SUMMARY

Keywords: *excess moisture, drainage network, drainage channels, channel clogging, shore erosion, geometric and hydraulic parameters, arable land, pasture, vegetation*

Sustainable agriculture involves economically viable agriculture that meets the current demands of the demand for healthy, high-quality food, but at the same time, to guarantee the protection and improvement of natural resources, in order to transmit them, unaltered, to future generations.

Through his doctoral thesis „**RESEARCH ON SUSTAINABLE VALORIZATION OF AGRICULTURAL LAND ARRANGEMENT WITH DRYING-DRAINAGE WORKS IN THE MOLDOVA RIVER WORK**" it is desired to highlight some practical aspects regarding the behavior of drying-drainage systems depending on the mode of operation, the category of use and their influence on the capitalization of the arranged lands and the development of the rural space.

The doctoral thesis is structured in two parts, Documentary study (17%) and Personal contributions (83%), consisting of the contents, introduction, thesis summary, 5 chapters containing 7 tables, 101 figures, conclusions and bibliography with 152 titles.

In the first chapter **- The stage of research on lands arranged with drainage-drainage works -** Growing world population and global warming are increasing the pressure on natural resources and, in particular, on soil productivity and sustainability with direct implications for agriculture and rural development.

Agricultural activities have positive but also negative effects, known and less known, on biodiversity and related ecosystems. Knowledge of agricultural methods that positively affect biodiversity should be identified in order to develop sustainable agricultural practices.

Drying-drainage channels are ubiquitous features in the agricultural landscape. The design of the two-stage canals demonstrates an increase in river stability, facilitates sediment deposition and creates important habitat characteristics.

This management practice can be a viable option for addressing erosion issues, imbalance of sediments and poor habitats in drainage-drainage systems (Kalcic et al., 2018; Hodaj et al., 2017; Krider et al., 2017; Dunn et al., 2016; D'Ambrosio et al., 2015).

Many researchers recommend controlled drainage and the creation of green buffer zones to reduce the loss of N and P from agricultural fields (Jia et al., 2006; Dukes et al., 2003).

Also, to increase water quality in ecological treatment systems, research supports the use of plants (*Typha latifolia, Lemna gibba, Cladophora* and *Myriophyllum verticillatum, Myriophyllum elatinoides, Pontederia cordata,* etc.) when treating wastewater or sewage (Kumwimba et al., 2017; Dollinger et al., 2016; Yang et al., 2016; Jarveoja et al., 2016; Otto et al., 2016; Bundschuh et al., 2016; Flora et Kroger, 2014).

Proper canal management could improve crop quality, recharge groundwater, mitigate floods, purify water or conserve biodiversity. The ecosystem roles of canals depend on many geochemical, geophysical and biological processes, the appearance and intensity of which vary greatly by its constructive parameters. The main dominant characteristics are vegetative cover, canal morphology, soil properties, sediments, biota and network topology.

Chapter II - **The natural setting of the Moldova river meadow** - presents the natural conditions that favor the appearance of excess water in the river basin of the Moldova River. The dense

hydrographic network, with shallow riverbeds, in some sectors even on the surface, was a permanent cause of excess moisture, with heavy rains causing flooding of nearby agricultural land.

Significant average multiannual rainfall, uneven distribution by months and seasons, but also large amounts falling in 24 hours and 1-5 consecutive days, associated with low soil permeability, lead to the appearance and prolongation of excess moisture.

The Moldavian meadow and the terraces in the form of strips, approximately parallel to the riverbed, with small slopes and many micro-depressions favored the excess of water, of rainy, phreatic nature and of the floods of the hydrographic network, in different forms and intensities.

Part II of the thesis begins with Chapter III - **Purpose, research objectives and working methodology**. The main purpose of the research is to identify, group and research the conditions and forms of degradation to which they have been exposed, after 1991, the drying-drainage arrangements made in the Moldova river meadow, in order to practice a sustainable management of the soil resources on the arranged lands.

To achieve the proposed goal, the research had the following main objectives:

- highlighting the modification of the geometric and hydraulic parameters of the drainage network under the influence of exploitation;

- the influence of natural and anthropogenic factors on the characteristics and integrity of the drainage network;

- analysis and understanding of the processes that led to the degradation of drainage-drainage networks and the reappearance of excess moisture;

- sustainable capitalization of land areas arranged with drying-drainage works.

