SUMMARY OF THE PHD THESIS

The theme of the doctoral thesis called **"Research on finding solutions for the organization and anti-erosion planning of the lands affected by degradation processes in the middle basin of the Bahlui River"** had as its main objective the effects of anti-erosion planning and of agrotechnical works on erosion, fertility soil and the quality of the soil and water resources in the areas: Belcești, Podu Iloaiei and Ezăreni.

The middle basin of the Bahlui river includes the area in the North-East of Romania, and it is delimited by the Bahlui watercourse. The Bahlui River is very important in this part of the Moldavian region from the point of view of agriculture and the management of the water resources.

The main particular features of the middle basin of the Bahlui River include:

From an agricultural viewpoint, the lands in this area are predominantly arable with crop species such as wheat, corn, barley, sugar beet, etc.

There are other good conditions for the other agricultural uses of meadows, pastures, fruit trees, vineyard and vegetables.

From the viewpoint of the urban area and of the rural area, in this area there are important cities, such as the Iași city, an economic and cultural centre of the region, located on the banks of the Bahlui River.

From the hydrographic viewpoint, the Bahlui River runs through this area providing important water resources for agriculture and communities.

From the viewpoint of biodiversity, the middle basin of the Bahlui River includes a significant biological diversity with natural habitats and species of plants and animals characteristic of the Moldavian area.

In this area there is a developed infrastructure for irrigation and other agricultural activities that amplify the importance of agriculture to the local economy.

The middle basin of the Bahlui River represents an economically and ecologically essential region in N-E Romania with a wide range of human and natural activities.

The research work done is one of the major and priority themes of the current and perspective research because it establishes, according to rigorous scientific bases, some agricultural technologies that, on the one hand, contribute to the increase of the production and the superior utilization of the soil and water resources but on the other hand it decreases the pollution of the environment.

The works in the research themes are original because they have not been carried out in this area before and because they were monitored in their complexity, starting from the pedoclimatic conditions, the characteristics and the protection provided by the cultivated plants, the properties of the soil and the quality control of all the environmental factors.

The introductory part includes the first three chapters, whereas the individual contribution on the following six chapters.

Chapter 1 called History and the current degree of knowledge about the theme regarding erosion processes, presents the results of the research on the water and soil leakage through erosion in the Moldavian Plain, in Europe and globally.

In this chapter, there are also Criteria related to the good condition of the soil established at the level of the European Union.

It is practically important to know the evolving quality of the soils that have benefited from works to combat erosion and the efficiency in the decrease of the erosion because it contributes to the prognosis

of the improvement and it helps to establish pedo-ameliorative measures that determine the continuous and progressive increase in the fertility of these lands.

The introduction presents the importance, the novelty and the objectives of the works from the theme of the doctoral thesis.

Chapter 2 is called Principles to establish agrotechnical methods on the sloping arable lands. It presents the principles that must be taken into account for the efficient utilization of the sloping lands by achieving an optimal ratio between the crops with a high protection degree and the crops with a low protection degree, by stimulating the production ability of the plants, by providing a high mechanization degree and by complying with all the economic-organizational, technical and technological requirements for these areas with sloping lands.

Chapter 3 is called Degraded areas in the North-East region and in the Moldavian Plain. It includes information about the condition of the areas affected by the degradation processes in the North-East Region as well as the situation of the agricultural areas planned with works to combat erosion, the drying and drainage works and the structure of the crops in the North-East Region and in the Moldavian Plain.

In the Moldavian Plain, it was presented the situation of soil erosion and the research made in the experimental perimeters in Podu Iloaiei and Scobâțeni.

The second part of the thesis is structured in 6 chapters and it includes:

- measurements, analyzes and determinations regarding the agroecological conditions in three experimental perimeters;
- the evaluation of the effects of the anti-erosion cropping systems on the sloping land;
- the evaluation of the erosion process and of the crop production.

The studies were based on determinations and measurements on the slopes of BH Bahlui in the localities of Ulmi - Belcești, Podul Iloaiei, Scobâlțeni and Ezăreni.

Chapter 4 is called Materials and research methods. It presents the methods used to determine erosion, the collection and the analysis of the data regarding the factors that determine the erosion processes as well as the establishment of the technologies to plan the lands affected by erosion and other types of degradation.

For the ameliorative perimeters in Belcești, Podu Iloaiei and Ezăreni, it was decided to evaluate the effects of works to combat erosion and of some technological elements, such as crop rotation, fertilization, soil works on erosion, the physical-chemical properties of soil and water and on the crop production.

