

# Ecological Evaluation Criteria of Soil Suitability for Drainage

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Evaluation of soil reclamation needs should be done by existed agricultural and economical parameters, but also new ecological ones have to be introduced. There are not any solid criteria for negative drainage impact on environment evaluation so far. Therefore, the aim of this work was to suggest possible criteria for thoroughgoing evaluation of soil drainage suitability. According to suggested criteria, threshold values of soil drainage suitability are introduced. In the field “Orlača” eugley soil shouldn’t be drained, whereas fluvisol and semigley are partly suitable for drainage.

**Key words:** drainage, ecological assessment

## Introduction

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Ecological evaluation of the soil suitability for drainage based on ecological parameters should become a permanent criterion of drainage projects. The criteria that include both ecological evaluation of the drainage project and agricultural assessment havenot been established so far. The aim of this work was to propose some criteria for soil suitability for drainage using the sample region Orlača for three type of hydromorphic soils.

### **General Characteristics of the Research Region**

There are three type of soil on the research region Orlača with total area of 1650 ha. On the lowest part of the region and longitudinal depressions is eugley type of soil on the parent leached marshy soil. On the higher part of the region – ledges is noncalcareous vertisolic semigley meadow black type of soil. On the part of the region conecting the riverside is loamy, deep calcareous fluvisol type of soil. Present productive value of the soils are significantly reduced due to high water table depth waterlogging zone of root system during the most period of year (autumn – winter-spring) on fluvisol and vertisolic semigley, whereas eugley is waterlogged mostly all over the year. Potential productive value of the soils are very high.

Research area is grown by following type of vegetation, tipical for wet land: marshy vegetation, low land meadow and forest vegetation. Cincovic (1956) researched that region and found out following phytocenoses: *Schoenoplectus llacuster* – *Pragmites communes*; *Tuphoides arundinacea*; *Bolboschoenus maritimus*; *Eleocharis palustris*, zatim asocijacije *Agrostideto iuncetum effisi*, *Molinietum coeruleae*. Dolinske livade su

predstavljene tipovima: *Cynodontetum*, asocijacija *Brometocynosuretum cristati*, *Trifolium pallidum – Alopecurus protensis*; *Polygonum bistrorta – Poa trivialis*. Forest vegetation is consisted of willow, poplar and oak (Tanasijević et al., 1966).

Conventional approach of the land suitability for improvement usually is based on soil physical, hydrological and chemical properties. Obtained results are analyzed in order to propose specific works on the each marked area of the region usually shown on the map that can lead to soil fertility and productivity increment. Limiting factors regarding environmental protection has not been considered in this approach.

To harmonize the need of modern agriculture with the principles of environmental protection, new criteria of soil suitability for drainage that include some additional parameters that limits drainage in some regions are proposed in this work.

Some possible criteria that could be used for environmental assessment and soil suitability for drainage is presented in Table 1.

Table 1 Suggested criteria for evaluation of soil for drainage

+ Criteria which support drainage	Sign +
➤ Excess water and its duration – waterlogged soil throughout the year and every year – waterlogged soil half of the year and every year – short seasonal occurrence of excess water	*** ** *
➤ Soil fertility and productive capacity – non-tilled soil – autochthonous vegetation – arable land suitable for crop production – arable land suitable for orchards and vineyards	* ** ***
➤ Soil fertility – eugley – meadow soil	***** ***** *****

