

## EVOLUTION OF LAND IMPROVEMENT ARRANGEMENTS IN ROMANIA

### Doctoral Thesis - Abstract

for obtaining the scientific title of doctor at  
Polytechnic University of Timisoara

in the field of PhD **Civil Engineering and Installations**

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#### General conclusions:

The work creates a complex and up-to-date bibliographic monograph in the field of land improvement works.

The natural conditions, as well as the unfavorable human influence over a long period of time, led to land degradation, affecting approximately 6 million ha of agricultural land.

The current context of prevention and mitigation of the consequences generated by climate changes manifested on soils, as well as the adaptation of the needs of human society to the new climate conditions, is a mandatory measure for the progress of society.

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Actuality is represented by measures and solutions for inventorying the current situation of land improvements in the Timis County, systematization of the drainage canal network by relocating them for the reversible use of drainage water for irrigation (storage of drainage water in reservoirs, in the canal network, etc.); regulating the water level on the drainage canals in the Checea Jimbolia drainage facility, for the future implementation of local irrigation facilities.

The works of design, execution and operation of land improvement arrangements are done in close connection with the works of water management, management of communication routes, in accordance with the interests of the land owners, with the documentation of urban planning and territorial development, keeping account also of the environmental protection requirements.

Considering the importance of land improvement works in terms of the quality of life, water, environment, the determining role of these works in the social and economic development of society, it is necessary to carry out extensive investment works, in the context of the emergence of new technologies less energy-efficient and environmentally friendly.

The thesis presents the evolution over time of land improvement facilities in the world, in Banat and with priority in Timiș County, to which are added proposals regarding their perspective in the context of the new guidelines regarding the systematization of drainage-drainage facilities, the systematization of the territory in the context of the use of drainage facilities and for irrigation, where the technical conditions allow it. The paper briefly presents the following: financing programs from European funds for land improvement infrastructure, land improvement plans in Timis County in the context of urban development, classification of land improvement plans according to emissaries, management of land improvement plans, improvement proposals and studies as the case may be, investments in the infrastructure of land improvements for their rehabilitation/modernization in order to prevent and reduce the consequences generated by climate changes that manifest themselves on soils,

waters and biodiversity. Applying a state-of-the-art software - Mike11, for hydraulic modeling we made a presentation of the variation of the water level over time, on the CPE desiccation channel in the Checea Jimbolia pumped desiccation facility. The hydraulic flow model was made in two variants: variant 1 when the water flows from the drying channel are evacuated and variant 2 when the drying channel is kept full. As a function of the hydrograph of the inlet flows in various scenarios of using the channels for drainage or irrigation purposes, the following was obtained: the longitudinal profile through the CPE drainage channel with the water levels along the channel, the rates of sediment deposits, the flows discharged by SP Cenei, the volumes of water discharged from the CPE canal and the minimum and maximum possible irrigated surfaces from the CPE drainage canal, taking into account the transit flows and the volumes of water available in the CPE drainage canal for the two calculation options studied. It was proposed to adapt land improvement arrangements to the new equipment, machines and technologies used in agriculture with the aim of increasing agricultural production.

The content of the thesis is structured on 8 chapters, developed on 314 pages, comprising a number of 224 figures and 46 tables with data and results, and a bibliography containing 139 representative classic and current bibliographic titles, which ensured a very good documentation, making contributions to knowledge, something that will be highlighted next. At the end of the thesis is Appendix 1 - Tables with the precipitation recorded at the ANIF rain gauges in the period 2009-2021.

In Chapter 1 entitled: "Introduction and general problems" of the doctoral thesis, a bibliographic synthesis was made of the historical evolution of land improvements from ancient times to the present.

The first land improvement works, both worldwide and in our country, to combat drought, excess humidity, and soil erosion were chronologically the following: pond cleanup, dams, drainage with open channels, irrigation facilities following the networks of drainage, respectively complex drainage-drainage facilities, combating soil erosion, drainage-subirrigation, complex drainage-drainage-irrigation facilities, etc.