For three areas with works to combat soil erosion established 20 years ago (in Ezăreni) and 40 years ago (in Podu Iloaiei and Scobâlțeni), digital maps were made with the evolution in time of the characteristics of the works to combat soil erosion.

For the perimeter in Ulmi and Belcești, it was decided to create a project in order to organize and develop the land and it was drawn up a digital map with the works to combat erosion provided for in the project.

This chapter presents the experiences with different crop rotations and fertilization systems of the sloping lands organized by the author, as well as the used devices and equipment.

In the hydrographic basin of the Bahlui there is a large number of reservoirs, where a large part of the eroded material accumulates, which determines the clogging and the decrease of their utilization degree.

Furthermore, in the hydrographic basin of the Bahlui, the territory was organized and the works to combat erosion were done according to the degradation types of the agricultural land, whereas the study monitored the evolution way of the works to combat soil erosion and their effect on the reduction of water erosion in the area.

Chapter 5 is called Agricultural systems used to improve the quality of the soil and to decrease erosion. It presents systems of conservative and ecological agriculture that can be applied in different countries in order to achieve a sustainable agricultural production and to protect soil, water and air.

Chapter 6 . The obtained results regarding the works to combat soil erosion in the Moldavian Plain and their effects on the production and the physical-chemical properties of the soil and the agricultural-terracing processes.

The agricultural-ecological conditions of the past six years and the effects of erosion on the agricultural-terracing processes were presented by measurements on the changes in the slope of terraces.

It is described the influence of the crop rotation on the production, on the properties of the soil and on the soil erosion in the Moldavian Plain.

Chapter 7. The effects of the crop rotations on the production and fertility of the soil on the sloping arable lands in the Hydrographic Basin of the Bahlui (in the region of Podu Iloaiei and Scobâlțeni, assessed by the effects of the crop rotation on the production and the fertility of the soil on the arable lands as well as the resulted physical and chemical properties.

Chapter 8 is called The influence of the climatic conditions and erosion on the works to combat soil erosion in the Hydrographic Basin of the Bahlui (in the region of Ezăreni).

It presents the obtained results regarding the agricultural-terracing processes in this area and the effects of the works to combat soil erosion on the physical-chemical properties of the soil.

Chapter 9 - The design of the works to combat soil erosion in the Hydrographic Basin of the Bahlui (in the region of Belcești-Ulmi) and the creation of the digital map with the anti-erosion management of the area, the results of the physical-chemical properties of three soil profiles in the area and, at the end, the indices with the physical-chemical properties of the water from the reservoir in Tansa Belcești and from the well located in the area of the Ulmi perimeter.

CONCLUSIONS

Results regarding the climatic conditions of three areas where the research was conducted.

In the period 2012-2023, the average annual rainfall registered at the Research and Agricultural Development Station in Podu Iloaiei, Iași, was from 416.5 mm (in 2017) to 628.7 mm (in 2016). The average rainfall registered in the past 12 years was 519.0 mm.

In the past 12 years, there have been decreasing amounts of rainfall, especially in the period July - September.

The average rainfall registered in the past 62 years (1962-2023) was 542.9 mm.

On the Bahlui watercourse in the Podu Iloaiei locality, it was registered:

In the year 2019, the amount of rainfall was 565.4 mm, of which 18 rains with the total of 343.8 mm (60.8%) caused water and soil leakage by erosion.

In the year 2020, the amount of rainfall was 494.7 mm, of which 14 rains with the total of 247.5 mm (50.0%) caused water and soil leakage by erosion.

In the year 2022, the amount of rainfall was 419.7 mm, of which 11 rains with the total of 186.4 mm (44.4%) caused water and soil leakage by erosion.

In the year 2023, the amount of rainfall was 441.4 mm, of which 11 rains with the total of 186.4 mm (44.4%) caused water and soil leakage by erosion.

In the period 2018-2023, the number of rain events that caused erosion was between 9 events in 2023 and 22 events in 2021.

Among the total amounts of the registered rainfall, the torrential rains that caused erosion represented a ratio from 47.89% in 2018 to 63.6% in 2021.

On the Bahlui watercourse in the locality of Belcești, Ulmi, the data were collected from the hydro-meteorological station in the village of Munteni.

In the year 2021, there was a number of 11 torrential rains, namely 40.95% (158.8 mm) of the total of 387.8 mm.

In the year 2022, there was a number of 6 torrential rains, namely 125.9 mm (38.4%) of the total of 328.3 mm.

In the year 2023, there was a number of 8 torrential rains, namely 139.0 mm (39.9%) of the total of 348.8 mm.

