

Drainage Harmonized with Environmental Conservation

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Needs for fertile soils for intensive agriculture production is surely current issue in one side and care for environmental change due to the drainage in another one. Income increment obtained on reclaimed (drained) soil and environmental protection are contradictory demand. To satisfy both sides, the solution should be a compromise among lands area that could be drained and those ones that could be partly drained or not drained at all.

The aim of this work was to suggest technical solution of drainage for the field “Orlača” which should be a compromise between two demands: sustainable agriculture and environmental protection. According to the thoroughgoing review of the drainage problem (source of sufficient amount of water, duration of ponding, type of soil, soil fertility and suitability for agriculture) and existence of low protected flora and fauna as well as presence of economically valuable plants and animals, is suggested not to drain a

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great part of area (> 50 %). Old canal network should be kept and rebuilt in order to maintain suitable water regime of the soil suitable for agriculture production.

Key words: drainage, ecological assesment

INTRODUCTION

Soil improvement comprise application of specific works such as drainage, irrigation, erosion control, soil fertility increment, etc. All those works will necessary change natural conditions. Some of them will cause minimal effect and lead to the betterment of environment as erosion control or irrigation. However, drainage significantly changes surroundings. In one side, food demand will be increasing issue in future, and therefore availability of fertile soil area to achieve it. On the other side, there is urgent need to protect environmental conditions of the region with specific flora and fauna. To fulfill all the requirement compromises have to be made.

In this sense, during the last decade experts of the Department of Soil Reclamation at the Faculty of Agriculture in Belgrade-Zemun has attempted to design every project especially drainage ones to cause minimal negative effect on environment. In this way, our country is approaching to the modern design procedure which is indispensable in the developing countries.

Sustainable development implied use of natural resources for good production according to the needs of present generations with no damaging future ones (OCF, 1979). Jacobs (1991) emphasized that surroundings has to be preserved with the full capacity of

a; functions and remain unchanged by the time. Minimum level of capacity implied avoidance of any possible catastrophe. The maximal level has to ensure to future generations consumptions of the environment in the same extension as present one.

Drainage system construction inevitably is changing natural conditions such as soil water status, heat transfer through out the soil profile, cause swamp and water pond disappearance, depleting groundwater table depth, etc. All the changes by the time will cause disappearance of autochthon plants of the region and accompanying animals.

According to the General Spatial Plan and the Water Resources Management Plan of the Republic of Serbia, drainage system is to be constructed over 700000 ha in different regions all over the country. Diversity of the wet region could be described as periodically over logged areas, swampy areas, riverside wet land, river-delta, mount of river, flooded forest, deteriorated forest and agriculture ecological systems (orchards, plow lands).

Significant part of mentioned area is endangered by the water excess of inland water and water flooding from the rivers or runoff. Soil water status of those lands has to be stable and suitable for agricultural production and countryside life. Therefore, drainage system construction should be the main works. Changes of the environmental conditions are certain. Positive role of drainage system on the environment would be observed if it is constructed to support irrigation systems.

Beside the general procedure of the design of drainage systems that should be followed (drainage criteria, drain depths, canal depths, etc) and preconditions given by Local Water Authority according to the Water Law (1991) has to be fulfilled, new approach toward environmental protection might be preservation of “Ecological Zones”

within the drainage project area. Existence of such zones undertake part of the land named for the natural wet vegetation and accompanying fauna, eventhough it could be drained and used for agriculture. This approach ensures survival of autochthon vegetation and animals of the specific regions.

Conventional Concept and Introduction of New Approach of Drainage

System Design

In this work, new approach of drainage system design based on sustainable agriculture development is given for the specific area, called “Orlača”. Such solution could be proposed for the design of drainage systems over the 700000 ha of the remaining wet land in Serbia.

The drainage area is situated on the opposite side of “Obedska bara”- protected bird refuges zone of the world importance (Fig. 1). Most of the year water logging was observed on 1965 ha (Fig. 2).

Place for Fig. 1

Results of the field research have shown that ground water table depth strongly depends on water level in the river Sava. River Sava is one of the main sources of water excess in the filed. Additional amount of water comes from precipitation and runoff from the mountain. This area hardly naturally drains even when water level in the river is low, due to topography with marked depressions and ledges.

Place for Fig. 2

Soils of the area are potentially fertile (eugley, alluvium, semigley). It could be possible to obtain area of high productive value introducing drainage system. Beside the betterment, series of negative effect could be caused on the environment such as destruction of hygrophyte vegetation and accompanying animals. Layout of the existing soil type is shown in Fig. 3.

