

## LAND RECLAMATION IN ROMANIA. HISTORICAL RETROSPECTION AND PERSPECTIVE

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**Abstract.** *In Romania from about 15 million hectares of agricultural land and 9.7 million hectares of arable land, 5.3 million hectares are affected by soil erosion, 5.5 million hectares are affected by excess humidity and 5.5 million hectares are affected by drought. Prior to 1990, 3.1 million hectares were equipped for irrigation, 3.1 million hectares for works to check excess humidity and only 2.2 million hectares for soil erosion control. After 1990, several rehabilitation projects were carried out, but most of them dealt with irrigation. The latest National Program of 2016 provides for an area of 2 million hectares for irrigation, especially in the Danube Floodplain. There are no rehabilitation programs for soil erosion control or excess humidity, other than the ones partly included in the irrigation systems.*

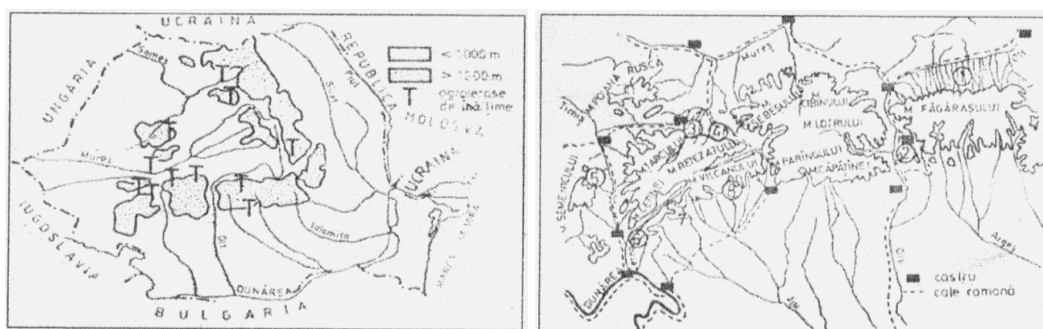
**Keywords:** land reclamation, retrospection, history.

### 1. Introduction

Expert studies have shown that on more than half of Romania's agricultural land three natural calamities produce significant harvest losses. These are drought, excess humidity and soil erosion. For farmers the most visible is drought, which almost every year causes damage in one region or another during one of the vegetation seasons. In order to combat the drought, as early as the end of the 19<sup>th</sup> century some proposals for large-scale irrigation equipment were made but were not implemented (Lup, 1997). As far as excess humidity is concerned, since the 18<sup>th</sup> century, more than one million hectares have been drained but the problem has not been solved throughout the country (Lup, 2014). While in the western and south-western parts of the country drainage and regularization of watercourses works are made, throughout the rest of the country, ponds and fisheries are set up, and small vegetable areas are equipped for irrigation, while the works against soil erosion are almost unknown. At the beginning of the 20<sup>th</sup> century, studies were developed for large-scale irrigation equipment but were not finalized. Among these we mention the work titled *Irrigation Studies in Romania* by engineer V. Roșu, 1907, for an area of 150,000 ha and engineer Al. Davidescu's *For the Irrigation of 1,773 Thousand ha* (Lup, 1997). However, the two world wars prevented works on large areas. Only after the seizure of political power by the communist-totalitarian regime in 1945, and then after the nationalization of all the country's wealth, elaborated works to combat drought, excess humidity and soil erosion became possible.

## 2. Material and Method

The material used is predominantly bibliographic and comes largely from the research done in this field by the first author. This is the historical part of this article. In addition, the current land reclamation programs, that include both works that are undergone at this time and short-term 2020 and mid-term 2030 future programs, are overlapping. The authors also mention legislative acts (laws, decrees) that approve these programs as they entail big investments. The method used is specific to this type of research: material collection and selection, processing, comparisons, conclusions and recommendations of the authors in relation to the past and the future of this type of study. From a historical point of view, the material is structured as follows: a) the old, medieval and modern period until the end of the 19<sup>th</sup> century; b) the first half of the 20<sup>th</sup> century; c) the planned economy period until 1989; d) the market economy period. Rehabilitation of the works made during the planned economy period and the perspective of 2020-2030.