Thus, in 1950 I.C.I.D. was established. – International Commission for Irrigation and Drainage based in New Delhi, India. The role of this commission is to stimulate and promote the development of science and technology, agriculture, economics, ecology and social sciences in the management of water and land resources for irrigation, drainage, soil management, including research and development to support profitable agriculture. With more than 50 years of experience, I.C.I.D. is involved in many international projects regarding land improvements, quality and environmental protection, agriculture, etc. and collaborates with other world or national organizations.

In our country, the execution of land improvement works, including those for flood defense and drainage, began many years ago, followed today by irrigation.

As a characterization of the situation in the Banat, there are the confessions of Grisellini, who in 1780 published a work in Vienna about the Timișean Banat, in which he stated: "Besides the Aranca marsh, the waters of the rivers Beghei, Timiș, Bârzava, together with a lot of the streams and discharges of the springs had been left to fate, undammed, these waters had flooded almost all the low lands, soon forming new marshes, larger than the old ones. The famous Pontic swamps of old and new Rome could not even be compared with those of Banat. The permanent atmospheric changes in this region, thanks to the natural position it is exposed to and the infectious evaporations that rose from so many foul-smelling and rotten waters, made it the saddest place to stay".

At the beginning of the 19th century, the first dams were built in Banat, Mureș was dammed, Aranca valley was canalized, then Bârzava and Timișul were dammed.

In the Banat area, the existence of swamps, a chaotic interweaving of the Timiș and

Bega streams, fighting floods, restoring fertile soil to agriculture have been more or less organized multi-century concerns. Banat was born from the swamp and developed with great efforts made by the past generations, but it will return to the swamp if the ways of understanding and solving the problems of land improvements are not found.

The infrastructure of land improvements that served the agricultural and forestry systems, designed to the greatest extent during the period of the planned economy, is no longer adapted to the new resulting exploitation structures. In the process of restructuring and reform, an important part of the existing infrastructure either could not be adapted anymore, due to the non-allocation of funds from the budget and was abandoned or remained unused, as a result of not adapting to the new structures and in many situations damaged or destroyed by miscreants. The drainage works on the territory of Timiș, Arad and, to a lesser extent, Caraș-Severin counties are decisive for the development of agriculture in this area. The lands in this part of the country, as well as those in Bihor and Satu Mare counties, were transformed as a result of these drainage works from swamps and unproductive lands periodically affected by floods and excess humidity into lands suitable for agricultural activities with a high productive potential. Globally, climate change has led to global warming causing major changes in agriculture and forestry. In Europe, the southern (Mediterranean) area risks coming under the influence of aridification, which leads to migrations of the human population, thus subjecting the center of Europe to a series of pressures with extremely complex characteristics.

In Chapter 2 entitled: "Evolution over time of land improvement works", the role and importance of these works, as well as the administrative organization, exploitation and maintenance of land improvement arrangements, were synthesized. It is specified that in order to follow the realization and exploitation in good conditions of land improvement works, it was necessary to organize specialized units, with a more important role being those established after 1944 when the state was directly involved in their execution and maintenance.

Thus, in 1910, by the Royal Decree given by Charles I, the first National Land Improvement Service was established, whose general director was the renowned engineer Anghel Saligny.

The chronological evolution of these is presented, including: for studies, design and execution, the Construction Trust for Land Improvements (TCIF) Timisoara for the activities in the west of the country; - for exploitation and maintenance works, 13 (thirteen) Enterprises for Exploitation of Land Improvement Works (IELIF) were established, which in 1983 their number increased to 41, bringing together the activities at the county level both for design and execution, as well as for exploitation and maintenance of land improvement works being coordinated by the General Economic Directorate of Land Improvements and Agricultural Constructions (DGEIFCA) subordinated to the Ministry of Agriculture.

