

## DRAINAGE SYSTEM MAINTENANCE PROBLEMS IN THE MELIORATION REGION OF VDP "JUŽNI BANAT"

**D. Rudić<sup>1</sup>, Nevenka Djurović<sup>1</sup> and Radmila Pivić<sup>2</sup>**

**Abstract:** The aim of this paper is a case study of a melioration region, which will show the state of the channel network, as well as the scope of the implemented maintenance measures, which resulted in the reduced functionality of the drainage system.

Melioration channels are in most cases in the function of drainage, and a minor number has a double function (drainage and irrigation). The dense network of channels, erected throughout the catchment area, is capable of receiving all the design surplus water.

However, during the past decade, the channel network was not maintained to the required level, which caused the reduced functionality of the drainage system. The channels are invaded by annual and perennial plants, channel cross-sections are silted with mud, there are landslides of the slopes, parts of water cross-sections are blocked, etc. These are the consequences of the inadequate maintenance of the drainage system and the accompanying structures.

**Key words:** melioration region, drainage channels, functionality and maintenance of the drainage system.

### **I n t r o d u c t i o n**

Drainage systems are constructed throughout a considerable area of hydromorphic soils in Serbia. On many soils, there is a dense channel network, which can accept the design surplus water. However, insufficient maintenance reduces the functionality of the drainage system. The phenomena, such as the channel obstruction by annual and perennial plants, mud silting of the channel

---

<sup>1</sup> Dragan Rudić, PhD, Professor, Nevenka Đurović, PhD, Assistant Professor, Faculty of Agriculture, 11081, Belgrade-Zemun, Nemanjina 6, Serbia and Montenegro

<sup>2</sup> Radmila Pivić, M.Sc., Research Associate, Institute for Soil Science, 11000, Belgrade, Teodora Dradžera 7, Serbia and Montenegro

cross- sections, sliding of the channel slopes, blocking the parts of the water cross- sections, etc., are the consequences of inadequate maintenance of the drainage system and the accompanying structures. As one of the main directions in the development of drainage in the future period is the reconstruction and the renewal of the existing systems, it is necessary to assess their state, as well as the reasons of their reduced exploitation capacity.

The aim of this paper is a case study of a melioration region, which will show the state of the channel network, as well as the scope of the implemented maintenance measures, which resulted in the reduced functionality of the drainage system.

### **Material and Method**

The Southwest part of the Carpathian foothills and Vršачko Brdo, between the river Brzava and the river Nera, is a unique hydrogeographic region. This natural entity is divided by the state border between Serbia and Romania in two parts. The boundaries on the Serbian side, i.e. the melioration region "Južni Banat" are: Deliblatska Peščara (Sands) and the river Danube in the Southwest, the river Nera and the state border in the Southeast and Northeast, and in the Northwest, the river Brzava and the border line between the municipalities Pančevo and Alibunar. The channel Danube-Tisa-Danube passes through the centre of the territory from the Northwest towards the Southeast. (3)

This region is characterised by two types of terrains: hilly-undulated in the Southeast part and lowland in the North and West parts. The climate can be characterised as moderate continental with the specificities of the semihumid climate. The climate parameters are favourable for the occurrences of sudden peak floods in the torrential catchments.

Groundwater occurs as phreatic water and artesian water. Phreatic waters are formed by precipitation and by the water of the surface flows of the Danube, Nera, Karaš, Guzajna, Keveriš and other watercourses. During the winter-spring period, they are at the depths of 0.5-1m. Before the channel network construction, they reached the surface of the terrain. Artesian water occurs at greater depths and frequently it is poor quality water: saline and with plenty of coal ingredients. Land cover is very diverse. There are 45 soil types, subtypes and varieties, and the majority are the soils of heavy mechanical composition.

The works on the regulation of soil water regime started more than 200 years ago by the construction of the first channels at the time when this area was under the Austro-Hungarian Monarchy rule. During the subsequent period, the population tried to mitigate and solve the water management problems through different forms of organisations (Water co-operatives, water communities, water organisations, etc.).

