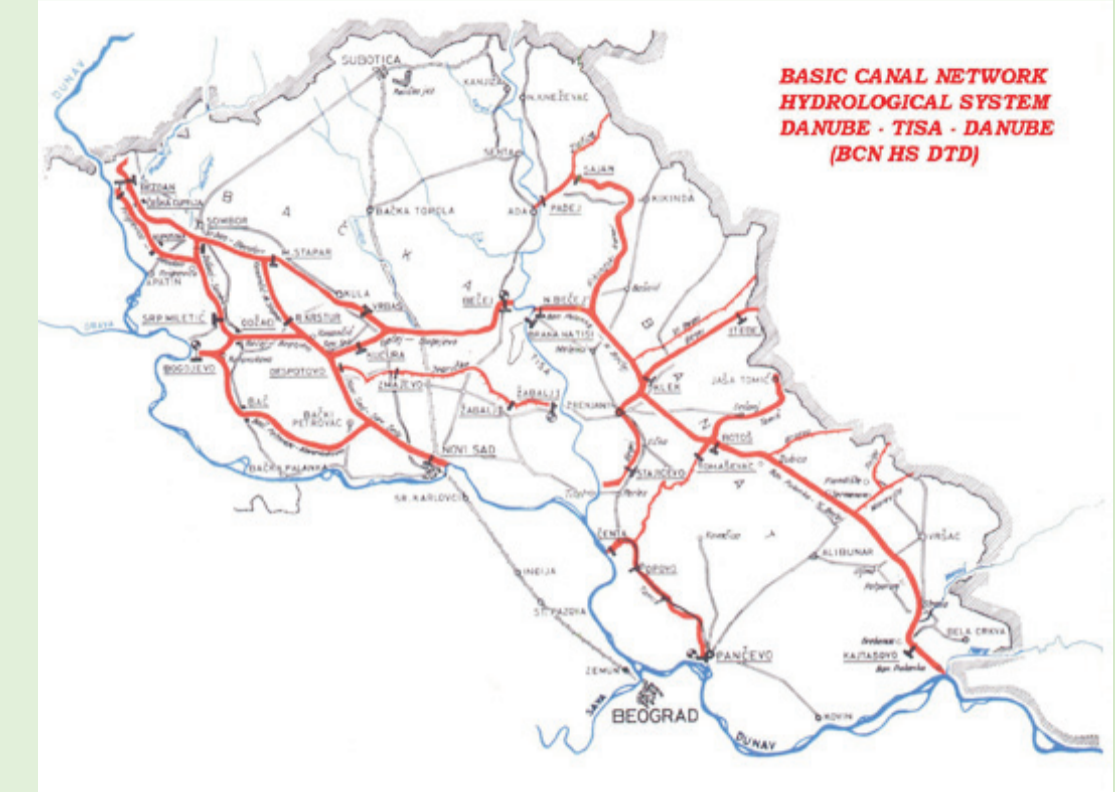
INFLUENCE OF IRRIGATION AND DRAINAGE TO AGRICULTURE PRODUCTION IN VOJVODINA PROVINCE

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Abstract The plain part of Vojvodina province is characterized by a relatively favourable soil, climatic and hydrological situation. However, in the course of the last two centuries extensive measures have been undertaken to protect the land from the action of unfavourable external waters and from excessive waters, along with the development of the system for irrigation. All these measures have created the conditions enabling fine regulation of the soil water-air regime as the basis for agricultural production and the development of the region as a whole. This paper is a review of natural characteristics of area and the size of water engineering projects grew (flood protection, drainage, irrigation), followed by numerous practical problems. In recent years it has become more and more evident that within the present water management system still not enough account is taken and use made of the interrelationships within the water systems.



CLIMATE, SOIL AND HYDROLOGICAL CHARACTERISTICS

The plain region of Vojvodina is distinguished by relatively favourable climate, soil and hydrological characteristics. However, in the course of the last two centuries extensive measures have been undertaken on the protection of the region against unfavourable action of external waters, land protection against excess water, as well as on the development of irrigation systems.

In the recent decade, climate extremes have been registered, either in the air temperature, amount of precipitation, or extreme hydrological occurrences manifested as the level and duration of high/low water stages. The sequences of favourable and unfavourable distribution and amounts of precipitation, external and internal waters, are of a certain cyclic nature. Some recent investigations (Savic i Salvai, 1997) have also pointed to the existence of these natural cycles that are characterized by the periods of 8, 11, and 28 years.

With the aim of reducing the disproportion between the water requirements and its available quantities, about 20 accumulations have been built in the region of Vojvodina in the course of the last 30 years. Before that, the Hydrological System Danube-Tisa-Danube (HS DTD) has been constructed with the objective of making for the potential water shortage and collecting the excess or used waters.