IELIF Timiș which had under its control 6 (six) water improvement systems (Timișoara, Sânnicolau Mare, Cărpiniș, Deta, Șag și Costei) and the SISPA Timișoara Section.

In 1962, within the Timișoara Polytechnic Institute, the Agricultural Hydrotechnics section was established at the Timișoara Construction Faculty, transformed in 1968 (as a name) into the Land Improvements section.

The changes generated by the Revolution of December 1989 lead to transformations in the country's agriculture and according to the provisions of the Land Fund Law no. 18/1990, the reorganization of the land improvement sector takes place.

In November 2004, the former Societate Națională de Îmbunătățiri Funciare S.A. split into H.G. no. 1407/02.09.2004 in two units:

- A.N.I.F. R.A - National Land Improvement Administration, Autonomous Directorate;

- S.N.I.F. S.A. - National Society of Land Improvements.

Starting from 2011, following GEO no. 82/2011, the land improvement activity is restructured and reorganized, creating the National Land Improvement Agency with a scope of activity at the level of each county (county branches), simultaneously with the drastic reduction of personnel and the material resources necessary for the exploitation, maintenance and repair of works from the managed heritage.

Following the appearance of Law 199/2012, the Agency is modified to have in its structure a central unit and territorial branches, which do not have legal personality. Branches can be made up of administrative units organized at the level of land improvement arrangements. The Timiș Territorial Branch for Land Improvements, without legal personality, has an economic-financial management, exploits, maintains and repairs land improvement facilities.

This chapter also presents the characteristics of the main land improvement works within the branch by exemplifying the irrigation, desiccation - drainage arrangements, combating soil erosion, as well as the flood defense works, which were handed over in 2012 to Romanian Waters.

In Chapter 3 "Evolution of legislation in the field of land improvements", the chronological evolution of Romanian and European legislation in the field of land improvements is presented.

It should be noted that in 2004 the field of land improvements was reorganized by the appearance of Law no. 138/2004, still valid today, to which the Methodological Norms of application were approved by GD 1872/2005, which regulate the application of its provisions with subsequent amendments and additions.

The National Land Improvement Agency is currently operating, a public institution under the Ministry of Agriculture and Rural Development, established by GEO 82/2011 and approved by Law 199/2012 with subsequent amendments and approvals.

In Chapter 4 entitled "National programs for financing land improvement infrastructure from European funds", the main financing programs in the land improvement sector are presented, as follows:

1. Financing programs for OUAIs, FOUAIs, from European funds FEADR through AFIR for the rehabilitation/modernization of the secondary irrigation infrastructure owned by the FOUAI/OUAI - Measure 125 - Improvement and development of agricultural and forestry infrastructure, with the sub-measures:

- Submeasure 125.a. "Improvement and development of the infrastructure related to the development and adaptation of agriculture";

- Submeasure 4.3 - Investments for the development, modernization or adaptation of agricultural and forestry infrastructure - Irrigation infrastructure component.

2. The National Program for the Rehabilitation of the Main Irrigation Infrastructure - the Ministry of Agriculture and Rural Development (MADR) developed the National Program for the Rehabilitation of the Main Irrigation Infrastructure in Romania to reduce the effects of drought on agricultural crops, the population and other environmental factors.

3. Submeasure 4.1 - Investments in agricultural holdings - necessary to increase the competitiveness of agricultural holdings by equipping them with high-performance machinery and equipment.

4. The National Recovery and Resilience Plan (PNRR) - the crisis caused by COVID-19 led to the need to strengthen the current framework for providing financial support to EU member states. To this end, the European Union has established a recovery and resilience mechanism to provide significant and effective financial support.

5. Romania's National Strategic Plan - through the initiative of the European Commission, the Strategic Plans (P.N.S.) were applied and approved at the level of European

countries, starting from 2023.

