

LAND RECLAMATION IN MOLDAVIA. PAST, PRESENT AND FUTURE

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Abstract: *At the end of World War II, Romania's land reclamation area - irrigation, drainage and soil erosion control works - was among the smallest relative to the actual needs of the country. This was despite the fact that landslides, floods, and especially droughts caused large, sometimes catastrophic damage. The yield losses caused by drought, floods, soil erosion triggered famine and human habitat destruction in all regions. During 1950-1989, there were successively developed extensive land reclamation programs reducing the backwardness of the country in this field. This paper analyzes the operation of the land reclamation during the transition to a market economy (after 1990), in the historic province of Moldavia, where, at the end of 1989, over 332 thousand ha were equipped for irrigation, 239.3 thousand ha were equipped against excessive moisture, and 798.2 thousand ha were equipped by soil erosion control works. We have also analyzed the state of the irrigation facilities, in particular. The actually irrigated areas in recent years; represents a little more than 12% of the existing potential in 1989. This paper also examines the causes that led to the disastrous state of the land reclamation, especially as far as the land equipped for irrigation in the province of Moldavia is concerned.*

Keywords: land reclamation; Moldavia; operation, rehabilitation

Among the historical Romanian provinces, Moldavia was apparently the most affected by natural phenomena, with the most serious consequences on the population and on households. Flash floods, floods, but especially droughts caused not only damage but also famine.

The Moldavian chroniclers of the Middle Ages describe the effects of such droughts. Grigore Ureche describes the effects of the exceptional drought from 1585, when *all springs dried up and all fruit perished*, and Miron Costin describes the one in 1660, when *people ate dry rush instead of bread and, therefore, Ștefăniță Vodă was named Papură Vodă (in English, the Rush Prince)*.

In more recent times, documentary sources mention that the great droughts that affected large areas took place in 1847, 1866, 1896, 1907, 1945-1946, which inspired the work entitled *Moartea căprioarei (The Deer's Death)* to the famous poet Nicolae Labiș.

Since the last decade of the nineteenth century, the irrigations have ceased to be just history and become a problem dealt with increasingly more by policymakers and researchers. Thus, in 1893, the engineer C. Chiru published the paper entitled

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Canalizarea râurilor și irigațiuni (*The Sewerage of Rivers and Irrigations*), and, in 1907, the engineer V. Rosu received the Romanian Academy Award for his work entitled *Studii asupra irigațiilor din România* (*Studies on the Irrigations in Romania*), which took into consideration an area of 150,000 ha in Oltenia, Muntenia and Moldavia, using the inner rivers as water source.

A special committee functioned permanently within the ministry, studying the issue of irrigations and impoundage, but, at the end of the Second World War, in Romania, 20,000 ha were irrigated, especially with vegetables and some with rice.

Floods and flash floods also created problems, especially since Moldavia was famous for the great number of fishing ponds (about 1500, with a total area of around 20,000 ha). However, the stews and ponds favored the production of floods, such as those in 1504 or 1659, which drowned several villages. Nevertheless, in this situation, the rulers recommended or even ordered that residents themselves drain the ponds. In the nineteenth century, there were mentioned flood control works and wetland reclamations, and Caragia's *Codex* (1817-1818) and the *Organic Regulation* (1834) mentioned the need to regulate rivers and drain moors.

With respect to soil erosion, the high agro-terraces from mountainous and sub-mountainous areas were known since ancient times, both in and outside the inner Carpathian chain, in Transylvania and Bucovina [1].

In 1983, there was launched *The National Program to ensure safe and stable agricultural yields by increasing the land's productive potential, a better organization and use of the agricultural land and of the entire surface of the country, in a uniform manner, equipping about 55-60 % of the arable land for irrigation, works of drainage and of soil erosion control*. [2] These areas were to be equipped by the end of 1989. In reality, only 3,067 thousand ha (55.8 %) were equipped for irrigation, draining was performed on 3,107 thousand ha (56.2 %) and soil erosion control works - on 2,200 thousand ha (41.5 %).

Land reclamation. According to the last program, in Moldavia, the following areas were scheduled for land reclamation works: 794,500 ha for irrigation, 340,300 ha for drainage and 932,200 ha for soil erosion control work.

What has been achieved before the end of 1989, compared to the program, is shown below (Table 1).