Place for Fig. 3

Present state of agricultural activities on the research area is very poor. Only 35.2 % of the total area has been used for field crops grown in the summer period, mainly on ledges and higher part of the area, which is partly drained by the open canal network (Fig. 4). Swamp and marshy vegetation are spread out over 35 % of the total area, forest and makia over 13.6 % and pastures and meadows over the 16.2 %.

Place for Fig. 4

Existing drainage canal network and newly designed one is shown on Fig. 5. The design has been based on conventional design procedure. Most of the area is covered by thorough canal network. Water from the lower level canals flows into main canal and interceptive canal. Due to lower elevation of the region in comparison with the water level in the river Sava, water is pumped (over dyke). On the contrary, new approach of drainage system design proposes new principles which compulsory include evaluation of area based on ecological parameters. Such areas have high degree of specie diversity as well as tract diversity. Tract diversity implied constant, periodical or rarely flooded area, swamped area, river branches, wet meadows, flooded forest etc.

Place for Fig. 5

Diversity of flora and fauna implies a lot of species that exist naturally on the region. Ecological evaluation can be made on the assessment values of the region which are important to be conserved according to the national and international Law (Red List of European Union, International Union for Environmental Protection (IUCN), Bern's convention, etc. (Knežević, 2000).

Technical solution given in Fig. 5 has not been realized in site, due to lack of investment. Applying the new approach of drainage system design, new technical solution is shown in Fig. 6.

Place for Fig. 6

This solution comprises also one part of the area left for the natural vegetation and wild life which is over logged longer than 6 months. In this part of the area, environmental conditions are not disturbed significantly, so it can be conserved. Contribution to that solution comes from the fact that excess water should be pumped in the conventional design procedure, which makes system expensive and arises the question of economical convenience.

Higher part of the area, where is water logged in the shorter period of the year would be drained by the open canal network as it is shown in Fig. 6. Water from the lower level canals would flow in the existing interceptive canal and pumped by the existing pumping station. Rehabilitation of the drainage canal should be done on the deteriorated sections and be cleaned from sludge.

There is discrepancy between drainage and principles of environmental conservation. Only drainage can lead to revenue increment of the population increasing the total fertile area for agriculture. However, environmental assessment can be based on

different methods (value substitution method, economical evaluation of benefit method, evaluation of suitability, contingent evaluation. Non – economical value has to be mentioned, which represent readiness for nature conservation for future generation (Knežević, 2000).

This sample region can be used for economical evaluation of both drainage design approach. We are aware that new approach might be economically more convenient. On one side, investment in drainage systems would be high as well as cost of maintenance, and on other side benefit from specific environmental are multiple (hunting, fishing, tourism, collecting medical herbs, value of woods, etc.

CONCLUSION

Drainage system enable improvement of land to the level that can be used for agriculture production, but on other side can have in most of the cases negative impact on environment. Income increment obtained on reclaimed (drained) soil and environmental conservation are contradictory demand. To satisfy both sides, solution should be a compromise among land area that could be drained and those ones that could be partly drained or not drained at all. The final result should ensure sustainable agriculture development and environmental conservation.

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Odvodnjavanje zemljišta uskladjeno sa očuvanjem životne sredine, I

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Rezime

Primena odvodnjavanja svojim efektima neminovno vodi promeni prirodnih uslova sredine. Potreba za plodnim zemljištima na kojima je moguće ostvariti visoke prinose u budućnosti će i dalje biti aktuelna. S obzirom da su povećanje dohotka s jedne strane i očuvanje biljnog i životinjskog sveta s druge kontradiktorni zahtevi, jasno je da rešenje treba tražiti u kompromisnom izboru površina koje će se odvodnjavati. Krajnji cilj ovoga rada je da se na primeru projektnog područja "Orlača" predloži kompromisno tehničko rešenje koje obezbeđuje kako održivi razvoj poljoprivrede, tako i očuvanje prirodnih eko-sistema. Na osnovu sveobuhvatnog sagledavanja problematike (uslova prevlađivanja, tipova zemljišta, pogodnosti zemljišta za poljoprivrednu proizvodnju, postojanje zakonom zaštićene, i ekonomski vredne flore i faune) predloženo je da se ukinu novoprojektovani kanali, tako da se značajan deo površine ne odvodnjava (> 50 %). Zadržala bi se i rekonstruisala samo postojeća kanalska mreža čiji bi zadatak bio održavanje povoljnog vodnog režima zemljišta na području pogodnom za ratarsku proizvodnju.

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