These National Strategic Plans are part of the new Common Agricultural Policy (C.A.C.), designed for a transition to a modern agriculture.

Also in this chapter, a SWOT analysis was carried out at the level of Timiș county, on all the activities carried out between 2004 and 2021, identifying the strengths and weaknesses of the land improvement sector as well as opportunities and risks in the development of the sector.

In Chapter 5 "Land improvements in Timiș county in the context of urban development. Classification according to emissaries", presents its own classification of land improvement arrangements in Timiș County according to emissaries.

The land improvement facilities are made up of agricultural and non-agricultural areas delimited by well-established perimeters in which land improvement works are arranged - canals, hydrotechnical constructions, pumping stations, exploitation cantons, drains, discharge mouths, visiting homes, hydrogeological wells, exploitation roads, buried irrigation pipes, hydrants, etc. - patronized by the rules for their operation, maintenance and repair under the conditions of securing the resources taking into account their technical characteristics, applicable to the physical inventory of each arrangement.

The drainage canals, whose task is to remove excess water from the soil, form a system of ecological corridors, thus a system of connection between important elements of the landscape. Each watercourse has its own importance because it takes the outflow from a particular watershed and distributes it hierarchically among the outlets.

In addition, each water body has a limited important conservation area, where only the green area is allowed. These related networks penetrate the interior of localities through drainage channels and promote the spread of local plant and animal species.

The facilities on emissaries existing in Timiș county are the following:

1. Emissary – Bega River. In addition to the role of transportation, water from the Bega canal is also used in agriculture. A system of pumping stations has been built on the Bega Canal, which leads water from the Bega to the polders in case of flood, thus reducing flooding. Another purpose for which the pumping stations are made is desiccation, the land surfaces of the Banat are swamps, so the surplus water is pumped into the Bega canal.

The facilities that have the Bega Navigable River as their emissary are the following:

- The Behela gravity desiccation plant;
- The Upper Bega gravity drainage facility;
- Gravitational drainage and soil erosion control (CES) Bethausen Ohaba;
- The Galațca pumping system;
- Gravitational drainage and combating soil erosion (CES) Ghiroda Recaș;
- Planning to combat soil erosion (CES) Fădimac – Cladova;
- Gravitational drainage and soil erosion control (CES) Mănăștur – Bunea Mare;
- Designing drainage by pumping and combating soil erosion (CES) Miniș - Chizdia;
- Gravitational drainage and combating soil erosion (CES) Recaș Chizătău;
- Riu Glavița gravity drainage system;
- Complex arrangement of irrigation and drainage by pumping Șag Topolovaț;
- The installation of drainage by pumping Șeba – Timișat;
- Gravitational drainage and soil erosion control (CES) Traian Vuia Dumbrava.

2. Emissary - Timiș River. The Timiș is the largest inland river of the Banat, which originates in the Semenic mountains, in the Caraș-Severin county, then passes into Serbia where it flows into the Danube, at Pancevo, forming the Romanian-Serbian border for a length of 3.3 km. It crosses the entire Timiș county, a series of facilities evacuating the waters both by gravity and by pumping.

The facilities that have the Timiș river as their emissary are the following:

- The Bociar gravity drainage system;
- Caraci pumping drainage facility;
- Cernabora Timișina gravity drainage and pumping system;
- The arrangement of drainage by pumping and combating soil erosion (CES) Cerestău Dicșani;
- Gravitational drainage and combating soil erosion (CES) Cinca;
- The development of Gravitational drainage and soil erosion control (CES) Hitiăș Coștei;
- Complex arrangement of gravity drainage, by pumping and combating soil erosion (CES) Moravița;
- Pogoniș pumping dewatering facility;
- Gravitational desiccation and soil erosion control (CES) Perimeter Etalon Lugoj;
- The installation of gravity drainage and by pumping South - Lanca - Birda;
- Gravitational drainage and soil erosion control (CES) Șergani Cernabora;
- Șurgani gravity and pumping desiccation facility;
- Roiga gravity and pumping desiccation facility;
- The Rudna Giulvăz drainage system by pumping;
- Timișul Mort drainage system by pumping;
- Drainage arrangement by pumping and combating soil erosion (CES) Timișul Superior.