Compared with the schedule figures, the irrigation works were the lowest, being achieved only in proportion of 41.8 %, with variations between 62.6 % in Galați county and 11.5 % in Suceava county. One explanation could be that the investment per unit area in the last years reached 40-50 thousand lei/ ha, while the investments for equipping one ha against excessive moisture or soil erosion was of about 2.5 or less per unit area (ha).

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Table 1. Areas scheduled for, and equipped by land reclamation works in Moldavia, by the end of 1989

No	County	Irrigations			Drainage			Soil erosion control works		
		Programme	Achieved	%	Programme	Achieved	%	Programme	Achieved	%
1.	Baclo	43200	24000	55,6	8200	3217	39,2	140900	103355	73,4
2.	Botosani	123200	24700	20,0	12400	9875	79,6	84400	95016	112,5
3.	Galati	231700	145100	62,6	71500	49060	68,6	174500	154378	88,5
4.	Iasi	112400	53000	47,2	49300	36111	73,2	153200	103582	67,6
5.	Neamt	18500	10500	56,7	14500	10032	69,2	34400	35048	101,9
6.	Suceava	39100	4500	11,5	69400	43194	62,2	98100	81064	82,6
7.	Vaslui	49700	30400	61,2	59800	39260	65,7	190500	179135	94,0
8.	Vrancea	176700	39900	22,6	55200	48531	87,9	56200	46651	83,0
9.	Total	794500	332100	41,8	340300	239286	70,3	932200	798229	85,6

The relatively high achievement degree of the drainage program is due to the fact many areas equipped for irrigation also need works to combat excessive moisture, especially in spring and autumn. The large share of soil erosion control works, sometimes over the program share, is also explained. Radical works, such as terracing, are few; the largest share belongs to simple works, such as drawing ditches somehow on the level curves, on pastures, with the three furrows plow pulled by the tractor. Moreover, we must not forget that only the hydro-improvement works are confirmed by the national statistical system; therefore, taking into account the customs of the era, some land reclamation works have existed only on paper, and even for the hydro-improvement works, there are exaggerated reports, such as 3532.6 thousand ha for the end of 1988 [3].

The main features of the irrigation systems in Moldavia. Compared with most of the irrigation systems from Romania, the hydro-improvement works from Moldavia are distinguished by some special features. Among these, the most important are:

a) *Size.* In a reference system, where the equipped areas exceeding 500 ha are considered large systems, it can be said that everything that was built in Romania falls under the *giant* category. By this criterion, only one system is *very large*, i.e. Covurlui Plain, with an area of 91,342 ha; other six systems have surfaces between 10 and 25 thousand ha (middle category) and another 4 are *small* systems, with areas smaller than 10 thousand ha.

b) *Electricity consumption.* It is an important criterion in assessing the irrigation costs, since the electricity necessary in order to pump, transport and administer the water to plants accounts for over 60 % of total irrigation expenditure. In turn, the electricity consumption is directly dependent on the overall height of water pumping. The English Company *BINNIE-PARTNER and HUNTING TECHNICAL SERVICES LTD*, which studied more than 100 irrigation systems in Romania, concluded that the maximum pumping height for a profitable irrigation is 70 m. This company classified the irrigation systems in Romania according to their energy consumption per ha in four levels: low consumption: below 700 kWh/ha; average consumption: between 700-1400 kWh/ha; medium-high consumption: between 1400-2100 kWh/ha and high consumption: over 2,100 kWh/ ha [6].

According to this classification, the grouping of the irrigation systems in Moldavia is the following:

- Low consumption: less than 700 kWh/ ha	52,098 ha	19.9 %
- Average consumption: 700-1400 kWh/ ha	62,603 ha	23.9 %
- Medium-high consumption: 1400-2100 kWh/ ha	140,161 ha	53.6 %
- High consumption: more than 2100 kWh/ ha	6816 ha	2.6 %
	<i>Total</i>	<i>261,678 ha</i>
		<i>100.0 %</i>

The national low consumption average accounts for 10%, the average consumption - 28.6 %, the medium-high consumption - 48.2 % and high consumption - 13.2 %.