<ul style="list-style-type: none"> <li>- alluvium</li> <li>- black marsh soil</li> <li>- peat soil</li> <li>- pseudogley</li> <li>- vertisol</li> <li>- saline, sodic soil and arenosol</li> </ul>	<p>***</p> <p>***</p> <p>**</p> <p>**</p> <p>*</p>
<ul style="list-style-type: none"> <li>➤ Economic criterion based on cost/benefit ratio <ul style="list-style-type: none"> <li>- cost/benefit &gt; 1</li> <li>- cost/benefit = 1</li> <li>- cost/benefit &lt; 1</li> </ul> </li> </ul>	<p>*****</p> <p>*</p> <p>***</p> <p>-</p>
<ul style="list-style-type: none"> <li>- Criteria which support environmental protection</li> </ul>	<p>Sign</p> <p>-</p>
<ul style="list-style-type: none"> <li>➤ High quality forest vegetation <ul style="list-style-type: none"> <li>- common oak, ash 300 – 500 trees / ha</li> <li>- common oak, ash &lt; 300 trees / ha</li> <li>- elm, poplar, willow 300 – 500 trees / ha</li> <li>- elm, poplar, willow &lt; 300 trees / ha</li> </ul> </li> </ul>	<p>***</p> <p>**</p> <p>***</p> <p>**</p>
<ul style="list-style-type: none"> <li>➤ Coppice vegetation <ul style="list-style-type: none"> <li>- field maple, hawthorn</li> <li>- common dogwood, viburnum, amorpha</li> <li>- other</li> </ul> </li> </ul>	<p>**</p> <p>*</p> <p>-</p>
<ul style="list-style-type: none"> <li>➤ Protective role of vegetation <ul style="list-style-type: none"> <li>- flood control</li> <li>- windbreaks to control wind erosion</li> </ul> </li> </ul>	<p>**</p> <p>*</p>
<ul style="list-style-type: none"> <li>➤ Wildlife protection <ul style="list-style-type: none"> <li>➤ wildlife - protected by law <ul style="list-style-type: none"> <li>- economically valuable species</li> <li>- unthreatened species</li> </ul> </li> <li>➤ Birds - protected by law <ul style="list-style-type: none"> <li>- economically valuable bird species</li> <li>- unthreatened species</li> </ul> </li> <li>➤ Other animal species protected by law</li> </ul> </li> </ul>	<p>***</p> <p>**</p> <p>-</p> <p>***</p> <p>**</p> <p>-</p> <p>***</p>

**Results of applied ecological evaluation of the soil suitability for drainage on Orlača region**

Soil suitability for drainage of region Orlača shown in Table 2 is based on thorough analysis of both agronomical and environmental aspects.

➤ <b>Criterion/Type of soil</b>	<b>Eugley</b>	<b>Semigley</b>	<b>Alluvium</b>
➤ <b>Water excess and its duration criterion</b> – waterlogged soil throughout the year and every year – waterlogged soil half of the year and every year – short seasonal occurrence of excess water	waterlogged soil throughout the year and every year (***)	waterlogged soil half of the year and every year (**)	short seasonal occurrence of excess water (*)
➤ <b>Soil fertility and productive capacity</b> – non-tilled soil – autochthonous vegetation – arable land suitable for crop production – arable land suitable for orchards and vineyards	Non tilled soil (*)	Arable land suitable for crop production (**)	Arable land suitable for orchards and vineyards (**)
➤ <b>Soil Fertility criterion</b> – eugley – semigley – alluvium	eugley (****)	semigley (****)	alluvium (****)
➤ <b>Economic criterion based on cost/benefit ratio</b> – Cost/benefit (B/C) > 1 – Cost/benefit (B/C) = 1 – Cost/benefit (B/C) < 1	B/C = 1 (***)	B/C > 1 (*****)	B/C > 1 (*****)
Criteria which support environmental protection			
➤ <b>High quality forest vegetation</b> – common oak, ash 300 – 500 trees / ha – common oak, ash < 300 trees / ha – elm, poplar, willow 300 – 500 trees / ha – elm, poplar, willow < 300 trees / ha	Present asoc. <i>Populetum i Salicetum</i> (**)	-	-
➤ <b>Coppice vegetation</b> – field maple, hawthorn – common dogwood, viburnum, amorpha – other	-	Field maple hawthorn, acacia, other (**)	
➤ <b>Protective role of vegetation</b> – flood control – windbreaks to control wind erosion	Flood protective vegetation (**)	-	-
➤ <b>Wildlife protection</b> ➤ wildlife - protected by law – economically valuable species – unthreatened species ➤ Birds - protected by law – economically valuable bird species – unthreatened species ➤ Other animal species protected by law	N <sup>1</sup>   (***)   (***)	N <sup>2</sup>   (***)   (***)	N <sup>3</sup>   (***)   (**)