### Drainage

This melioration region is characterised by the following:

- 2,413.01 km of drainage channel network, situated in 27 drainage basins.
- These basins cover the area of 155,209 ha.
- At this moment, the total volume of excavated channel network without the volume before the reconstruction and without the volume of silt removal is 19,491,463 m<sup>3</sup>
- Within the drainage basins, and aiming at the normal function of traffic within and outside the catchments, 640 box culverts of different diameters were constructed, 42 frame culverts of various dimensions, as well as 679 pipe culverts of various lengths and diameters.
- To evacuate the surplus water from the catchments into the receiving stream, 16 pumping stations were constructed, total capacity 46.66 m<sup>3</sup>/sec, as well as 42 gates of various types and dimensions.
- Total area covered by the channel network amounts to 2,536 ha.
- 167.73 km of embankments were constructed during the regulations of the flows of the Brzava, Moravica, Rojga, Granični Nasip, Vršački Channel and Mesić, DTD, the Danube and Nera.
- To protect the settlements (Vršac and Veliko Središte), floodwater retarding structures were constructed, i.e. the dam Mesić and the dam Veliko Središte.
- 7 channel controls with their functional structures were constructed on the structures for flood control.
- Within the drainage catchments or drainage systems, altogether 15 buildings of pumping stations or channel controls were constructed.
- 80 piezometers and 35 excavated wells are observed in the region in order to monitor the first aquifer.
- The horizontal tile drainage was installed over the area of 5,000 ha for the efficient regulation of soil water and air regime. About 20,000,000 meters of drain pipes of various diameters with different filter materials were installed. (1,2)

Based on the assessment of the general state of the region "Južni Banat", it can be concluded that the region is dissected by a dense network of natural and artificial flows. Natural watercourses are the rivers and streams, and the artificial watercourses are melioration channels which are in most cases in the function of drainage, and a smaller number has a double function (drainage and irrigation). By the construction and completion of the primary channel Danube-Tisa-Danube, all water from this hydrographic region is directed into the Danube near Banatska Palanka, instead into the river Tamiš. The channel DTD is the receiving stream for almost 99% of the internal and external waters, and to the lesser degree the recipient is the Danube, i.e. Nera.

## Results and Discussion

### Maintenance of drainage system

The following works should be emphasised in the framework of the necessary works for the maintenance of water structures:

The works on the maintenance of the drainage system

The works on the maintenance of protection structures.

The works on the maintenance of the drainage system include:

-Functional works which include the work of engineers and technical staff, water-management workers and pumping station operators,

-Silt removal from the channel network and excavation of intervention channels (machine/m<sup>3</sup>, machine/hour, manual/m<sup>3</sup>),

-Spreading of excavated material and old waste heaps (m<sup>3</sup>),

-Installation of pipe culverts with the procurement of the material,

-Machine and manual mowing of annual plants and cutting of woody plants with the removal from the cross sections,

-Maintenance and overhaul of pumping plants, work on mechanical pumping of water into the recipient, as well as the maintenance of electrical plants.

The works on the maintenance of protection structures include:

-Functional jobs referring to the work of engineers and technical staff, water-management workers and pumping station operators,

- Grading of the top of embankment,

- Mechanical and manual mowing of the top and the slopes of embankment and the five-meter wide belt,

- Brushwood cutting, mechanised and manual,

- Weed treatment with herbicides,

- Weeding of the embankment facing,

- Maintenance of embankment gates and marks,

- Grass mowing in the channel and brushwood cutting,

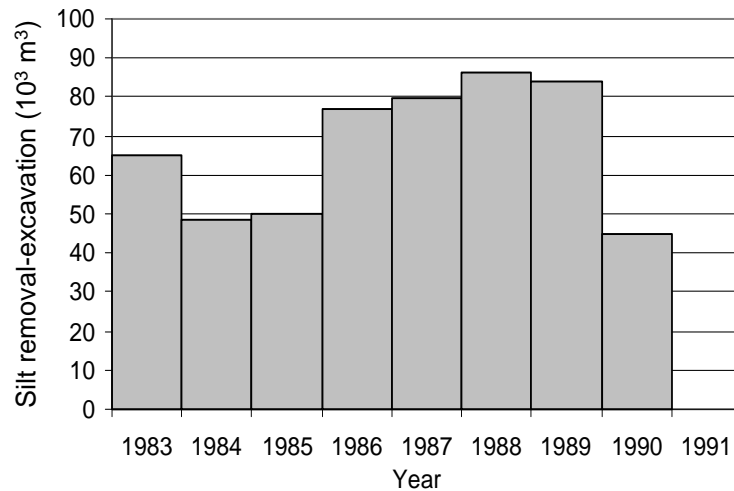
- Repair of lesser damages of the banks,

- Maintenance of marks and dams,

- Flood control. (2,4)

Figures 1-3 present the scope of some works performed on the maintenance of the drainage system during the period 1983-1991. The maintenance of water structures during this period was proportional to the economic power of the society. The maintenance of water structures was insufficient, so the function of the constructed water structures was reduced. (Regarding the protection structures, they are in quite a good condition, except the bed of the embankment on the river Brzava, which were damaged by erosion and frequent water level oscillations. The greatest hazards in the riparian area of these watercourses are the

landslides. In the cases of high water levels, they can cause break of embankment and cause flooding of the infrastructure on it.)