c) *Irrigation standards*. In terms of the national average irrigation standard of 2,100 cubic meters/ha, the irrigation systems, averaged over the 8 counties, are classified as follows: Galați county – 2,400 cubic meters/ha; Bacău, Vaslui and Vrancea - 1,500 cubic meters/ha; Botoșani county – 1,200 cubic meters/ha; Iași – 1,100 cubic meters/ha; Neamț and Suceava counties – 1,000 cubic meters/ha.

d) *Water sources*. The Danube supplies 112,144 ha, i.e. 42.3 %, of Covurlui Plain. Siret River provides the water for 79,688 ha (30.0 %) and Prut River – for 73,561 ha, i.e. 27.7 %.

e) *Design features*. The parliamentary commission, which had assessed the situation of the irrigation systems and of other land reclamation areas, established, in 2009, the following: Although, at the respective time, the constructive solutions were considered in step with the time, many components to the projects have not been completed, such as:

- the impermeabilization of the open canals for water supply and transport, on about 50% of their length, the water losses being considerable;
- the non-performance of drainage (there are recorded only 200 thousand ha) and water circulation systems, with negative effects on large areas – sloughing and secondary salinization;
- the lack of the automation elements for water distribution, as well as of those for water measurement (to this day, not even one m³ of water has passed through a water meter), which led to uncontrolled water consumption, random irrigation and watering standards, high costs;
- the use of poor quality materials, equipment and aggregates that ensured an overall efficiency of water use which did not exceed 50%, compared to the projected share of 83 % [8].

The same deficiencies have been reported since 1991 by a governmental commission established in order to analyze and solve the problems related to land reclamation works: *The works have been carried out since 1966 in irrational rhythms; in the last 15 years, the expansion of the irrigated areas has been pursued in particular, in some cases, giving up the technical requirements in conception and execution and the environmental protection requirements. The canals are unlined on about 40 % of their length, the losses reaching 30-60 %, the yield of the pumping aggregates is below the catalogue values, the watering equipment have low reliability, others are technically outdated... The equipment for soil erosion control, the most necessary among all land reclamation works, were left behind, have not been operated and maintained properly due to the lack of interest of the former Agricultural Cooperatives and of the People's Councils, and due to the lack of money for the agropedological improvement measures*

and to the lack of money for the implementation of the agropedological improvement measures [5].

The operation of the Irrigation systems. The main parameter that expresses the use of the areas equipped for irrigation is represented by the actually irrigated area reported to the entire area equipped for irrigation (table 2).

Real or not, the areas irrigated in 1990 (when the state agricultural enterprises and the agricultural cooperatives still existed) were close to the areas equipped for irrigation in 1989. The share of the areas irrigated at least once was 82.8 %.

On the other hand, in the period analyzed by the parliamentary investigation [8], the irrigated area was much smaller: 5.6 % in 2006; 17.3 % in 2007; 11.4 % in 2008 and 12.5 % in 2009, per all the irrigation systems in Moldavia.

Table 2. The effectively irrigated areas compared with the areas equipped for irrigation in 1989, period 2006-2009

No	County	Equipped 1989 (ha)	Irrigated 1990 (ha)	Equipped 2009 (ha)	Irrigated (ha)			
					2006	2007	2008	2009
1.	Bacău	24000	12044	22854	121	1296	420	665
2.	Botoșani	24700	16803	19819	0	300	0	304
3.	Galați	145100	121482	139286	16035	43266	30519	29692
4.	Iași	53000	50543	48934	106	2144	1259	1470
5.	Neamț	10500	9444	4232	0	0	0	0
6.	Suceava	4500	3864	3454	0	0	0	0
7.	Vaslui	30400	25083	29662	415	4343	1404	4714
8.	Vrancea	39900	35772	30296	0	150	300	340
	<i>Total Moldova</i>	332100	275035	298537	16677	51499	33902	37185
	<i>The share of the irrigated areas %</i>		82,8		5,6	17,3	11,4	12,5

According to the analysis conducted by the Parliamentary Committee in 2009, the main causes that led to the significant reduction of the irrigated area are the following:

- The dissolution of the large operating structures of agricultural cooperatives, in the beginning due to Law no.18/1991 on the land fund and, then, to Law no.1/2000;
- The degradation of the hydro-improvement infrastructure, triggered by destruction, theft, disrepair, abandonment, lack of interest from the new land owners who had benefitted from re-allotment. This was also accompanied by the inability of the decision makers and of governing authorities to manage and organize the exploitation of an important agricultural heritage and, at the same time, of the national economy.
- The progressively increasing charges for the irrigation water and, especially, the differentiation of the pumping speed levels also contributed to the reduced interest in irrigation;