Sum	+ 11 / -10	+13 / -8	+12 / -5
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Near the research region there is Obedska bara – bird refuge park protected both by national and international Law (Fig. 1). It represent natural living place for autochtone species protected by Law suc as: Insecta, Amphibia, Reptila , class of Hirudinea and Mollusca (Sl. glasnik SRS 11/90 i Sl. glasnik R. Srbije 49/91).

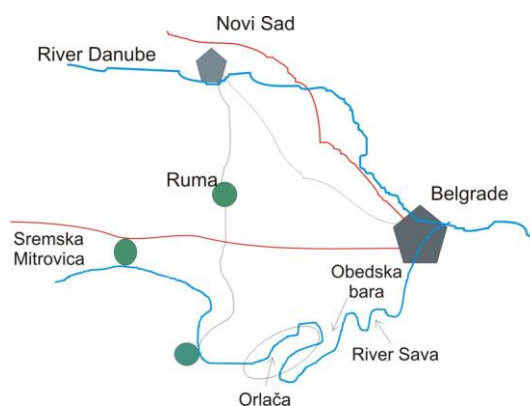


Fig. 1 Geographic position of the research region

Eventhough waterlogging does not cause such a huge problem as in eugley one, this type of soil is also suitable living place of protected flora and fauna.

Part of the region where alluvium soil is dominant is already partly drained and cultivated. Special preservation should be given to those species protected by the Law, but only near meander of river Sava.

Suggested criteria has been qualified and summed for each type of soil as positive (criteria which favouraze drainage) and negative value (which favouraze environmental conservations). Summed values are shown in Fig. 2.

