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# Ecological evaluation of the irrigation in some agricultural areas of Bulgaria

## Abstract

The irrigation water coming from rivers, ponds and wells contains different pollutants in Bulgaria. In the present paper are included some data of the influents of the irrigation water on agricultural crops and soils. Globally more attention is paid to the quality of irrigation and theimprovementof water distribution uniformity. Soil erosion is another problem, which can be avoided in the process of irrigation when water is applied without runoff on the soil surface. Some types of sprinklersystem were evaluated in the condition of Bulgaria.

*Key words: irrigation, pollution, environment*

## Introduction

Bulgaria is situated in zone of unsustainble moistening.The annual precipitation have fluctuated from 500 to 700 mm.They are insufficient for most agricultural crops during the growing period. According to the agrometeorological data for more than 100 years a circle dry spell set in summer have been noticed.The rainfall less than 400 mm have been occurred in plain regions of North and South Bulgaria,e.g. it means 42.7% of all arable land of the country. The rainfall are changing from 90 mm to 190 mm during the crop-growing season.That's why the need for irrigation on plays the most significant role.It's not possible to get some crop production without irrigation.

## Ecological aspects of irrigation

The water resources of Bulgaria are rivers, underground waters and the 2000 numbers dams-big, medium and small. Information on the condition of the waters in Bulgaria was collected and analyzed by Standard National Automated System for Environmental Protection (SNASEP).The quality of river waters is being determined on the basis of the water samples taken once monthly and the laboratory analyses carried out to estimate 12–20 basical parameters: ph, dissolved oxigen, temperature, dissolved solids, total suspended solids, iron, manganese,nitrites, nitrites, free amonia, phosphorus, total organic carbon, $BOD_5$, COD, chlorides, alkalinity. Some analyses from one part of the control points are being made to determine the heavy metals, cyanides, phenols, detergents and petroleum products.

Surface water evaluation was done on the base of a complex evaluation coefficient $K_{ko}$,which reflects pollution accor-

ding to five groups of parameters.This coefficient gives information about pollutants above maximum permissible amount. According to the coefficient the river classification is shown in table 1.

On this adopted basis is the following classification: River Osum, Provadiiska, Mesta, Struma and the Danube are medium polluted; River Ogosta, Iskur, Vit, Toundzha and Maritsa are strongly polluted; River Yantra, Rousenski Lom, Kamchiya and Arda are very strongly polluted.

The causes of the river pollution are the lack of sewage-treatment plants or the bad state of them. In table 2 are given the more significant polluters of some rivers in Bulgaria.

$BOD_5$ rates for the most of bulgarian rivers exceed maximum permissible amount.They have reached up to 800–1000 mg/m$^3$ (Skout, Iskur, Provadiiska, Maritsa and s.o.).The concentration of lead is above permissible level (River Arda – 290 mg/m$^3$), of arsenic (River

TABLE 1. A complex evaluation coefficient of rivers (surface waters)

| $K_{ko}$ | < 1 | 1 – 2 | 2 – 6 | 6 – 12 | > 12 |
|---|---|---|---|---|---|
| Evaluation of the water pollution | unpolluted | slightly polluted | medium polluted | strongly polluted | very strongly polluted |

TABLE 2. Pollution of some rivers in Bulgaria

| N | River | Polluters |
|---|---|---|
| 1. | Ogosta | Organical pollution from pigbreeding farm |
| 2. | Skout | Cellulose production factory Misia, organical pollution from cattlebreeding farm |
| 3. | Iskur | Faults of the municipal sewage-treatment plant near Sofia, Metalurgical factory Kremikovtsi |
| 4. | Vit | Cellulose production factory, Plant of fodder and yeast production, cattlebreeding farms |
| 5. | Osum | Industrial and municipal wastewater effluents |
| 6. | Yantra | Unconstructed municipal sewage-treatment plant in Gabrovo,Sugar-refinery, Industrial and municipal waste water effluents of town of G.Oriahovitsa |
| 7. | Rositsa | Industrial and municipal wastewater effluents of a town of Sevlievo |
| 8. | Rousenski Lom | Factory of antibiotic production-Razgrad, Industrial and municipal wastewater effluents from Popovo, waste waters from pigbreeding farm |
| 9. | Kamchiya, Toundzha | Industrial and municipal wastewater effluents |
| 10. | Maritsa | Industrial water from copper production factory, industrial and municipal wastewater effluents |
| 11. | Arda | Wastewater effluents from the floatation factory |
| 12. | Mesta | Plant of fodder and yeast production, cellulose production factory, industrial and municipal wastewater effluents of towns |
| 13. | Strouma | Chemical pharmaceutical factory, industrial and municipal wastewater effluents from sewerage |

Topolnitsa – 300 mg/m$^3$), of phenols (River Toundzha 50 – 115 mg/m$^3$). According to the data of the rivers have been summarized that some of them are not suitable for irrigation.