- The destruction of the electricity transmission network, together with the disconnection of the power supply network and its partial dismantling (extraction of transformers), motivated by its inactivity;
- The lack of conviction of many landowners of the economic benefits brought by the agriculture under irrigation, associated with the delay in setting up IWUA/IWUO (Irrigation Water Users Association/ Irrigation Water Users Organization);
- The shortage of the equipment for the administration of water to plants;
- The mismatch between the activities conducted for the rehabilitation of the irrigation infrastructure and the actual water demand, at the level of the hydro-technical system;
- The uncertainty on the selling market regarding the breeds that respond best to irrigation, such as maize or vegetables, in terms of a very permissive policy as far as the imports are concerned.

It also considered that one of the main reasons of the low irrigation rates is represented by the deficiencies in the watering equipment, which results from the data submitted by branches. It is noteworthy that, in some areas – in southern Moldavia, for example – there were established IWUAs (Irrigation Water Users Associations) on areas larger than those reported functional in 2009. The actually irrigated areas are instead much smaller than the contracted ones.

Across counties, the area actually irrigated in 2009 is smaller than the one that might have been irrigated with the existing equipment and much smaller than the contracted area, resulting in a significant shortage of the watering equipment.

Regarding the drainage works, the Commission concludes that they were neglected and that, in case of natural disasters, they would not cope. Causes: Lack of funding and the disorganization produced by Law no. 138/2004, which separated ANIF (National Agency of Land Reclamation) and SNIF (National Society of Land Reclamation), depriving the latter of the specialized personnel and of the necessary equipment.

In connection to the soil erosion control works, the situation is similar. The commission accused the way in which the restitution of land was applied under Law no.18/1991, i.e. in the hill-valley direction, which favored erosion. The issue of the maintenance or restoration works is complicated by the fact that both actions need both the current owners' agreement and contribution.

Studies for the rehabilitation of the irrigation systems in Moldavia. The report drafted by the governmental commission in 1991 [5] reveals that not less than 787 land reclamation works were under execution, of nearly 105 billion lei. The authorities had to decide what to resume, what to cease, and what to keep. Therefore, the rehabilitation studies began.

The first study was conducted by the English company BINNIE-PARTNER and HUNTING TECHNICAL SERVICES LTD, in collaboration with ISDLR (the Institute for Study and Design for Land Reclamation, Bucharest). It was concluded that the limit of the irrigation economic efficiency is where the extra profit obtained by irrigation intersects with the additional irrigation expenditures. In turn, these expenditures are heavily influenced by the consumption of the electricity needed to pump water and, thus,

by the pumping height. There was drawn a scale of the economical viability of the areas equipped for irrigation, according to the water pumping height (Table 3).

Table 3. The economic viability of the irrigated area according to the pumping height, in connection to the source

No.	Hg (m)	Area equipped for irrigation (million ha)	Economic viability
1	0-10	0,50	Exceptional
2	10-30	0,25	Very good
3	30-45	0,25	Good
4	45-55	0,25	Satisfying
5	55-65	0,25	Satisfying/ Unsatisfying
6	65-90	0,60	Unsatisfying
7	> 90	1,00	Disastrous !

Source: Study of Irrigation and Drainage in Romania (1992-1994)

This limit is reached somewhere at pumping heights greater than 70 m. All the systems included in this study were classified according to this criterion (104 in number). There was also drafted a map where all irrigation systems (or parts of the system) whose pumping height was over 70 m were marked on the legend.

In Moldavia, 16 irrigation systems have been analyzed, and it was found that the following have heights of over 70 m: Cămărăsești-Aval, Horia-Liveni and Ripiceni-Rock (Botoșani county); Racova-Filipești (Bacău county) and Covurlui Plain, with an area of 100 thousand ha (Galați county). It should be mentioned that, according to the BINNIE study, in perspective, in Romania, maximum 1.3-1.5 million ha would be economically irrigated.