## 3. Results and Discussions

### 3.1. The old, medieval and modern period until the end of the 19<sup>th</sup> century.

For the human species, as for any other living organism, survival means food, and when fruit and wildlife could no longer provide it, man had to cultivate the land. Thus, agriculture was born at first in the hollows of the forest and then it was developed on deforested areas.

The need for food growing with the demographic evolution, the method of increasing the productivity of the land was undertaken: irrigation, drainage, cultivation of sloping land, trough terraces to prevent erosion.

Thus, land reclamation was born, and this happened similarly in the territories inhabited by Romanians (Fig.1.2).

Traces of irrigated areas were identified not in dry areas, but where water was available without much expense. In Figure 1 irrigations continue in history until the Latène period (5<sup>th</sup> century BC – 1<sup>st</sup> century AD.) and are located in the Southern Carpathians from Cerna valley to Dâmbovița valley comprising the piemonts. Irrigated through overflow were meadows, vegetables in the garden system. Also for the increase of cultivated areas, terraces were built, climbing up to 1,200-1,400 m of altitude (Fig. 2).

During the Middle Ages, land reclamations were represented by a large number of triple-role ponds: water mills activation, fish production and irrigation of vegetable gardens. For Transylvania we have written testimonies about ponds in the 12<sup>th</sup> century Crișana, 13<sup>th</sup> century fisheries on the Someș, Crișuri and Mureș rivers, 15<sup>th</sup> century ponds in Brașov and Sibiu. In 17<sup>th</sup> century Moldavia, the historical sources mention the existence of over 1,500 ponds, with a total area of about 200,000 ha (Davidescu D., 1994).

In the period between the second half of the 18<sup>th</sup> century and the first half of the 19<sup>th</sup> century, both in Wallachia and in Moldavia several irrigation works were performed, among which we can mention:

- Canalul Iazul Morilor-Târgoviște (Mill Pond -Târgoviște Canal), about 7 km in length, built in 1748, initially used for mills functioning and then for irrigation;
- Canalul Leaotul-Iazul Morilor-Prahova (Leaotul-Mills Pond-Prahova Canal), 26 km in length (1890);
- Canalul Sturza de la Focșani (Sturza Canal at Focșani), on the Putna river;
- Canalul Morilor și Canalul Mărăcineni (Mills Canal and Mărăcineni Canal on the Buzău river).

In the field of excess humidity elimination and works for flood control, the first studies date back to Dacian times. Later on – the 17<sup>th</sup>-18<sup>th</sup> centuries - there is evidence of flood control and drainage of swamps works in various areas of Wallachia, such as Rădăuți in Moldavia or the Dâmbovița Basin in Wallachia.

A special case is that of Banat and the Western Plain, where the former Habsburg Empire began from the second decade of the 18<sup>th</sup> century extensive drainage works, regularization of watercourses, water supply, on an area of over one million hectares.

At the end of the 19<sup>th</sup> century, in Romania, there was a special interest in irrigation and the first studies on irrigation of field crops appeared. The Italian engineer Gioia proposed a sub-Carpathian canal, and engineer Chirul published the study: *Canals on Rivers and Irrigation*.

### **3.2. The first half of the 20<sup>th</sup> century.**

The studies continue, from which we mention: *Studies on Irrigation in Romania 1907*, author Eng. V. Roșu. An area of 150,000 ha in Oltenia, Wallachia and Moldavia was considered, having as source of water the inland rivers, *The Study of Irrigation of the Danube Plain and the Inland Rivers*, author Eng. Davidescu. The study was taken up as a standard estimating 212 lei/ha. On this project there had been talks among Romanian and foreign specialists for 20 years until the author's death.

In 1929, a commission studied the possibility of embankment of the Danube and introducing irrigation on large areas. There were intermittent talks up to the Second World War without taking a concrete measure in the field, and even less during the war.

However, research was carried out in vegetation pots on the contribution of irrigation to the yield increase by: N. Chirițescu-Ava 1923, Amilcar Vasilescu 1932, Gh. Ionescu-Șișești and I. Valuță 1934, insufficient for the elaboration of irrigated technologies for the plants in the fields. The technology of rice was improved and the area cultivated with rice grew from 560 ha in 1940 to 3,250 ha in 1944.

