

ENVIRONMENTAL DEGRADATION PHENOMENA IN IRRIGATION SYSTEMS

FENOMENE DE DEGRADARE A MEDIULUI ÎN SISTEME DE IRIGAȚIE

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Abstract. *Irrigation systems in the eastern part of Moldova have advanced infrastructure wear and tear. The degradation of the system's infrastructure has had a negative impact on the natural and human environment. The research carried out highlighted the negative influence of the absence of maintenance and repair works of the irrigation system on the site environment. The most active polluting factors are represented by the transport of alluvium in canals and pipes, the development of vegetation in the location of the pumping stations, the soil pollution with the noxious substances from the irrigation water, etc. The state of the environment within the irrigation system causes a human and landscape discomfort.*

Key words: canals, degradation, ecological status, impact, pipes

Rezumat. *Sistemele de irigații din zona de est a Moldovei au o uzură avansată a infrastructurii. Degradarea infrastructurii sistemului a determinat un impact negativ asupra mediului natural și uman. Cercetarea efectuată a evidențiat influența negativă a absenței lucrărilor de întreținere și reparații a sistemului de irigații asupra mediului din amplasament. Factorii poluanți cei mai activi sunt reprezentați de transportul de aluvioni în canale și conducte, dezvoltarea vegetației în amplasamentul stațiilor de pompare, poluarea solului cu noxele din apa de irigație etc. Starea mediului din cadrul sistemului de irigație determină un disconfort uman și peisagistic.*

Cuvinte cheie: canale, conducte, degradare, impact, stare ecologică

INTRODUCTION

The environment has been influenced by natural factors since its formation on Earth. Some of the natural factors have a negative influence on the environment by producing disastrous phenomena. These include climate change, earthquakes, volcanoes, floods, landslides, droughts etc. The development of human society has led to the emergence of anthropogenic factors, which began to be more influential than natural ones since the 20th century (Bica, 1998). In the last period of time, there is a coupling of natural risk factors with anthropogenic ones, a situation that determines catastrophic phenomena.

Environmental protection in the areas of irrigation systems is necessary given some negative effects of the exploitation process on watering plants (Law

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137, 1995). The current way of operating some irrigation systems in Romania can produce a series of pollution phenomena with influence over a long period of time. The differentiated management of the components of the irrigation system determines an inadequate management of the maintenance, repair and rehabilitation works of the infrastructure and superstructure.

The paper aims to present the results of research on environmental degradation in the area of irrigation systems by natural and anthropogenic risk factors more active in recent times.

MATERIAL AND METHOD

The study and research material is represented by the irrigation systems located in the eastern part of Romania. The research considered the irrigation systems located in the meadow area of the Prut River and located in Vaslui County (fig. 1).



Fig. 1 Study and research area: a - location of irrigation systems in the Prut river meadow; b - channel CA3 and SPP 9 Oțetoaia; c - supply channel CA3, Plot SPP8 Oțetoaia (Luca, 2020)

The Albița - Fălciu Complex Irrigation and Drainage Development currently has a developed surface of 16,973 ha. Irrigation systems are located on the first terrace and in the meadow of the Prut River. Irrigation systems were designed in 1977 and were executed between 1977 and 1978. After 1990, the irrigation infrastructure (basic pumping stations, supply and distribution channels) is operated by the Territorial Branch

of Land Improvements South Moldova. Irrigation plots are managed privately by OUAI in the area. The system contains irrigation plots equipped with pressure pumping stations (SPP) and monofilament pumping stations (SPPM). The pumping stations are fed by a network of channels (Luca, 2016).

For a series of irrigation plots, technical expertise was performed to determine the current constructive and functional state. At the same time, the influence of the degradation of the irrigation system on the environment was analyzed.

The research method is the one used to carry out technical expertise for land improvement objectives and in particular for irrigation systems with water supply of pumping stations using a network of canals.

RESULTS AND DISCUSSIONS

The Albița - Fălciu Complex Irrigation and Drainage Development has been in operation for over 40 years. Irrigation and drainage systems were under state administration until 1990. After 1990, the management system was modified, being mixed, the state and farmers' associations. The mode of administration has influenced the evolution of the environment by intensifying some natural and anthropogenic risk factors.

The area considered in the study is particularly sensitive to the phenomenon of pollution on multiple levels. The site is mostly located in the meadow, has a flat surface exposed to winds, with a shallow groundwater and influenced by the Prut River. The land is intensively cultivated without adequate soil protection. All these characteristics determine a seasonal amplification of the pollution phenomenon determined by natural and anthropogenic factors.