The study and research were carried out on the area of the four drying-drainage systems, arranged between 1960-1975 and 1978-1980, comprising a total area of 8,761 ha, of which 3,059 ha with underground drainage, namely: the Rotopăneşti-Rădăşeni-Fântâna Mare system (5527 ha of which 1806 ha with underground drainage), the Drăgoieşti-Berchişeşti system (1790 ha of which 553 ha with underground drainage), Băişeşti-Dumbrava system (790 ha of which 500 ha drained) and the Bogdăneşti-Baia drying-drainage system (654 ha of which 200 ha drained).

The network of canals totaling approximately 127 km was telescopically dimensioned, taking into account the slope and the transited flows. Underground drainage works, about 1575 km of absorbent and collector drains, they were arranged according to the longitudinal scheme in the low area, on the lands with a small slope and according to the transversal scheme in the high area, on the terraces. The lines of absorbent drains, made of ceramic tubes and rifled PVC, have average lengths of 200 m, spaced at 15-20 m and laid at 0.8-1.20 m depth, depending on the terrain and hydrogeological conditions.

In the scientific approach undertaken, in order to achieve the proposed objectives, we used a series of research methods and means specific to pedology and geomorphology.

The taxonomic classification and the characterization of the pedological cover from the studied area was made based on the pedological studies prepared by the O.J.S.P.A. Suceava at a scale of 1: 10,000, for the administrative-territorial units Fântâna Mare, Baia, Cornu Luncii, Drăgoiești, Horodniceni and Rădășeni. In this sense, the scanning, georeferencing and vectorization of the Soil Units maps were performed and the soil names from the Romanian Soil Classification System were equivalent (SRCS 1980) and the Romanian Soil Taxonomy System (SRTS 2003) in the Romanian Soil Taxonomy System (SRTS 2012). The correction of the boundaries of the ground units was carried out using, as support, Numerical Terrain Model. We also performed soil profiles from which samples were taken for the analysis of the physico-chemical parameters of the soil.

To highlight the change in the geometric and hydraulic parameters of the channel network, after 40 years of operation, topographic measurements were performed with the ROVER STONEX S7-G GPS, and the Auto-CAD Map 3D 2014 program was used for data processing.

The cartographic materials were obtained using TNTmips v.6.9 and QGIS. An important step in spatial modeling was the realization of the Numerical Terrain Model (MNT) by vectorizing contours and elevations on topographic maps at a scale of 1: 25,000.

In Chapter IV - **Behavior in operation of the drainage-drainage network** - the results of the researches regarding the modification of the geometric and hydraulic parameters of the channel network are presented, after 40 years of operation, under the influence of the category of use of the arranged surfaces and the highlighting of the factors that accelerate the degradation of the drying-drainage systems.

On arable land, after 40 years of operation, changes in the geometric parameters of higher order drainage channels have reduced the flow section, on average, by 15%.

The clogging and erosion of these channels does not endanger the collection, transit and evacuation of water from excess moisture. However, the vegetation of shrubs and hygrophilous developed in the section of the canals decreases the speed of water flow, facilitating the sedimentation of the alluvium and the clogging of the drains.

Clogging of the section of the lower order channels, which serve drained arable surfaces, in thickness of 0.40-0.70 m led to the complete obstruction of the drain drains.

In the conditions of private property and land exploitation on individual plots, the lower order canals with only the role of drainage were completely taken out of operation, by introducing them in the agricultural circuit and/or by clogging.

On areas with pasture use, the canals have a much modified section, due to the erosion of the shore and the clogging of the bottom of the canal. Repeated crossing of animals over the drainage network, through undeveloped places, grazing and watering on the canal section accelerates the shore erosion and clogging of the drainage network.

The modification of the geometric and hydraulic elements of the channels is closely related to the species of grazing animals. If when grazing with sheep, the clogging of the channels is, on average, 0.80 m, for grazing with cattle the thickness of the alluvial layer is about 1.20 m. Due to shoreline erosion, the channel light has generally increased by 0.80 m for sheep grazing and by 1.80 m for cattle grazing.

High degree of clogging of the belt channels, on the surfaces with the use of pasture, disrupts the transit of collected water and in periods of heavy rainfall causes water overflow and flooding the drying-drainage surface.