In the area of excess humidity, the specialists' attention focused on the Danube Floodplain. After A. Saligny's death in 1924, Gr. Antipa's concept gained ground, namely the submersible embankment (Botzan et al., 1991).

The issue of soil erosion remains in the research phase without a statistic of the old terraces, vineyard plantations, and soil-setting plantations (Davidescu, 1994).

### **3.3. The planned economy period 1945-1989.**

The new political power established on March 6, 1945 found a war-damaged agriculture, and land reclamation as described above. The catastrophic drought in 1945-1946 would follow, a situation in which the increase of agricultural yields was a priority, and the solution - irrigation. In 1950, the land reclamation situation was the following: irrigation - 42,000 ha, embankments - 622.2 thousand ha, drainage - 358.0 thousand ha and only 2,000 ha of anti-soil erosion works.

In 1950, the new political power was determined to put an end to this situation, and even if the complicated process of collectivization had begun only one year before, actually after the 1945 agrarian reform, and especially after the 1948 nationalization, the economy of the new socialist state was strong enough to allow large investments, especially since, besides the confiscation of the economy, it also had the power to make decisions.

The electrification plan. This was the name of the first program of land reclamation works, named after the Soviet model, as it was considering the construction of the Bicaz hydroelectric plant, and from its reservoir intending to provide water for the irrigation of an area of 300,000 ha.

In the same 10-year plan (1950-1960) 2.7 million hectares would be equipped for irrigation in the driest areas, of which, in the beginning, 1.2 million hectares would use the Danube River as the source of water for 500 thousand hectares, lake reservoirs for another 500 thousand hectares, and for 200 thousand ha inland rivers: Jiu, Argeş, Olt, Ialomiţa, Siret. In this first decade, 158,000 ha were equipped for irrigation (but no hectare from the Bicaz reservoir), 185,000 ha of embankments, 138,000 ha of drainage and 98,000 ha of anti-soil erosion equipment/facilities. During the first years of this period, the irrigated areas were extended for the supply of vegetables to the capital city and other working-class townss, for cereal crops, for the cultivation of cotton on furrows in the Modelu, Rosetti, Zimnicea areas.

In 1962, by HCM (Decision of the Council of Ministers) 1050/1962 the embankment and drainage of 300,000 hectares in the Danube Floodplain was approved in order to increase the arable area of the state's households. At organizational and research level, in 1966 *The Land Reclamation Department of the Superior Council of Agriculture* was established, and in 1969, after a series of reorganizations, *The Institute for Studies and Research for Land Reclamation* was established (1971), which would become in 1978 *The Institute for Research and Technological Engineering for Irrigation and Drainage* (ICITID Băneasa-Giurgiu).

The National program for extending land reclamation works in 1966-1970. Under this program, irrigation systems were built in Jegălia on 23,000 ha; Gălăţui-Călăraşi 82,000 ha; Carasu 200,000 ha (partially). In July 1970, *The National program on water resource management, the extension of irrigation works, embankments, drainage and soil erosion control in RSR (Socialist Republic of Romania) in 1971-1975 and general and prospective provisions until 1985* was launched.

**Table 1.** Area programmed to be equipped until the end of 1989 - thousand ha -

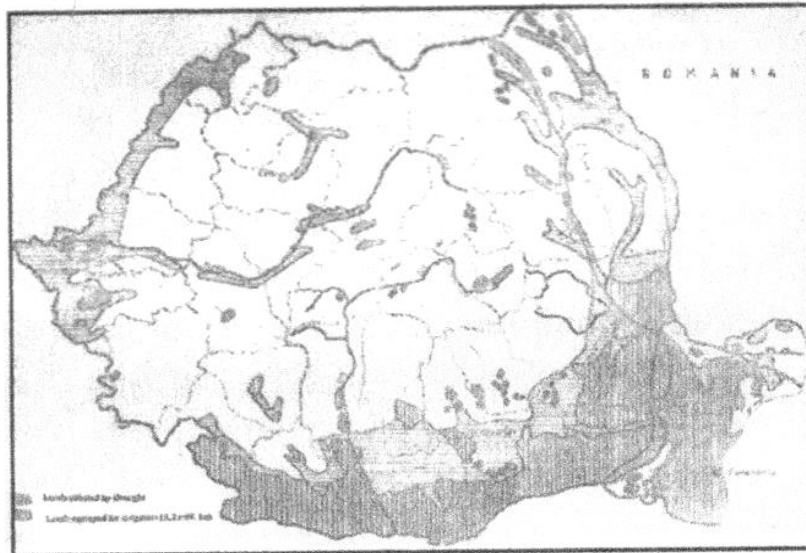
Action	Equipped area (potential)	Equipped area on 31 dec.1982	Remaining area to be equipped	Equipped in 1989
1. Equipment for irrigation	5,500	2,380	3,120	3,109
2.Drainage	5,530	2,576	2,954	3,085
3. Soil erosion control	5,300	1,718	3,582	2,222

