

LAND RECLAMATION WORKS OPPORTUNITY AND FEASIBILITY IN CLIMATE CHANGE CONTEXT

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Abstract

Land reclamation works are distributed across the territory, their positions being related to in situ factors. The governmental entity responsible off is the National Administration for Land Reclamation Works in Romania, administrating aprox. 3 million possible irrigated hectares, 3.1 million hectares possible drained, 2.2 million hectares equipped with soil erosion control works. Existing land reclamation systems shows different technical or/and economical deficiency taking in consideration the climatic changes evidenced by the evolution of temperatures, rainfall events distribution and intensity.. The comparison made with European countries goes to technical proposals for improving the stated Romanian situation, managing all together the aspects of land reclamation systems economic recovery, forest protection implementation, biomass exploitation, wastewater use. The main conclusion is that there are needed investments for dedicated land reclamation works in order to mitigate the effects of climate change. Cause to the great value of total costs it is recommended a progressive approach of the schemes, avoiding effects treatment and assessing the works behavior at every step. It is mandatory to carry out efficient, profitable investments, enabling execution and operation costs covering. Multidisciplinary analysis of issues and adopting of new design and operation concepts for protection systems in land reclamation field of interest is the base of any solution.

Key words: biomass exploitation, forest protection, land reclamation, valorization of degraded lands

INTRODUCTION

All over the world, land reclamation works of irrigation, drainage, soil erosion control and water courses regularization are unevenly distributed across the country both due to hydrological, climatically, pedagogical, geo-technical conditions, natural events recorded, existing works, but also due the public interest manifested by promoting projects and funds allocation for their construction, maintenance, operation, engineering, increasing the safety, and rehabilitation. The same situation is recorded over the Romanian territory, the distribution of land reclamation system being governed also by political interest, considering the fact that the major part of those schemes are designed and built during the communism period, when local reasoning was subsequent to the national one.

MATERIALS AND METHODS

There are recorded and reported (Figure 1) by the National Administration for Land Reclamation Works in Romania (NALRWR) as irrigated an area of 2,991,943 hectares, with 10,630 km canals, 26,700 km buried pipeline, 2,710 pumping stations and 13,384 of hydraulic works (dams, bottom outlets, falls, weirs, culverts, gates).

For drainage, there are equipped 3,085,895 ha, having 56,600 km canals, 40,660 km drains, 736 pumping stations and 42,236 hydraulic works. In order to control the soil erosion, there are 2,226,469 ha furnished, having 13,220 km canals, 19,833 km drains, 45,600 hydraulic works, 73,381 m of retaining walls and bank consolidations, namely 23,477 ha of dedicated forest plantations (NALRWR, 2016).

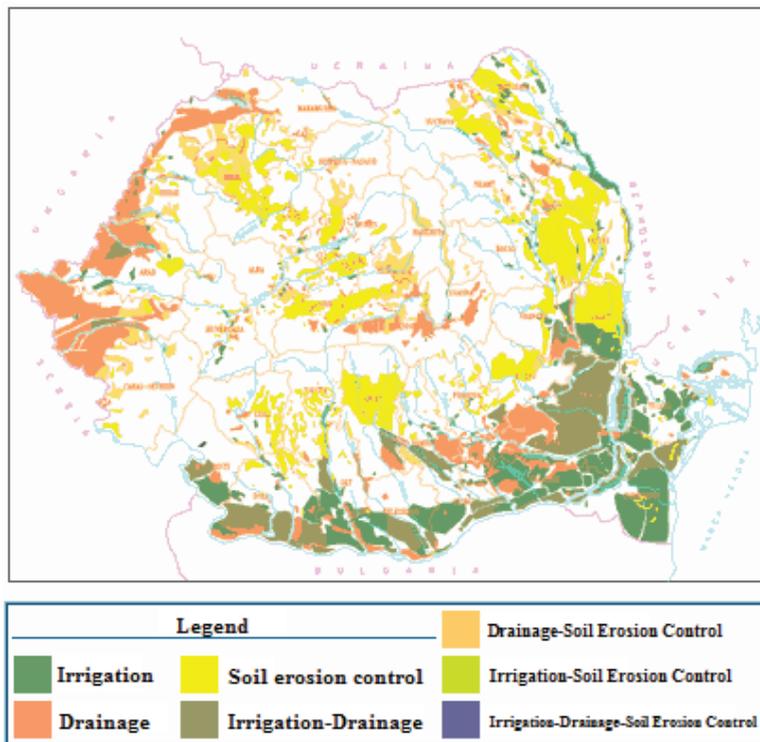


Figure 1. Distribution of land reclamation works in Romania (NALRWR, 2016)

Existing systems shows deficiencies related to:

- Design and execution in a period of time when economic system was centralized;
- Designed for serving large surfaces;
- Investment and exploitation return was made unitary, through state economic system;
- Lack of energy efficiency criteria.