River Danube is the considerable water resource of Bulgaria. During the last 30 years waters were slighly polluted on the base of mineralisation, biogenetical elements, specific toxic ingredients, fat and petroleum products etc. According to the bulgarian standard the waters of the Danube are evaluated 3$^{rd}$ category as defined by order N 7 of 1986. It means suitable for irrigation and industrial use.The turbidity of water, which is up to 40% makes difficulties in drip irrigation. The filters get very ofen clogged. During April and May has been estimated the increased concentration of nitrates, nitrites, amonia, phorphorus and iron.It's a result of spring high waters coming from leached agricultural lands of Central Europe.The intensity fertilization brings heavy pollution of the Danube water. Yearly Bulgaria put to use $1.10^9$ m$^3$ water from the Danube.The cooling of the Kozlodouy nuclear power plant uses 150 m$^3$/s. Irrigation and industrial water supply use about $260.10^6$ m$^3$ yearly.The concentration of total solids in some parts of the river are between 50–150 mg/ l; rates of $BOD_5$ are average 3–5 mg/ l; fat and petroleum products are 0.2–0.6 mg/ l.

Observations of radioactivity of the Danube have been done regularly along theall course of the river, especially near nuclear power plant. Rersults have shown, that no case of increased total alfa- and beta- radioactivity (they vary between 0.025 – 0.253 Bq/l).The technogenic ceasium – 137 concentrations of riverbed deposits before and after the nuclear power plant vary from 5 to 14 Bq/kg. It means that there aren't changings of the environment.

In Bulgaria the underground water condition is better than the surface waters.The underground water quantity was evalueted $6.5.10^9$ m$^3$ per year or up to 30% of surface water flow-off.The irrigation water utilization is on the average $333.10^6$ m$^3$ yearly. It means only 11.1% of exploited water resources.During the last 25–30 years have been built factories, polluted the environment. The intensive chemical use in agriculture has worsened the underground waters. Have been observed the following parameters: chlorides, nitrates, sulfates and total mineralisation.Nitrate pollution was registered in the Loudogorie and Dobroudzha regios, chloride pollution - in the low lands along the Danube and the Black Sea; many areas (Trakiya region) have been affected by sulfate, but combined mostly with nitrate and chloride pollution; excess general mineralisation has been registered in hypsometric depression areas. In table 3 are given some data of underground water components around some settlements in Bulgaria.

It can be come to conclusion, that most of underground waters are suitable for irrigation, except some regions with high concentration of Cl, $SO_4^{2-}$, B, Pb, As etc. In Bulgaria most of the dams and lakes are in good condition for irrigation, but some of them have exceeded the level of toxicity. Dam of Topolnitsa was built to irrigate a large area.Some of the rivers, which flow in it, are polluted with heavy

TABLE 3. The underground water contents around some settlements in Bulgaria

| Town ( Village ) | Ingredients (average ) |
|---|---|
| Provadia | Total mineralization –1116 mg/ l |
| Varna | Total mineralization – 1092 mg/l |
| Ijambol | Total mineralization – 1086 mg/l |
| Hakanovo | Sulfates – 448 mg/l; nitrates –78 mg/l chlorides – 300 mg/l; total mineralization – 1609 mg/l |
| Straldga | Nitrates – 129 mg/ l |
| Kameno | Total mineralization – 1050 mg/ l |
| Karlovo, Nova Zagora, Stambolijski | Total mineralization – above 1050 mg/l, nitrates – above 80 mg/ l |

metals: copper, lead, zinc and cadmium.The concentration of these elements in fishes are 2 – 5 times above permissiible level: cadmium 0.619–1.963 mg/kg; lead 6.186 – 23.330 mg/kg; copper 4.618 – 7.445 mg/kg; zinc 78.4–165.655 mg/kg.Although these data, the water of the dam has been used for irrigation in north of Plovdiv.The heavy metal high concentrations of growing crops were estimated.

The ecological disturbance are the farm land subject to water and wind erosion by region and over the national territory.These disturbed land are on average 1.02.10^6 ha in Bulgaria. In Plovdiv region they are on average 100.10^3 ha. The water erosion is especially related with irregular gravity irrigation, lack of soil conservation activities or unproper design.Unadjusted discharge has formed excessive runoff, a deep percolation and poor distribution uniformity. Sprinkler irrigation on steeper terrain (more 2%) results water erosion of the soil.Some bulgarian mechanized semi-stationary water spraying installation (PDI–20 K, PDI –20 M ) have created rain with high application rates 16–20 mm/ hr with ther gun sprinklers type R -90 S, R - 50 S.

## Conclusions

The quality of irrigation water gives sufficient influence on the environment.It must be paid attention to all factors, affecting on quality of water.The introduced salts and heavy metals together with irrigation water have been accumulated by crops.After that there is a risk to the health of human. It isnecessary to make a pollution control of all water resources, especially near plants, factories, working with an old technology.

## Literature


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