Source: National Program 1983

1983 - The national program for ensuring secure and stable agricultural yields by increasing the productive potential of the land, better organization and unitary use of agricultural lands, the entire area of the country, the performance of irrigations on about 55-60% of arable land, of drainage and soil erosion control works. In figures, this program looks like this (Tab.1). At the end of 1989, of this last program only 56% of the irrigation program was implemented, somewhat less (55.8%) of the drainage program, and only 42% of the area planned for soil erosion control. Even these figures given as *official* by designers and builders (DGEIFCA) can be questioned in view of the era's tradition of reporting fictitious figures (obviously higher in achievements and lower than the actual ones, concerning the unresolved negative phenomena, for example excess water, salinization, swamping, etc.).

In fact, the same DGEIFCA published in 1998 data on the equipped areas, which were much larger than the official ones, presented in the following year, i.e. 1989. For example, according to the above-mentioned institution, the area equipped for irrigation at the end of 1988 was by more than 480 thousand ha larger than the one presented officially at the end of the following year, i.e. 1989.

The same happened in drainage, i.e. the area was by over 400 thousand ha larger than the official one (presented in the next year), and in soil erosion control works, i.e. the area was by more than 270 thousands ha larger (in 1988), compared to the final figures published in the following year, i.e. 1989 (6).



Source: DGEIFCA

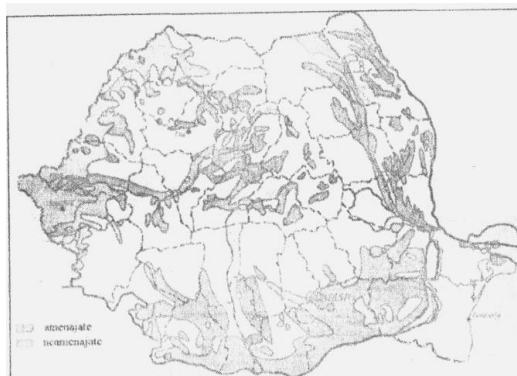
**Fig. 3.** Areas affected by drought in Romania.

In all land reclamation programs irrigation was given priority as the most efficient and quickest way to increase yields per ha.

As far as location was concerned, the frequency and duration of droughts were taken into account. The largest areas were equipped in the south and east of the country using the Danube River as water source (for about 85% of the equipped areas). Figure 3 shows the areas equipped at the end of 1989 compared to the last program (1983).

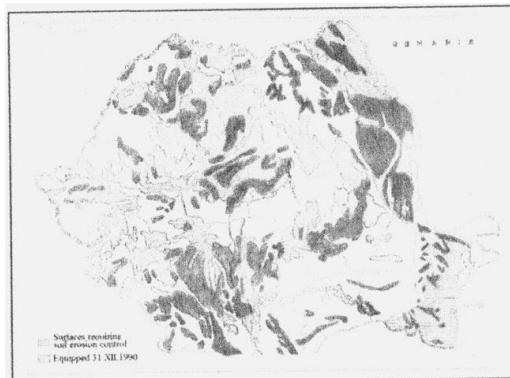
In this period, the most important factor was the degree of aridity of the area and less the economic suitability. For example, Nicolae Ceausescu himself recommended that by the end of 1985, Brăila County and the entire Dobrogea should be equipped for irrigation without taking into account the water pumping and relief height.

Figures 4 and 5 show the areas where work was carried out to fight excess humidity and soil-erosion, respectively, compared to the areas scheduled in 1989.