Note: Ratio of the required works  $227.500 \text{ m}^3$  annually

Fig. 1.- The works of silt removal-excitation ( $10^3 \text{ m}^3$ ) performed in the period 1983-1991

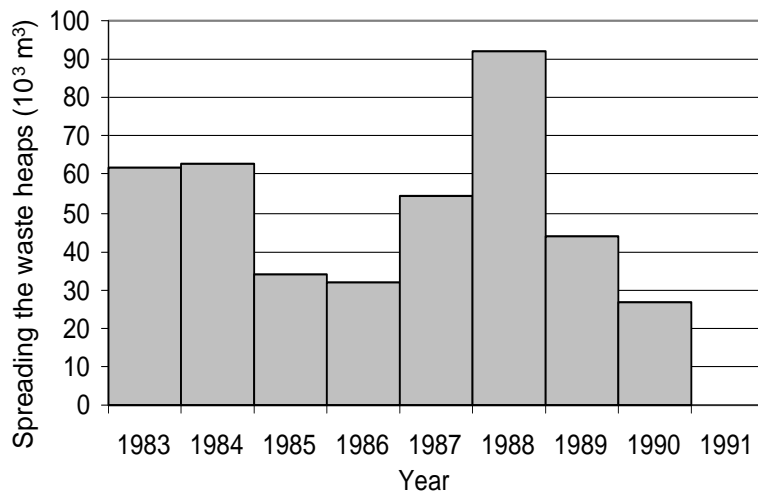


Fig. 2.- The works of spreading the waste heaps ( $10^3 \text{ m}^3$ ) performed in the period 1983-1991

The data presented in the Figures point to an impermissibly low volume of works on the maintenance of the erected drainage system. Namely, for the systems to be in function, according to the criteria of their maintenance, the

channel network should be mowed twice a year, both annual and perennial plants, and the mud silted parts of the channel network should be cleaned, which is according to the criteria of silt removal every ten years. In other words, the tenth

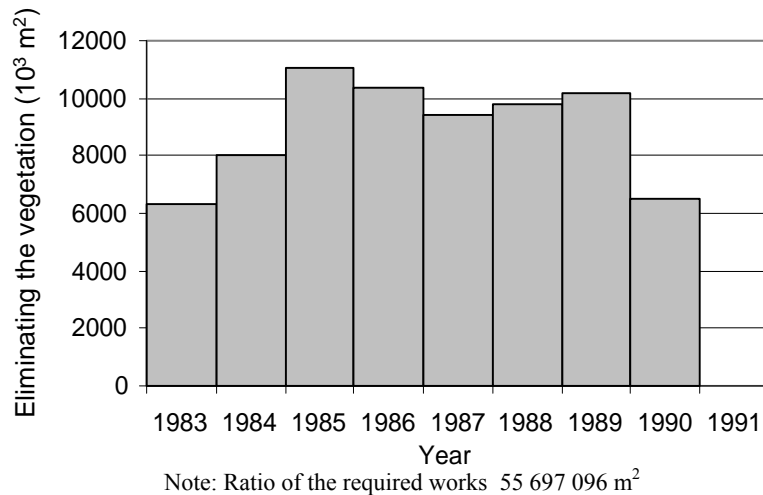


Fig. 3.- The works of eliminating the vegetation ( $10^3 \text{ m}^2$ ) performed in the period 1983-1981

part of the channel network should be cleaned every year with the norm of  $1\text{m}^3/\text{m}^1$ . For the total length of the channel network of 2,275 km, the annual quantity of silt removal is  $227.5 \times 1000\text{m}^3$ , i.e.  $227,500\text{m}^3$  annually. As the total area under channels is  $27,848,548 \text{ m}^2$ , this means that the area for two mowings is  $55, 697,096 \text{ m}^2$ . During this period, only 30% of necessary works of silt removal-excavation and 16% of necessary works of eliminating the vegetation have been performed. Based on the ratio of the required and the performed works, it can be concluded that the design functionality of the constructed channel network gradually decreases.

The area of the greater part of the catchment is dissected with a dense network of channels, capable of receiving all the design surplus water. However, during the summer 1999, there were flood events, which flooded 4,000 ha of farmland in this catchment. The reason was not the inadequate density of the channel network, but its poor state. During the past decade, the channel network was not maintained to the required level. The channels are invaded by annual and perennial plants, and the channel cross- sections are partly silted. Landslides occur on the slopes of some of the major channels in the downstream stretch and they block a part of water cross- sections. One of the causes of flood events is also the occurrence of extremely high precipitation, which exceed notably the multiannual averages. During the summer there were occasions of 100 mm of

precipitation in only one day. We should also mention the reduced soil cultivation and the absence of additional land reclamation measures predicted by the design documents.