On the Nicolina watercourse, a tributary of the Bahlui watercourse in the area of the Ezăreni farm, there were 14 rains events in the year 2018 that caused water and soil leakage by erosion, namely 278.8 mm (47.3%) of the total registered rainfall of 590.1 mm (100%).

In the year 2019, there was a number of 15 torrential rains that caused erosion, namely 300.4 mm (49.7%) of the total rainfall of 603.4 mm (100%).

In the year 2020, there were six torrential rains that caused water leakage by erosion, 112.6 mm accumulated, namely 22.3% of the total annual rainfall of 504 mm (100%).

In the year 2021, there was a number of 17 torrential rains with the total of 304.6 mm, namely 60.4% of the total annual rainfall of 504 mm.

The rainfall that caused water and soil leakage by erosion in the year 2022 was of 112.6 mm (44.1 %), namely 9 rains.

The obtained results regarding the agricultural-terracing processes, due to erosion and to soil works, in the areas where the research was conducted

At the Research and Agricultural Development Station in Podu Iloaiei, on the land with a general slope of 13.04%, by the agricultural-terracing process, the slope of the cultivated strips decreased to 7.25 and 11.08, and the other slope increased from 17.66 to 73.5%.

On the land with the general slope of 16%, in Podu Iloaiei, Iaşi, by the agricultural-terracing process produced in time, due to erosion and soil works, the slope of the cultivated strips decreased to 11.1%, and the other slope increased to 50.5%.

On the land with the general slope of 11.8%, in Ezăreni, by the agricultural-terracing process produced in time, due to erosion and soil works, the slope of the cultivated strips decreased to 8.22 - 10.78%, and the other slope increased to 26.18%.

At the perimeter with a sloping land in Belcești, Iași, the development project was made in 2019.

The obtained results regarding the physical characteristics of the sloping lands planned with works to combat soil erosion

On the land with the slope of 14.5% in the Agricultural Research Station in Podu Iloaiei, Iași, the highest values of the apparent density (Te-4 - corn 1.45 g/cm^3) were registered on the terrace number four, where erosion is stronger, and the lowest values at the base of the slope (Te-1- corn, 1.29 g / cm^3).

The percentage of hydrostable aggregates was from 55.5% in the non-eroded soil at the base of the sloping land and 35.2% in the heavily eroded soil in the middle third of the slope. The bulk density of the soil was 1.31 g/cm3 (100%) in the lower part of the terrace platform and 1.38 g/cm3 (106%) in the middle third.

On the terraced slope in the Agricultural Research Station in Podu Iloaiei, soil erosion determined the decrease of the percentage of the macro aggregates by 14.0% in the slightly eroded soil (the upper third) and by 37.7% in the strongly eroded soil (in the middle of the slope). The percentage of the hydrostable aggregates was from 50.02% in the non-eroded soil at the base of the slope of the land to 37.63% in the highly eroded soil.

In the perimeter of Ezăreni, soil erosion determined the decrease of the percentage of the macro aggregates by 14.0% in the slightly eroded soil (the upper third) and by 37.7% in the highly eroded soil (the lower third). The percentage of the hydrostable aggregates was from 50.02% in the non-eroded soil at the base of the sloping land and 37.63% in the highly eroded soil. On the terraces at the base of the slope cultivated with corn and wheat, the percentage of the hydrostable aggregates was 60-65%, but on the terraces no. 3, 4 and 5, due to erosion, the percentage of the hydrostable aggregates decreased below 30%.

The apparent density (g/cm^3) on the sloping arable land in Ezăreni, Iași, had average values from 1.11 gr/cm^3 in the upstream part of the terraces to 1.18 gr/cm^3 in the downstream part of the terraces. The registered minimum value was 1.05 gr./cm^3 and the maximum one was 1.24 gr./cm3.

The apparent density on the slope in Belcești, at the depth of 0-20 cm, had values from 1.35-1.45 gr/cm^3 at the base of the slope, 1.28-1.46 gr/cm3 in the middle of the slope and between 1.21-1.48 gr./cm^3 in the upstream part.

Good growing conditions are achieved when the compaction degree of the soil, determined in the spring before plowing and at a good moisture content, is up to 200 psi (pressure units) (1.35 Mpa), up to 300 psi (2.0 Mpa) acceptable conditions and over 300 unfavourable conditions.

The penetration resistance on the terraces 1-4 with slightly eroded soil was between 0.6 and 1.4 Mpa at the depth of 25-30 cm and values between 1.2 and 1.8 Mpa at the depth of 35-80 cm .