A second study for the rehabilitation of the irrigation systems was conducted by the Japanese company JICA (Japan International Cooperation Agency) in 1994-1995 [7]. It studied an area of 22,360 ha in Vrancea county, which would have been supplied by the water from Calimanesti dam and from Siret-Baragan canal. The extra profit obtained by irrigation was estimated at 12.2 %, compared to the previous situation.

A final study on the rehabilitation of the irrigation systems was initiated by MAPDR in 2009 and it was conducted by the Dutch company *Fidman Merk at SRL* [9]. The study entitled *the Project for the Irrigation Sector Rehabilitation and Reform (PRRSI)* was completed in 2011. There were analyzed virtually all Romanian irrigation systems, on an area of 2,965 thousand ha, by different criteria: the current level of use, tariffs for the water supply, IWUO (Irrigation Water Users Organization), the aridity index. These four criteria were given grades and a final score between 10-53 was established. For Moldavia, 8 irrigation systems were studied and proposed for the inclusion in the investment plan (Table 4).

The figures presented in the table above show great differences between the areas equipped for irrigation existing in the NALR (the National Agency of Land Reclamation) heritage and the economically viable ones, but also between the latter and the effectively

irrigated areas, although their owners have expressed their intention to irrigate virtually the entire area equipped for irrigation, existing in NALR statistical record.

Table 4. The irrigation systems from Moldavia proposed for the inclusion in the investment plan for the next period, according PRRS1

No.	Irrigation system	County	Analyzed area ha	Economically viable area ha	Area irrigated in 2009 ha	Area equipped in IWUO ha
1	Letea	Bacău	1118	1118	415	1118
2	Dămieniști	„	2276	2276	192	1381
3	Brateșul de Sus	Galați	4116	4116	2769	4136
4	Câmpia Covurlui	„	90920	26363	28381	98233
5	Țigănești și Perieni	Iași	3368	1178	127	3368
6	Terasa Trifești-Sculeni	„	17258	13092	1465	3052
7	Albita-Fălciu	Vaslui	16937	16937	4790	15296
8.	Putna	Vrancea	2385	2385	380	2385
	<i>Total</i>		138398	67485	38519	128369

Source: PRRS1 – 2011 Data [9]

The causes that led to this situation are known from the repeated analyzes, studies and surveys conducted in the last 25 years, which also made proposals for the rehabilitation of some areas that, however, do not exceed 50 % of the area statistically equipped at the end of 1989. Nowadays, in Moldavia, very small areas (11,030 ha in the south of the historical province of Terasa Nicoresti Tecuci) were rehabilitated and there are plans to resume the work on Siret-Bărăgan Canal project, which, however, covers only a small part of Moldavia's needs.

Conclusions

1. We have inherited from the previous political regime of 1990 an impressive amount of land reclamation, more than 3 million ha equipped for irrigation and another 3 million ha equipped for the removal of excessive moisture, and over 2.2 million ha equipped for soil erosion control. Nevertheless, the regime's ambitions were higher: 5.5 million ha equipped for irrigation; 5.53 million ha equipped for drainage and 5.3 million ha - for soil erosion control.

2. If there is no doubt as far as the necessity of last two categories of works is concerned, the irrigations under Romania's conditions have given raise to different opinions, especially because the market economy adapted as an economic system changed the situation.

3. The State is not the only master of the country's resources anymore and it can no longer afford discretionary transfers of goods from one economic sector to another. The

investments must be economically profitable not only nationally but also in the economic sector, where they are carried out, especially since the companies that support and exploit them are private and they can not afford to work at a loss.

4. For the correct dimensioning of the irrigation systems, we used foreign companies specialized in this field, some of them mentioned in this paper. The unanimous conclusion was that the size of the irrigation sector should not exceed 1.5 million ha and that the irrigation systems require adaptations to the new operating structures, including at the economic level.

5. NALR went through several reorganizations and, therefore, it became an impediment, since there was inherited a heritage, an institutional structure that no longer has an activity object. On the other hand, the new great estates established on drained land – in an abusive manner, according to several specialists - do not want to abandon the irrigated agriculture system and use dry farming instead, requiring substantial financial support to the state.

6. The trend of the irrigated areas in the last decade demonstrates, however, that even in the next decade there will not be irrigated more than 1.2-1.5 million ha, which will bring Romania to arable shares similar to the ones of the states with similar climatic parameters.

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