3. Emisar - Old Bega River - is the old course of the Bega River, before the construction of the Bega Canal, and currently it drains the waters from the original basin, located in the northern part of the municipality of Timișoara. In Serbia, it joins the current course of the Bega canal, near Zrenjanin, for 1.8 km forming the Romanian-Serbian border.

The facilities that have the Bega Veche river as their emissary are the following:

- Beregsău Amonte gravity drainage facility;
- The arrangement of drainage by pumping Begheiu Vechi - West Timișoara;
- The Checea – Jimbolia drainage system by pumping;
- Gravitational desiccation arrangement and combating soil erosion (CES) Fibiș – Alioș;
- The arrangement of drainage by pumping Răuți – Sânmihaiu German;
- The arrangement of drainage by pumping Uivar – Pustiniș;
- The installation of gravity and pumping drainage Vinga - Biled - Beregsău.

4. Emisar - Aranca, the hydrographic basin of the Mureș River - is the river that flows in Romania and Hungary, 789 km long and flows into the Tisa. The Mureș springs from the Hășmașu Mare Mountains and flows into the Tisa River. For 22.3 km, the river forms the Romanian-Hungarian border.

The Aranca Canal is the old course of the Mureș River, being considered the main collector of the Aranca Plain. Starting from 1887-1894, the Aranca hydrotechnical system was built. The facilities that have the Aranca river as their emissary are the following:

- The Aranca pumping system;
- Mureșan drainage system by pumping;
- Sânnicolau – Saravale drainage arrangement by pumping.

5. Emissar - Bârzava River - is a river that originates in the Semenic Mountains, in Caraș-Severin County, crosses Timiș County, Vojvodina Province in Serbia and flows into the Timiș River. Of the 166 km, 127 km are on Romanian territory, forming the Romanian-Serbian border for 3.8 km. The facilities that have the Bârzava river as their emissary are the following:

- Banloc pumping drainage facility;

- Bârzava – Mijlocie drainage arrangement by pumping;
- The Livezile drainage system by pumping;
- Nord Lanca Birda drainage arrangement by pumping;
- The Partoș Glogoni pumping system.

Chapter 6 entitled "Management and monitoring of land improvement arrangements", presents a synthesis of the land improvement activity, the way of organization and administration of this sector and a description of each land improvement activity.

The European Union has promoted legislative instruments for the protection and sustainable management of water resources. For this, the necessary framework for sustainable water management must be ensured, which implies quantitative and qualitative water management and healthy ecosystems.

Weather dependence in agriculture has led Romania to face and overcome the phenomenon of "soil drought", i.e. the low reserve of water in the soil resulting in the destruction of millions of hectares of crops, bringing many Romanian farmers to the brink of bankruptcy.

The National Agency for Land Improvements has as its main objective to guide sustainable development on a correct path, towards protecting environmental factors, including energy efforts in the direction of interventions and mandatory measures in the field of water improvements, in the context of a dynamic world and unpredictable events and strongly marked by global climate changes as well as the danger of degradation of environmental factors.

The land improvement facilities are located in watersheds, which are part of the Basin Management Plans, which include issues of basin importance with transboundary effects.

The development of both agricultural and risk management strategies at the agricultural level are in an interdependent relationship with the improvement of the parameters of the land improvement arrangements, administered by the agency.

In Romanian agriculture, the use of irrigation is recommended. By using them, farmers improve their competitiveness and increase the security of a high production from one year to another, regardless of the climatic conditions, create jobs and produce raw material especially for the food industry but also for other industries.