In order to return the existing systems in the economic and technical are of functionality it could be done the following:

- Rehabilitation of existing systems by keeping initial design and operation criteria;
- Development of new systems based on technical and economic efficiency principles;
- Complex systems development, integrated into local economic systems;
- Development of complex systems, designed to meet environmental requirements in the context of significant climate changes.

Analyzing the situation of European irrigation facilities (Eurostat, 2007), it could be found

that Italy holds the leading position, the irrigable area of 3,950,500 hectares, representing 26% of the total area designed in EU countries, the total agricultural land in Italy being 17,841,450 ha. Among EU countries, the largest agricultural area has Spain (33,162,190 ha), however only 3,671,340 ha are irrigable. Slovenia, Malta, Lithuania, Latvia and Estonia have practically negligible irrigated areas, under 5,000 ha, the last having no irrigated surfaces.

RESULTS AND DISCUSSIONS

There is required:

- Development of irrigation systems for slopes, in order to soil erosion protection and economic recovery;
- Land use structure reorganization structure for slopes on the basis of environmental criteria;
- Valorization of degraded lands or areas with degradation risk, in order to obtain biomass;
- Forest protection implementation;

- Integration of forest belts and forests in the river system;
- Integration of channels, particularly irrigation ones, in the river system;
- Recovery of agricultural and forest biomass for energy purposes;
- Exploitation of biomass for improving soil properties;
- Recovery of waste (sewage or agricultural sludge) to improve soils' properties;

- Utilization of wastewater in irrigation;
- Cleaning the river system, exploitation of biomass and of existing landfills.

Soils in Romania are considered degraded (Figure 2) through anthropogenic causes by fertility decreasing, chemical pollution, crusting, gullies and landslides, silting and warping, water erosion, unstable without interventional works (Dumitru et al., 2000).

SOIL DEGRADATION OF ANTHROPOGENIC CAUSES IN ROMANIA

(Cn=fertility diminishing, Cpp=chemicals pollution, Pk=krust, Wd=Gullies and Landslides, Wo=Silting, Wt=water erosion, Sh=Stable under human pressure, Sn=Stable under natural conditions)

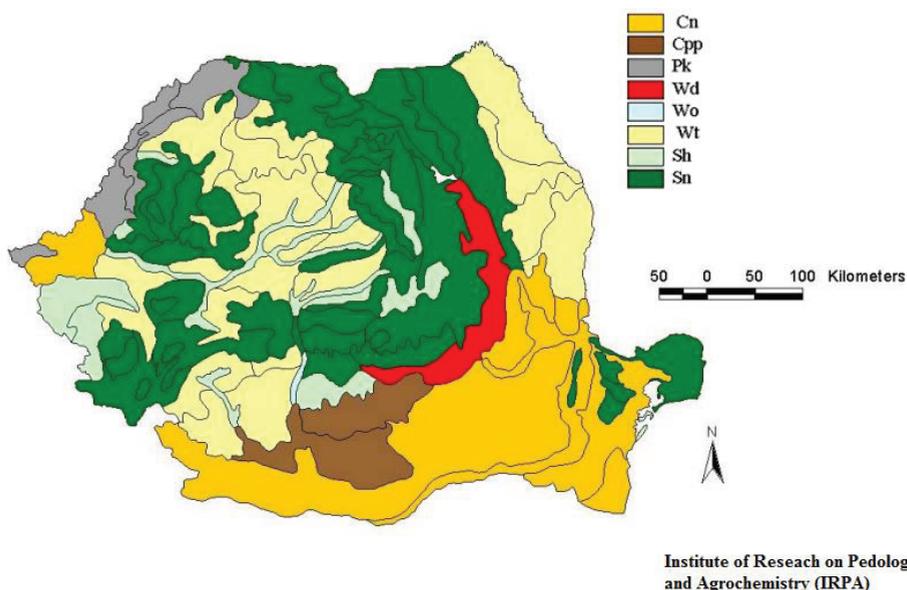


Figure 2. Chart of soil degradation of anthropogenic causes in Romania (Dumitru et al., 2000)

In terms of soil erosion control, except for dedicated systems, there are complex schemes, knowing the fact that the most affected counties by the phenomenon (erosion specify total) are: Buzau (41.5 t/ha and year) Vrancea (34,0 t/ha

and year), Prahova (31.0 t/ha and year), Arges (27.9 t/ha and year), Valcea (26.8 t/ha and year). Maximum values in Romania, broken down into surface erosion, deep erosion and landslides are shown in Tabel 1.