On the terrace five, where the land is moderately eroded, the resistance to penetration at the depth of 30-80 cm exceeded 2.0 MPa.

On the terrace six, where the soil is highly eroded, the resistance to penetration at the depth of 40-60 cm exceeded 2.4 Mpa and at the depth of 60-80 cm it reached 3.0 Mpa.

On the terrace six with more highly eroded soil, the penetration resistance values from the downstream and upstream of the terrace were more differentiated in the plowed soil layer (0-30 cm), from 0.5 to 1.4 Mpa, and faded with the depth of 30-80 cm (1.4-1.8 Mpa.

In the upstream area of the land with a slope of more than 19%, the penetration resistance was 1.13-2.09 Mpa at the depth of 0-30 cm, 1.48-2.37 Mpa at the depth of 30-60 cm and of 2.27-3.78 Mpa at the depth of 60-80 cm.

Results regarding the chemical properties of the planned sloping lands

On the terraces with arable land on the slope in Ezăreni, Iaşi, the pH of the soil had values from 5.41 to 6.89, the content of mobile phosphorus from 10.4 to 34.2 ppm, the content of mobile potassium from 215 to 289 ppm and the content of humus registered values from 3.59 to 4.08 %. On the Belcești slope, the content of humus was between 3.30 and 3.42%, the content of mobile phosphorus was of 9.4-11.5 ppm and the content of potassium was of 119-161 ppm.

On the lands with a slope of 16% slope planned with agricultural terraces in SCDA Podu Iloaiei to the slightly eroded land at the base of the slope, the pH had values from 7.0 to 6.3, and in the highly eroded area in the lower third, the pH had values of 6.1-6.9.

The content of organic carbon registered values from 16.4 to 17.3 gr./kg on the slightly eroded soil and values from 14.8 to 16.1 on the highly eroded soil.

The content of mobile phosphorus registered values from 14 to 65 ppm on the slightly eroded soil and values from 161 to 178 ppm on the highly eroded soil.

The content of mobile potassium registered values from 179 to 198 ppm on the slightly eroded soil and from 10 to 58 ppm on the highly eroded soil.

The obtained results regarding water and soil leakage by erosion on the planned sloping lands

The structure of the crops that determined the decrease of the soil losses by erosion below 2.27 t/ha, included 20% autumn wheat, 20% peas, 20% corn and 40% legumes plants and perennial grasses. On the lands with a slope of 17%, the decrease in the percentage of weedy plants, from 60% to 20%, caused the decrease of the amounts of the eroded soil by 69.3% (1.83 t/ha/year).

From the research conducted on erosion, based on the direct determinations with the help of plots for the control of the erosion (25 x 4 m), it was found that erosion in the Moldavian Plain, in the pea-wheat-corn rotation, had an average value of 3.35 t/ ha/ year. These elements are necessary for establishing the structure of the crops and for the dimensioning of the anti-erosion works, which causes the decrease of soil erosion below the limit corresponding to the natural capacity of the annual recovery of the soil, of 1-3 t/ ha/ year of the eroded soil.

The obtained results regarding the water and soil leakage by erosion, in different crops, in SCDA Podu Iloaiei, show that out of the total of 556.0 mm of the registered rainfall, 356.7 mm (64.16%) caused

rainfall, which was between 7.7 mm for perennial grasses in the second vegetation year and 27.6-29.9 mm for the corn and sunflower crops.

The decrease of organic matter in the soil is a threat in Mediterranean areas where, according to the European Soil Bureau, almost 75% of the total area analyzed in Southern Europe has a low (3.4%) or very low (1.7%) content of organic matter in the soil. Researchers consider that the soils with a content of organic matter which is less than 1.7% are in the pre-desertification stage.

The average annual losses of soil registered in the Moldavian Plain were 0.161 t/ha for perennial grasses in the second vegetation year, 3.883 t/ha for beans, 6.369 t/ha for corn and 6.733 t/ha for sunflowers.

The average annual losses of nitrogen, registered in the period 2017-2020, were 1.469 kg/ha for perennial grasses in the second vegetation year, 5.326 kg/ha for autumn rape, 17.603 kg/ha for corn and 18.353 kg/ha to the sunflower.

From the obtained results regarding erosion at different crop rotations, it was found that on the lands with a slope of 16% in the Moldavian Plain, the soil losses by erosion decreased below the allowed limit of 2.0 t/ha only in the case of a crop rotation of 3 or 4 years with three soils cultivated with legumes and perennial grasses that protect the soil.