Irrigation contributes to ensuring the conditions for the development of agricultural crops in conditions of a climate with pronounced aridity (Nicolaescu *et al.*, 2005). However, irrigation can have a direct and indirect negative impact on the environment in which it operates. The direct type impact, determined by natural and anthropogenic factors, is represented by the following phenomena:

- the introduction of water taken from a river with a certain degree of pollution on the ground negatively influences the quality of surface water and groundwater for a certain period of time (Hâncu *et al.*, 2003);
- irrigation water can cause soil degradation by chemical effects, including contamination with various biological substances;
- sprinkler irrigation water (irrigation method used exclusively in the current stage by land managers) can cause erosion degradation of agricultural land;
- the presence of irrigation with the related constructions and installations substantially modifies the living conditions of the flora and fauna habitat in the area of action; irrigation alters the diversity of plant and animal species by destroying some or raising others.

The indirect impact, determined by the anthropic factor, is represented by the following phenomena:

- the application of intensive agriculture over periods of time, which reduces the amount of minerals in the soil;

- excessive fertilization of the land, with influence on the pedological characteristics of the soil;

- modification of the soil texture through the applied technological works.

For the studied area, several technical expertises were prepared in which the influence of irrigation on the environment was analyzed. The documentation analyzed the condition of the structural components of the irrigation system that interfere with the environment. The data obtained through technical expertise allowed the analysis of the impact of constructions and installations for irrigation on the habitat in the study area. The irrigation system has been in operation for about 40 years (Luca 2014; Luca 2015; Luca 2020).



Fig. 2 The impact of the meadow vegetation (reed) on the hydro-mechanical and electrical installations from SPPM, Plot 7 Doniceasa-Fălciu: a - occupying the location of the pumping station with vegetation; b - the influence of vegetation on the operating conditions of the pumping unit (Luca 2016)

The field research highlighted the following aspects:

I. The sources of pollution are diverse and are represented by the following groups:

I.a - Alluvium transported by irrigation water on the route from the source to the emission from the sprinkler system. Alluvium contributes to the clogging of the supply channels of the pumping stations (fig. 1.b, fig. 1.c) and of the drainage channels (fig. 2). Alluvium influences the texture and structure of irrigated soil. Alluvium contributes to increased wear of nozzles on watering equipment. This phenomenon is mainly registered in the irrigation plot SP7 Doniceasa - Fălciu, on the main supply channel CP5 for SPPM 7/4 ... 7/8. The canal is clogged at a height of about 65% (Luca, 2016).

I.b - Biological material, in particular grass, taken from the location of canals and transported in irrigation water on land occupied by agricultural crops. The absence of maintenance works on the location of the supply and distribution channels allows the development of polluting vegetation for the agricultural land. The wind picks up the seeds and introduces them into the irrigation water, after

which they are distributed with the sprinkler irrigation equipment evenly on the agricultural land (fig. 1.b, fig. 1.c). The CA3 supply channel from the SPP8 and SPP9 irrigation plots Oțetoaia has rich grass vegetation in the area adjacent to the canopy. Vegetation has become a source of soil pollution by taking seeds into irrigation water.

I.c - Biological material specific to the river meadow area, especially reed (*Phragmites australis*) excessively developed in the location of the constructions and installations of the pumping stations (fig. 2). The presence of groundwater at shallow depth favoured the development of reeds in the area of pumping stations, but especially in the drainage channels (they have water permanently (fig. 2)), but also in the irrigation channels (fig. 1.b). This situation is present in the location of the pumping stations SPPM 7/1 ... 7/8 from the irrigation plot SP7 Doniceasa - Falcu fed from the main channel CP5. The reed-like vegetation extended over the entire area adjacent to the crown of the CP5 canal. The pollution phenomenon negatively affects the structural condition of the pumping units, of the electrical installations and of the hydraulic installation (fig. 2).



Fig. 3 Impact of canals on the research area: a - drainage canal filled with vegetation and inoperable; b - CP5 supply channel, Plot 7 Doniceasa – Falcu clogged on variable lengths (Luca 2016)

I.d - Chemical pollutants taken with irrigation water from the Prut River. Most of them the pollutants in the Prut River are of organic origin. They come from the discharge of untreated wastewater, but also of incompletely treated wastewater in the treatment plants of the localities along the Prut River. Among the pollutants are ammonium ions, nitrites, heavy metals, hydrocarbons, and lately pharmaceutical substances are present.