FLOOD PROTECTION

Protection of land against adverse influence of external waters had in the beginning a local character. The embankments along the Danube and the Tisa constructed in the 19th century serve even today as the basis for the lines of protection against external waters. The most extensive works on modernization, i.e. reconstruction of protection embankments, were undertaken after the high waters of the Danube in 1965 and of the Tisa in 1971.

Peak elevation of the embankment crown was set for the 1% water. Apart from the reconstruction of the old embankments, some new ones have been built, accompanied by reconstruction of some auxiliary objects (watchman boots, telephone lines, roads, long-distance power lines, etc.). The maintenance of the objects for flood protection and their present state, despite of the existence of numerous problems, can be considered satisfactory.

DRAINAGE

Digging of canals has enabled transformation of more than 1/3 of the Vojvodina region into arable land. Before these undertakings that land was seasonal or perennial bogs and marshes. Nowadays, the Vojvodina region has a network of almost 20,000 km of these canals. About 60% of the drainage systems gravitate to natural water courses and the rest serves to evacuate the collected excess waters to the Basic Canal Network of the Hydrological System Danube-Tisa-Danube (BCN HS DTD). The digging of about 900 km of the BCN HS DTD, officially completed in 1975.

In the course of the 20th century, more than 100 pumping stations were constructed with the individual capacity up to 30 m³/s and a total capacity of about 400 m³/s. First such station was built in the far 1896. Besides, a number of other smaller objects for regulation of water level and flow have been built on the drainage systems. Among them, most numerous are culverts and bridges, about 20,000 in number.

Despite of the fact that Vojvodina is covered with the canal network and the necessary constructions on the drainage systems, floods caused by internal waters have occasionally occurred. In 1942, year flood endangered about 420,000 ha and in 2000 about 700,000 ha, mostly of agricultural land. From the aspect of reclamation, the year 2000 was especially interesting as the winter-spring period with large excess of water was followed by a dry summer with extremely large amount of rain in July.



| Land reclamation area | Drainage area (ha) | Thick of canals (m/ha) | Culverts (piece/km ²) | Pumping stations (m ³ /s) |
|-----------------------|--------------------|------------------------|-----------------------------------|--------------------------------------|
| Zapadna Bačka | 169,054 | 10.68 | 0.67 | 16.25 |
| Severna Bačka | 101,575 | 2.10 | 0.41 | 0.80 |
| Senta | 93,717 | 3.97 | 0.50 | 7.36 |
| Krivaja | 76,783 | 2.07 | 0.13 | 0 |
| Srednja Bačka | 52,048 | 7.95 | 0.68 | 8.50 |
| Bačka | 103,426 | 7.63 | 0.98 | 4.00 |
| Dunav | 128,275 | 10.05 | 1.15 | 24.37 |
| Šajkaska | 191,835 | 7.45 | 0.59 | 37.16 |
| Gornji Banat | 189,959 | 11.35 | 0.82 | 54.77 |
| Srednji Banat | 255,799 | 9.25 | 0.68 | 50.69 |
| Tamiš-Dunav | 138,064 | 5.90 | 0.43 | 24.86 |
| Podunavlje | 72,564 | 9.02 | 0.57 | 24.76 |
| Juzni Banat | 212,495 | 9.58 | 0.44 | 32.70 |
| Galovica | 194,341 | 13.38 | 0.53 | 47.05 |
| Bosut | 162,866 | 13.05 | 0.45 | 44.97 |
| Vojvodina | 2,143,401 | 8.81 | 0.61 | 378.24 |

IRRIGATION

At the present, about 40,000 ha are irrigated. Those areas that have available sources of water, primarily surface watercourses and accumulations, serve for growing mercantile crops, seeds and vegetables. With the exception of the northern Bačka region, irrigation of perennial plantations is not still widely practised. It can be assumed that in the existing circumstances of irrigation in Vojvodina there are no problems in supplying the necessary amounts of water. However, the problem of suitability of the water for irrigation is becoming more and more acute. It appears that the intensity of water requirement is in an inverse proportion to the quality of available water. Namely, in the regions of Northern Bačka, Northern and Middle Banat, which are characterized by somewhat smaller annual sums of precipitation and its unfavourable distribution, and where the requirements for irrigation are most pronounced, the water quality is significantly worse compared with that in other parts of Vojvodina.



CONCLUSION

The paper presents a creative way of living with water in Vojvodina. Such a way enables the potential of water system to be used more than has been done in the past. Moreover, a management system offers the prospect of solving major problems of the moment such as water quality. The social use and the functioning of these water systems as an ecosystem will thus be improved, with all the accompanying social and economic benefits.

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