Clogging of the canals on the pastures determined the clogging of the drains and their decommissioning, the stagnation of water in microdepressions prolonging the excess humidity and changing the floristic composition of the pastures, by replacing the valuable species with hygrophilous species of poor forage quality.

Chapter V - **Capitalization of lands arranged with drying-drainage works** - includes the evaluation of the soils within the drainage-drainage systems from the Moldova river meadow and the presentation of the way of capitalization of the arranged lands.

Characteristics and distribution of pedogenetic factors on different types and forms of relief, within the river basin of the river Moldova, they determined the formation of a varied range of zonal soils but also of some hydromorphic and/or halomorphic intrazonal soils, which leads to a mosaic aspect of the soil cover.

The highest share, within the drying-drainage systems, has the soils of the Cernisols class, of 62% (5469 ha), followed by those in the class Protisols with 21% (1831 ha), Luvisols with 9% (816 ha), Hydrisols with 7% (567 ha) and Cambisols with 1% (78 ha).

Among the soil types, phaeoziomas stand out clearly with 5469 ha (62.42%), they are followed by preluvosols 727 ha (8.30%), luvosols 89 ha (1.02%) and eutricambosols 78 ha (0.89 %). Among the azonal and intrazonal soils, alluvial soils occupy an appreciable surface of 1831 ha (20.90%), followed by stagnant soils 448 ha (5.11%) and gleiosols 119 ha representing 1.36% of the total area.

Despite the special agricultural potential of the lands in the meadow and terraces of the river Moldova, arranged with drying-drainage works, the deficient organization of this sector, after 1991, through increased fragmentation of agricultural land, exploitation on small plots improperly located in relation to the network of absorbent canals and drains, the lack of advanced agricultural technologies has led to the practice of subsistence agriculture depending on weather conditions.

The individual application of the soil works on the land plots determined the modeling in strips with ridges, with widths, level differences and variable transverse slopes, depending on the width of the plots, the agricultural machinery used to carry out the basic soil work, the direction of return of the furrow and the number of years used.

Landforming in ridge strips inconsistent with the position of the absorbent drains and the network of channels favors the stagnation of water in ditches and micro-depressions, causing the prolongation of excess moisture.

Prolongation of excess water, delay and improper performance of soil works, thus obtaining small yields, they determined the landowners to give up cultivating the surfaces where the excess moisture is manifested.

The exploitation of the surfaces arranged on the individual plots determines the decrease of the production by 20-50%, the losses being in direct correlation with the width of the plots, the duration of water stagnation in ditches, implicitly the delay of the application of the agricultural works and of the impossibility of the application of the agricultural technologies due to the small width of the individual plots of land.

The existence of a tradition for fruit growing and favorable eco-pedogeomorphological factors that include phaeoziomes in the third class of suitability for orchards, the main restrictive factor being the moderately-strong acid reaction (pH = 4.8-5.2), determined the extension of the cultivation of fruit trees on the lands arranged with drying-drainage works from the Rotopăneşti-Rădăşeni-Fântâna Mare and Băişeşti-Dumbrava systems.

The capitalization of the surfaces arranged through fruit tree plantations contributes to the socio-economic development of the area and to the increase of the living standard of the population from the rural area. Depending on the cultivation system and the cultivated varieties, the obtained productions, for the main cultivated species, vary between 40-80 t/ha for apple, 45-60 t/ha for hair and 25-30 t/ha for plum.

Grants awarded by the Payments and Interventions Agency for Agriculture, the lack of labor force due to the aging population and the appearance of some entrepreneurs determined, starting with 2014, exploitation of lands arranged on drainage sectors, especially in the Rotopăneşti-Rădăşeni-Fântâna Mare system.

In the conditions of exploitation of the lands arranged with drying-drainage works on drainage sectors or on merged surfaces, allowing the application of advanced agricultural technologies, the use of high quality biological material and the elimination of restrictions created by excess water, determines the superior capitalization of the productive potential of the soils and the obtaining of large, constant and quality productions. Increasing the efficiency of eliminating excess water and obtaining high yields, on areas that have been exploited for a period of time on individual plots, requires the leveling of the operation for the abolition of the gutters and ridges formed over time.

Sustainable valorization of the surfaces arranged with drying-drainage works requires the taking of some measures at local level regarding the information and education of the people in order to raise awareness of the role of drying-drainage works and the exploitation of areas arranged on drainage sectors and, last but not least, the organization of a rational grazing.