Source: DGEIFCA

**Fig. 4.** Excess humidity areas in Romania.



Source: DGEIFCA

**Figure 5.** Areas affected by soil-erosion in Romania and the level of works in 1990.

### **3.4. The market economy period.**

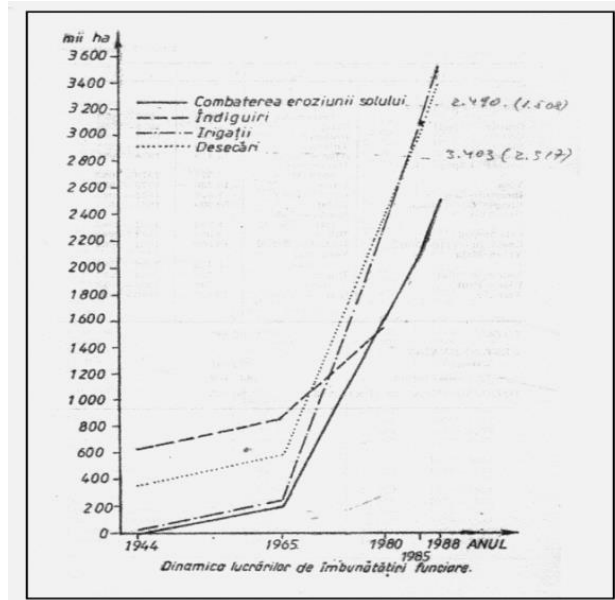
Compared to the national program in 1983, at the end of 1989 there were still 2.740 thousand ha to be equipped for irrigation; 2,445 thousand ha of drainage works and nearly 3,100 thousand ha of soil erosion control works had been carried out in over 700 sites and were in different execution phases.

In this situation, the new government stops the funding of the works and demands explanations from the over 85,000 specialists trained in the research, design and construction of the works. By order of the Prime Minister, a commission is appointed to analyze the situation and to propose measures.

The commission's first conclusion was:

Since 1966 the works have been carried out at an unrealistic pace (see Fig. 6); in the last 15 years the expansion of areas was given most of the attention, while in some cases the technical requirements have been abandoned in the conception and execution stage, as well as the requirements for environmental protection. About 40% of the irrigation canals are non-enclosed, water losses reaching 30-60%, the pumping aggregate yield is below the catalogue values, watering equipments have low reliability, and others are technically outdated. Regarding the fate of the objectives in progress, the commission proposed:

- Completion of 212 objectives;
- Conservation of 139 objectives;
- To continue the work on 230 objectives.



Source: DGEIFCA

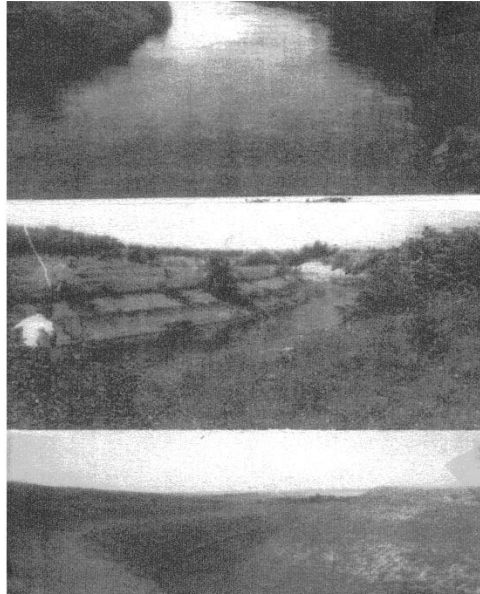
**Fig. 6.** The dynamics of land reclamation works.

For the proposals made, the commission requested the sum of 4 billion lei, while investments worth 25 billion lei are in progress.

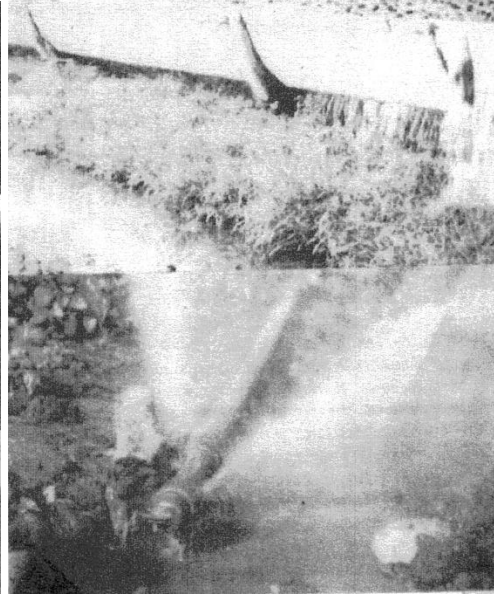
To this amount, the cost of the rehabilitation of the irrigation systems is added, given that some of them functioned for a longer or shorter period under the conditions established by the commission.