### **C o n c l u s i o n**

The melioration region "Južni Banat" is covered by a dense network of natural and artificial flows. Natural watercourses are the rivers and streams, and the artificial watercourses are melioration channels which are in most cases in the function of drainage, and a minor number has a double function (drainage and irrigation). The dense network of channels, erected throughout the catchment area, is capable of receiving all the design surplus water.

However, during the past decade, the channel network was not maintained to the required level, which caused the reduced functionality of the drainage system. The channels are invaded by annual and perennial plants, channel cross-sections are silted with mud, there are landslides of the slopes, parts of water cross-sections are blocked, etc. These are the consequences of the inadequate maintenance of the drainage system and the accompanying structures. It is necessary to mention that the years after 1991 were also difficult for drainage system maintenance. It is not so easy to estimate the volume of channels networks functionality, because if we adopt the constant rate of functionality decreasing per year, one can conclude that 10% of the channels networks are completely destroyed or out of order. And that is not the truth. The volume of works on the maintenance of the melioration system in the following period should be increased to overcome the deficiencies and to bring the channel network to the state of satisfactory functionality.

### **R E F E R E N C E S**

1. Analiza vodoprivrednih objekata, potrebe za nadogradnjom i potrebe za održavanje izgrađenih vodoprivrednih objekata sa posebnim osvrtom na teritoriju opštine Plandište. Marinković, P., Vodoprivredno društveno preduzeće "Južni Banat" Vršac, 2001.
2. Elaborat o redovnom održavanju i funkcionisanju sistema za odvodnjavanje u 2001. Ratkovic, M. V.D.P. "Južni Banat", Vršac, 2001.
3. Bilten povodom 130 godina postojanja vodoprivrednog preduzeća 1871-2001. Vodoprivredno društveno preduzeće "Južni Banat" Vršac, 2001.
4. Petković S., Rudić D., Stričević, R., Gregorić, E. (2002): Stanje hidrauličke funkcionalnosti kanalske mreže DTD u uslovima intenzivnog navodnjavanja.

Received December 26, 2003

Accepted March 29, 2004

PROBLEMI ODRŽAVANJA SISTEMA ZA ODVODNJAVANJE NA  
MELIORATIVNOM PODRUČJU VDP "JUŽNI BANAT"

**D. Rudić,<sup>1</sup> Nevenka Djurović<sup>1</sup> i Radmila Pivić<sup>2</sup>**

R e z i m e

Sistemi za odvodnjavanje izgrađeni su na znatnim površinama hidromorfni zemljišta u Srbiji. Na mnogima od njih nalazi se gusta mreža kanala koji su sposobni da prihvate projektovane viškove voda. Međutim, nedovoljno održavanje kanala utiče na smanjenu funkcionalnost sistema za odvodnjavanje. S obzirom da je jedan od osnovnih pravaca u razvoju odvodnjavanja u predstojećem periodu rekonstrukcija i revitalizacija postojećih sistema, potrebno je utvrditi stanje u kome se oni nalaze, kao i razloge njihove smanjene eksploatacione sposobnosti. Meliorativno područje "Južni Banat" je jedno od područja na kome je stanje kanalske mreže nezadovoljavajuće.

Izgradjenost kanalske mreže pokazuje da je površina većeg dela sliva ispresecana gustom mrežom kanala koji su sposobni da prihvate sve projektovane viškove voda. Međutim, kanalska mreža se u toku poslednjih decenija ne održava u meri u kojoj je to potrebno. Kanalska mreža je zarasla u jednogodišnje i višegodišnje rastinje, a kanalski profili su delimično zamuljeni. Neki od glavnih kanala na nizvodnoj deonici imaju pojavu kliženja kosina i zatvaranje jednog dela proticajnog profila. Zbog toga obim radova na održavanju meliorativnih sistema u narednom periodu mora biti uvećan, da bi se nadoknadili propusti i kanalska mreža dovela u stanje zadovoljavajuće funkcionalnosti.

Primljeno 26. decembra 2003.

Odobreno 29. marta 2004.

---

<sup>1</sup> Dr Dragan Rudić, redovni profesor, dr Nevenka Đurović, docent, Poljoprivredni fakultet, 11081 Beograd-Zemun, Nemanjina 6, Srbija i Crna Gora

<sup>2</sup> Mr Radmila Pivić, istraživač saradnik, Institut za zemljište, 11000 Beograd, Teodora Drajzera 7, Srbija i Crna Gora