It is worth noting in this chapter the presentation of the theoretical notions regarding the dimensioning of open channels, taking as a case study the main CPE discharge collector channel which is part of the Checea Jimbolia pumping system, Compartment I to SP Cenei I, which during the growing season provides water for the irrigation of related agricultural areas (104 ha).

The hydraulic flow model was made in two versions:

Variant 1 - Choice of boundary conditions regarding the inlet flows according to the inlet hydrographs at Km 36+705, 36+330, 35+580, 32+200, 23+375, 16+000, 10+275, 3+850 respectively in downstream at Km 0 the capable key curve of the drainage channel was introduced.

This variant assumes the operation of the Cenei pumping station conditioned by the flows that reach it so that the flows are discharged according to the capable key curve of the CPE drainage channel.

Variant 2 - Choice of boundary conditions regarding the inlet flows according to the inlet hydrographs at Km 36+705, 36+330, 35+580, 32+200, 23+375, 16+000, 10+275, 3+850 respectively in downstream at Km 0, a constant water level was introduced at an elevation of 77 m. This variant assumes the operation of the Cenei pumping station conditioned by the water level in the CPE canal so that the canal is kept full.

After running the MIKE11 program, the following was obtained: The key curve of the CPE canal next to the Cena pumping station, the longitudinal profile through the existing

canal, showing the water levels along the respective canal in the 2 variants: variant 1 and variant 2, showing the rates of deposits of sediments in variant 1 and variant 2.

During the studied period of 1 year days, the curves of water flows discharged in a year, respectively the volumes of water discharged in the same period, were drawn.

It is observed that strictly related to the periodic discharged flows without taking into account the volumes of water accumulated in the CPE channel, the variation curve of the possible irrigation surfaces can be drawn in relation to the transit period of the flows, taking into account an irrigation hydromodule of 0.6 and a watering efficiency of 0.9.

Calculating the total volume of water discharged from the CPE canal during the studied period of 1 year through the Cenai pumping station, results in a volume of 282087.6 thousand cubic meters/year. This volume of water discharged could ensure the irrigation of a very large area of agricultural land that can be calculated for an irrigation rate of 700 mc/ha corresponding to the study area for the corn crop. Applying the watering scheme of 6 waterings per year results in a possible irrigated area of 60,447 ha.

The minimum and maximum possible areas to be irrigated from the CPE canal are presented, taking into account the transit flows and the volumes of water available in the CPE canal for variant 1 and variant 2, respectively.

In conclusion, I specify the following: the hydraulic flow model was made in two variants: variant 1 when the water flows from the canal are evacuated and variant 2 the canal is kept full. As a function of the hydrograph of the inlet flows in various scenarios of the use of the drainage channels for drainage or irrigation purposes, the following was obtained: the longitudinal profile through the CPE drainage channel with the water levels along the channel, the elevations of the sediment deposits, the flows discharged by SP Cenai, the volumes of water discharged from the CPE drainage canal and the minimum and maximum possible irrigated surfaces from the CPE drainage canal taking into account the transit flows and the volumes of water available in the CPE canal for the two calculation options studied.

Considering the potential of water from desiccation, in 2022 the investment was designed and carried out: Local irrigation arrangement from the ANIF CPE canal (identical to HC55/1) Cena commune, Timiș county on a total gross area of approx. 104 ha.

The project includes the following components:

- the establishment of a network of underground pipes from PEID PN6 (with a total length of 2,300 m provided with 20 hydrants). The pipelines will be located underground next to the drainage channel HC 436/5-6 m outside its protection zone (over 2.5 m in front of the channel), on the lands owned by the beneficiary;
- purchase of mobile pumps with high efficiency and soundproofing, which will suck from the ANIF CPE channel (identical to HC55/1) and discharge into the connection chamber on the underground network of pipes (antennas) by means of flexible hoses, from where through mobile watering equipment will be supplied through the hydrants;
- the purchase of mobile sprinkler irrigation equipment - drum and hose irrigation installations with watering sprinklers, these will be connected to the hydrants on the underground pipe network.