The Carasu irrigation system in Constanta County, for example, operated for 20 years with non-waterproofed or imperfectly waterproofed canals and inadequate watering equipment (Fig.7-8).





Source: Rehabilitation study. Diagnostic Carasu and Vederoasa, Constanța County



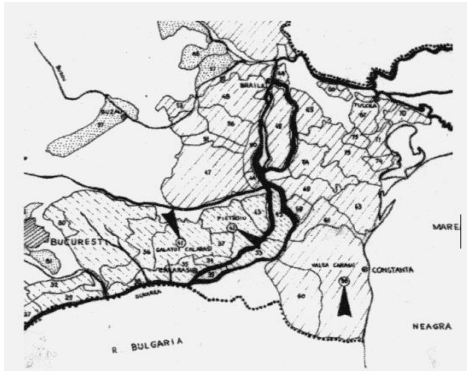
Source: Photo archive A.Lup

**Fig. 7.** Partially non-waterproofed channels in the irrigation systems Carasu and Vederoasa. **Fig. 8.** Suspended gutters imperfectly assembled and deteriorated watering equipment

Due to this situation, a period of rehabilitation of the irrigation systems began as early as 1990, taking into account not so much the wear and tear but the fact that they actually functioned without being completely equipped. The working pace (in some years, more than 200 thousands ha were equipped and put into use), and certainly the lack of financial resources have led the builders to give up some components such as waterproofing of canals, water measuring equipment, automation and for the indispensable components (pumping stations, watering equipment) to resort to the cheapest and least efficient solutions.

The assessments of the rhythm of the works, their quality and degree of reliability were acknowledged by the members of the commission and by the builders, but only in 1990 when the works carried out for the national irrigation system were already "history". The images in Figures 7 and 8 are eloquent in this respect.

The first irrigation systems for which rehabilitation studies have been initiated since 1990 were Carasu in Constanta County with an area of 200,000 ha, Gălățui Călărași County with an area of 85,000 ha and Pietroiu-Ștefan cel Mare Calarasi and Ialomița Counties with an area of 55,000 ha, the total area studied being of 345,000 ha (7). The study was conducted from the autumn of 1990 to the summer of 1992, in collaboration with the French company. The average investment for the three systems was estimated at approx. 3000 USD/ha. The location of the three irrigation systems is shown in Fig. 9.



Source: Rehabilitation study

**Fig. 9.** Location of irrigation systems Carasu, Gălățui and Pietroiu.



Source: Study of Irrigation and Drainage in Romania

**Fig. 10.** Location of hydro-ameliorative systems in Romania.

The findings of the diagnostic-study include:

- large water losses on non-waterproofed or partially waterproofed canals (Fig. 7);
- defective watering equipment, used improperly;
- incomplete and inefficient drainage especially in Gălățui and Pietroiu systems built on drained areas.

The exploitation of the three irrigation systems was more or less complete before 1990 with all the above-mentioned failures. Under these conditions, the technical and economic parameters were not achieved, irrigations of this period producing significant losses to the State which, during the entire period of exploitation, subsidized the water by up to 80% of the costs, and to the agricultural units by not achieving the planned yields. The authors of the study signalled the phenomenon of salinization especially in the systems in Călărași County, the drainage system being incomplete and inefficient. Regarding the actual rehabilitation, the process is delayed although the rehabilitation programs are renewed with each change of the government or minister. There are no data on the achievement of the works on the area of 5500 thousands ha foreseen in the program of 1983, not even on the rehabilitation of the area of 3000 thousands ha, which had already been equipped in 1989.