II. Pollution phenomena caused by anthropogenic factors. In the last 30 years, the pollution phenomena produced by the controlled or uncontrolled human action have intensified. In the case of the irrigation system, the following may be listed:

II.a - Absence or limitation of maintenance and repair works of the components of the irrigation system. This situation caused the flooding of the canals and pipes of the irrigation system. The effect is represented by the following:

- vegetation development in canals and on their location; the phenomenon is present in the drainage channels, as well as in / along the supply channels at the pumping stations type SPP and SPP at most irrigation plots (significant in this case are the channels CA3 and CA5);

- vegetation development in the area of the pumping stations; the phenomenon is general at the SPPM type pumping stations located on the irrigation water supply channels (significant in this case are the SPPM from the Irrigation Plot7 Doniceasa-Fălcu located on the CA5 channel);

- blocking the flow in the drainage channels and increasing the groundwater level in the soil, a situation that determines the salting of the soil and changes in the habitat of the area; some of the drainage channels are clogged and have blockages of the flow section; the high level in the drainage channels determines the increase of the groundwater level in the soil, a situation that favours the appearance and maintenance of the salting phenomenon (Marinov and Safta, 2001);

- degradation of the structure of the water supply channels of the system, a situation that caused large water losses and influenced the characteristics of the environment in the area; most of the supply channels have a degraded structure due to the exceeding of the exploitation period of the protection material due to the infiltration phenomenon (protection with large reinforced concrete slabs); the degradation of the concrete slabs led to the appearance of large water losses, a situation that influenced the stability of the canal and the constructions on it; a significant example is represented by the supply channel CA3, Plot SPP 9 Otetoaia at which the degradation phenomenon is very extensive (fig. 1.b)

- the presence of excess hydrocarbon dust, dust and aerosols in the area of the exploitation roads in the irrigation system (the roads are unmaintained and the bridges are not repaired); the pollution phenomenon is widespread throughout the irrigation system; as an example it is presented in figure 5 of the exploitation sump from the SPP8 Otetoaia Irrigation Plot;

- aerosols and gases from the circulation, parking and technological process of agricultural machinery;

- agricultural and household waste as a result of agricultural and human activities in the area of the irrigation system; the volume of this waste has increased over time and highlights those of plastics (bags, bottles, boxes, packaging, etc.); plastic bags thrown into the supply channels cause the blockage of the suction to the pumps and implicitly the accentuated wear of the pump rotor through the cavitation phenomenon.

III. Habitat changes for existing flora and fauna at the site of the irrigation system:

III.a - Habitat modification for flora and fauna in areas of land where the parameters of the irrigation process are not properly controlled. In this category are the feeding channels degraded in proportion of 80% and with high water losses, the drainage channels clogged on about 40 - 75% of the volume.



Fig. 5 State of degradation of traffic routes in the irrigation system with environmental impact in Plot SPP8 Oțetoaia: a - exploitation road along the canal; b - bridge on the drainage channel (Luca 2020).

III.b - Modification of the habitat in the area of agricultural land determined by agricultural waste from the technological process of sowing, growing and harvesting plant production.

The analysis performed in several irrigation systems in Romania shows that the current way of managing irrigated areas induces a negative impact on the environment. Both entities that work together in the management of the irrigation system (state and farmers) create major problems in ensuring the conditions of habitat stability, but also in the radical change of those present. This problem must be solved jointly by the two partners in order to solve the problems of environmental pollution.

The absence of coherent legislation in the field of environmental protection, as well as its firm application, leads to the pollution of landfills occupied by irrigation and drainage systems.

CONCLUSIONS

1. Anthropogenic risk factors have become predominant in recent decades and particularly influence the state of the natural environment in irrigation systems, affecting buildings and facilities, but also the habitat in the area of the system.

2. The supply channels of the irrigation system have become vectors for transporting biological pollutants in the network of canals and pipes of the irrigation system, a situation that favours the infestation of agricultural land.

3. Unmaintained drainage channels contribute to habitat degradation in the meadow area and cause the spread of polluting vegetation on agricultural land.

4. The absence of maintenance and repair works of the components of the irrigation system influences the transport of pollutants on the landscaped land with influences on the agricultural production, the quality of the irrigation water, as well as the living conditions for the zonal habitat.

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