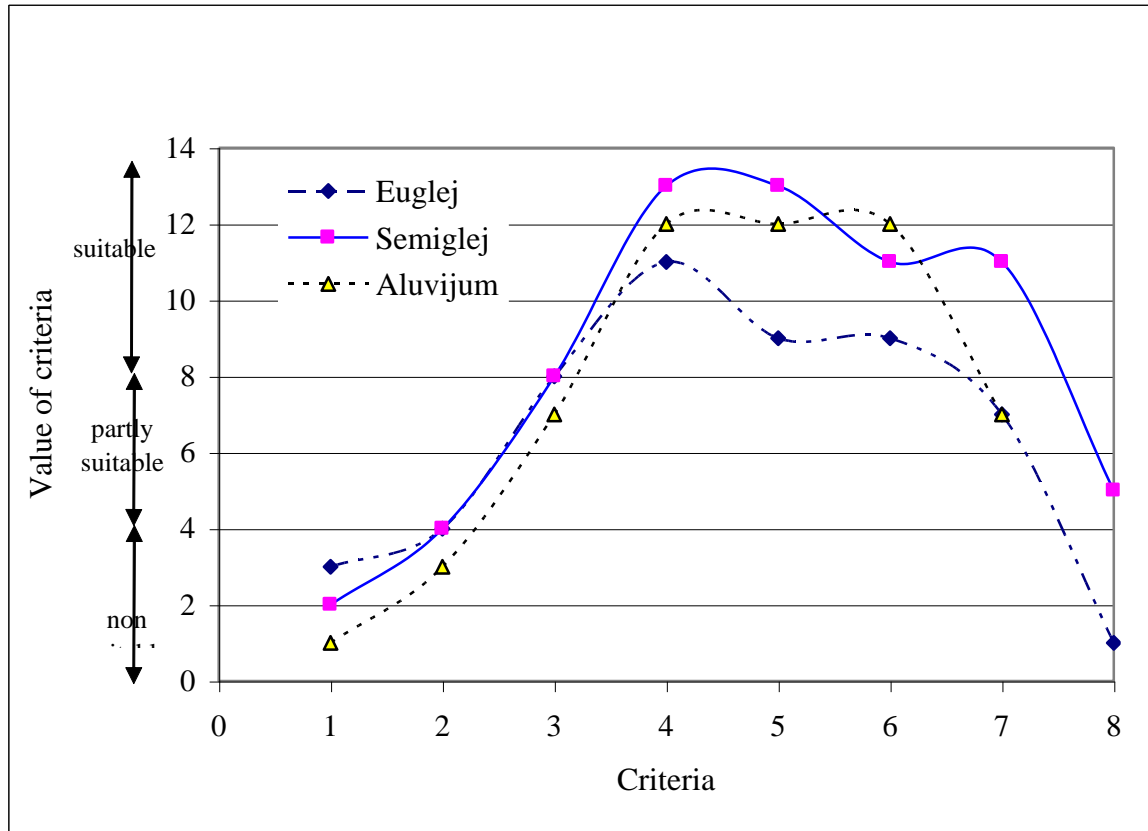


Fig. 2 Evaluation soil suitability for drainage on the Orlača region

First part of the curves as well as their maximal values represent usual approach of evaluation of soil suitability for drainage. Adding of all coefficients, maximal value obtained for semigley soil is 13, for alluvium 12 and for marshy gley (eugley) soil 11. Criteria which support environmental protection are presented on the decreasing part of the curve. Fig. 2 showed that drainage limitation is the most significant on the eugley type of soil. The last points of the curves represent the final values which comprise all the information both of positive and negative aspects of drainage. It is very delicate to find

out scalar value that can be taken as a limit value for determining of total soil suitability for drainage. Possible limit values of 4 and 8 are proposed in this work. Those limit values define 3 zones: zone suitable for drainage would be when sum of all coefficients of criteria are  $> 8$ , zone 2 means that soils are partly suitable for drainage, and sum of all coefficients of criteria are  $4 < \text{criteria} < 8$ , and zone 3 means that soils are not suitable for drainage and sum of all coefficients of criteria are  $< 4$ .

Using suggested criteria, eugley type of soil on Orlača region is not suitable for drainage. Thorough analysis of positive and negative aspects of drainage showed that alluvium and semigley soils falls into zone 2, meaning that are partly suitable for drainage. Special care has to be done including some additional criteria during the design procedure. Final result should be made in a compromise between agricultural and environmental requirements. Respecting restriction for drainage on semigley and alluvium, final drainage system design for Orlača region should be changed. Adopted drainage system design respecting the environmental requirements is shown in second part of the work.

## **Conclusion**

Evaluation of soil suitability has to include agricultural, economical and ecological parameters. Suggested parameters came out after exhaustive analysis of all positive and negative effects that can be caused by drainage. Evaluation of soils in Orlača region for drainage suitability showed that marshy gely (eugley) type of soil may be considered



unfavorable for drainage, whereas meadow soil (semigley) and alluvium are partly suitable.

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# **Kriterijum procene pogodnosti zemljišta za odvodnjavanje sa stanovišta očuvanja životne sredine**

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## **Rezime**

Vrednovanje meliorativnog područja trebalo bi da pored postojećih poljoprivrednih i ekonomskih uključi i ekološke parametre. S obzirom da do danas ne postoji čvrsti kriterijumi za sagledavanje negativnih uticaja mera odvodnjavanja na životnu sredinu, u radu su predloženi mogući kriterijumi za sveobuhvatno vrednovanje pogodnosti zemljišta za odvodnjavanje. Na osnovu predloženih kriterijuma uvedeni su pragovi pogodnosti zemljišta za odvodnjavanje. Pokazano je da močvarno-glejno zemljište područja “Orlača” ne treba odvodnjavati, dok su aluvijalno i livadsko zemljište uslovno pogodna za odvodnjavanje.

**Ključne reči:** odvodnjavanje, ekologija

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