*The Study on Irrigation and Drainage in Romania* (8). It was conducted by the UK firms BINNIE-PARTNER and HUNTING TECHNICAL SERVICES LTD between 1992 and 1994. A number of 104 irrigation systems from Moldavia, Dobrogea and the Danube Floodplain (Fig.10) were studied. Generally, the study found the same deficiencies, but unlike the previous one, it also analyzed the

problem of drainage, especially in the systems in the Danube Floodplain, mostly on drained lands.

As the study covered virtually Romania's entire territory, among its conclusions there are important recommendations:

- In technical and economic terms, in Romania, it is possible to irrigate efficiently 1400-1600 thousands ha;
- At a pumping height of over 70 m, water costs outweigh the extra income and, in conclusion, irrigation becomes economically inefficient.

*The Romanian Irrigation Equipment Study* (9). It was carried out by MORRISON KNUDSEN CORPORATION USA in the irrigation systems Giurgiu-Răzmirești, Ialomița-Călmățui Giurgiu County and Bărăgan Constanța County. Carried out in 1992/1993, it was interested in the capacity of the irrigation systems of Romania to introduce high-performance central pivotal irrigation equipment, movable ramps, etc.



Fig. 11. The location of the JICA study (highlighted area) within the *Siret-Bărăgan Canal* project.

*Feasibility study of the irrigation project in the Ruginești-Pufești-Panciu Area* (10)  
Vrancea County, conducted by the Japanese company JAPAN INTERNATIONAL COOPERATION AGENCY-JICA in 1994-1995, part of the *Siret-Bărăgan Canal* Project, which envisioned the irrigation of an area between 500-700 thousands ha. The study was located in the northern end of the project on an area of 22360 ha (Fig. 11, highlighted area). The study is important because, unlike the irrigation systems in the Wallachian Plain with pumping heights of up to 200 m, here the pumping height would have been only of a few meters and the area could be irrigated by surface leakage, therefore with low energy consumption.

*The PRRSI Project - Rehabilitation and Reform of the Irrigation Sector* (5).  
The study aimed at adapting the irrigation systems built before 1990 to the new agrarian structures and the requirements of the market economy. It was to be implemented by the competent ministry in the period 2004-2011. An irrigation system started in Sadova-Corabia Dolj County 40000 ha of a total area of 100,000 ha. It is partially rehabilitated.

*The Irrigation Sector Investing Strategy Study* (11).  
It consists of an economic analysis of the irrigation sector carried out in 2007-2008 by a consortium of the Dutch DHV system (Fidman Merk). The entire irrigation-equipped area before 1990 was surveyed, that is 3000 thousands ha. All the irrigation systems in the ANIF administration were analyzed according to the viable/non-viable criterion. It concluded that about half of the area equipped before 1990-1992 is viable, including systems or parts of systems that can become viable through rehabilitation. However, rehabilitation is considered a long-lasting problem, so there is a priority selection of 836 thousands ha viable at the time, but obviously after rehabilitation, which in principle means removing the deficiencies present since its putting into use. Interestingly, the practical Dutch classified the priority order according to efficiency criteria (seed culture), organization (OUAI), usability in recent years rather than the aridity-drought index (5<sup>th</sup> place). The study also mentioned that irrigation should not be the subject of slogans and political choices.

*The National Program for the Rehabilitation of the Main Irrigation Infrastructure in Romania 2016* (12).

It is the latest program developed by MADR/Ministry of Agriculture and Rural Development and aims at rehabilitating an area of 2,006,941 ha by 2020, divided into three phases and in 86 works, for which the amount of € 1015 billion is provided.

The program is motivated by annual harvest losses worth \$ 2874 million due to drought.

### **Conclusions**

In Romania, each of the three categories of calamities, i.e. drought, excess humidity and soil erosion, affect about half of the agricultural area of the country, which corresponds to the last program in 1983. Only about 60% of this program was achieved for drought and excess humidity and 40% for soil erosion control, although about 1,500 million tons of unrecoverable soil are lost annually.

- After 1989, the works did not continue according to the program, instead rehabilitation studies of the areas equipped until 1989 began.
- Periodically, rehabilitation programs are developed but only for the irrigation systems; currently the last number being of approx. 2 million hectares, respectively 1/3 of the 1983 program.
- The Danube Floodplain systems through the State-owned land ceded to domestic and foreign companies are a priority for rehabilitation.

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