Table 1. Values of erosion recorded in Romania (Motoc, 1982)

No	Surface erosion (t/ha and year)	Deep erosion (t/ha and year)	Landslide (t/ha and year)	Deep + landslides (t/ha and year)
1	Vrancea – 17.0	Buzau – 24.4	Valcea – 4.8	Buzau – 28.0
2	Alba – 14.3	Prahova – 14.4	Vrancea – 4.7	Vrancea – 17.2
3	Prahova – 14.2	Vrancea, Arges – 12.5	Mures – 4.5	Prahova – 16.8
4	Dambovita – 14.0	Valcea – 8.5	Iasi – 4.4	Arges – 16.1
5	Bacau, Buzau, Valcea – 12.0	Gorj – 8.0	Gorj, Buzau, Sibiu – 3.8	Valcea – 13.3

Forms of deep and surface erosion can be extinguished or enhanced through:

- hydraulic works and forest plantation (Figure 3);
- afforestation surfaces of surrounding area of watershed delimitation line;
- farms having function of soil erosion control on slopes and their irrigation;
- interception basins and water retention on the valley.



Figure 3. Soil erosion dam and vegetation planted

Strategy of wetlands valorization has evolved according to historical economic policy. Thus, in the last part of the XXth century, agricultural policy had as main objective the exploitation of all unproductive land for agricultural purposes through complex land reclamation systems.

The principle enunciated represents the base of Romanian existing systems development. For this reason, evading economic efficiency laws, mentioned systems have involved large investments and high operating costs. It is required the use of these surfaces under

minimal environmental impact in a mixt system of natural and agricultural areas; it is minimal environmental impact in a mixt system, of natural and agricultural areas; it is also important to identify and treat the moisture excess causes, not just the effects (Figure 4)



Figure 4. Surfaces affected by moisture excess

Since all the analyzed phenomena are influenced by vegetation, is conductive the use of forest belts complementary to land reclamation works, having influence effects on surface water and groundwater runoff, on soil properties, on soil erosion, on wind speed, on air and soil humidity, and lead to biomass production.

The most obvious effect is bound to surface water flow, lack of forest belts (natural or anthropogenic) being the main cause of “flash-floods” recorded (Figure 5).



Figure 5. Flash-floods – Stream in Zavruggia, July 18, 1987 (FOEN, 2000)

Analyzing available data (E. Gaume et al., 2009) it is found the augmentation of extreme events number of such phenomenon in the period of 60 years (1947-2007), with different distribution, function to territory and to the number and periodicity, different from country to country; the maximum number was registered in Slovakia in 1999-2000 (9 events) and Romania 2005-2006 (8 events).

Regarding rapid floods, their number is different concentrated over the year, the largest recorded being in Slovakia, July (17-18), followed by France October (12), Slovakia in June (10). In Romania there is registered a distribution on each season, the maximum being registered in June (9), followed by July (7), in May and August (5) (E. Gaume et al., 2009).

Regarding the biomass exploitation, the simplest solution is to the direct combustion in boilers or electro-thermal plants. But, for an integrated management it could be chosen: biogas obtaining and cogeneration or composting and agricultural recovery.

For sludge produced within watertreatment plants, whose organic load is high, it can be chosen to plug in methane tanks (Figure 6).



Figure 6. Methane tanks and fermenters for sludge processing

Here, through anaerobe fermentation, the volume diminishes during the stabilization process, a phenomenon accompanied by the release of biogas. By collecting it, it is proposed the use as a collateral energy source. This technology can be applied to organic waste resulting from agro-industrial units.

The described technology has high utilization efficiency, ensures peak energy production and allows energy storage and utilization at request,

does not involve major impact on the air. The remaining solid part has characteristics of an agricultural fertilizer. Operating temperatures are reduced and materials used in installations are cheap (Figure 7).



Figure 7. Cogeneration unit with thermal heat recovery from flue gases

It is desired, simultaneously, to improve soil quality and to reduce water runoff on slopes. Thus, runoff coefficient values, depending on slope and soil texture, vary from 0.1 to 0.6 in the case of forest land use, to the (0.3-0.8) values in the case of crops existence (Muresan and Plesa, 1992).

It is ascertained that the slope values have a stronger influence than soil texture on the coefficient, followed by vegetation type.

CONCLUSIONS

Nowadays, climatic changes are demonstrated, evidenced by the evolution of minimum, maximum temperatures, rainfall events distribution and intensity.

There are needed investments for dedicated works in order to mitigate the effects of climate change.

The high value of those works involves a progressive approach starting from causes, avoiding as much as possible effects treatment.

It is mandatory to carry out efficient, profitable investments, enabling execution and operation costs covering.

It is required a multidisciplinary analysis of issues and the adopting of new concepts of design and operation for protection systems in land reclamation field of interest.

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