The mobile motor pump will be located on the bench of the CPE channel (identical to HC55/1).

A flexible hose fitted at the end with a siphon that will be located in the CPE channel will be connected to the suction of the motor pump. A flexible hose will be connected to the discharge of the motor pump that will cross the dike by simply placing and protecting it on the crown for the crossing of agricultural machinery and will be connected to the connection chamber to the underground pipeline network.

In Chapter 7 entitled "Investments in land improvement infrastructure for the prevention and mitigation of the consequences generated by climate change that manifest



themselves on soils, waters and biodiversity", it presents a synthesis of the rehabilitation of pumping stations and some land improvement works after 1990 from Timis county.

The rehabilitation works of some pumping stations, hydrotechnical constructions and the bringing to functional parameters of the drainage canals carried out in recent years, in Timiș County, are presented, as follows:

1. In the Dewatering Facility with pumping, Țeba Timișat, the rehabilitation and modernization works at the Cruceni pumping station consisted of: replacing the pumping aggregates, the discharge pipes, the electrical installation and beautifying the pumping station building.

The Cruceni pumping station serves an area representing 60.35% of the area served by the Țeba - Timișat drainage facility with pumping, this being functional due to the priority maintenance of the basic works involved in operation, but it still requires repairs.

2. In the Aranca dewatering facility with pumping, the Aranca dewatering pumping station was rehabilitated, which has a major role in the development. The rehabilitation and modernization works included: replacement of pumps, pump piping, discharge pipes, electrical installation and beautification of the pumping station building.

The network of drainage canals is partially used to transport water for irrigation in the local facilities, which are being expanded in this facility.

3. As part of the Checea Jimbolia dewatering development, in Timiș County, the Cenei dewatering pumping station was proposed for rehabilitation, this only reaching the design phase. The network of drainage channels within the drainage facilities is functional, but it is partially covered with aquatic, grassy and woody vegetation. The main works that were carried out in the last 30 years were maintenance and repair works of the canal networks, consisting of their depotting, the destruction of grassy, aquatic and woody vegetation, the maintenance of hydrotechnical constructions, exploitation cantons and water stations. pumping.

4. Another area studied for the implementation of the investment works, includes the Aranca drainage facility, within which there are the areas arranged for irrigation (local facilities) and the weirs, as well as the Sânnicolau Saravale drainage facility, within which the Cenad pumping station is located, for which there were requests for rehabilitation by increasing the pumping capacity for irrigation from the Mureș River and the execution of some hydrotechnical constructions to direct the water to the beneficiaries.

As for climate changes, they are also highlighted by the frequency of precipitation in recent years based on data collected from the ANIF archive, in the period 2009-2021.

Atmospheric precipitation is the final product that reaches the earth's surface in a liquid state (rain, drizzle), solid (snow, sleet, hail) or in both forms simultaneously (sleet).

Timiș County has a moderate temperate continental climate, with some sub-Mediterranean and oceanic influences.

In the Timiș Plain, under the influence of maritime air masses, the amount of precipitation is higher than in the Romanian Plain, which has an annual average of 592 mm.

After analyzing the precipitation that fell at the ANIF stations, between the years 2009-2021, it was found that based on the climate data of recent years, a gradual warming of the atmosphere and a notable reduction in precipitation can be observed. From a pluviometric aspect, in the period 2009 - 2021, a decrease in the amount of precipitation was observed. The decrease in resources, especially in areas with deficits, leads to an increase in the lack of water, both globally and at the level of the country, the effects being amplified by pollution and the use of inappropriate technologies.

Agriculture, population and ecosystems will be affected by the rainfall deficit.

In the final part of the work, the bibliography is presented, including 139 bibliographic titles from the country and abroad, representative of the researches carried out.