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IMPLEMENTATION OF AN OPTIMIZATION PROJECT OF AN EXISTING DRAINAGE SYSTEM, IN VIEW OF PREPARING THE LAND FOR THE ESTABLISHMENT OF A HAZELNUT PLANTATION

Ilca Marin[1], Man Teodor Eugen[1], Beilicci Robert[1], Cojocinescu Mihaela[1]

Abstract: The optimization of drainage and irrigation systems is the key to success for a modern, competitive agriculture, the basis being to ensure, on the one hand, the necessary water and related hydrotechnical constructions, and on the other hand, to protect agricultural crops against water surplus. The paper presents the optimization of the network of drainage channels for a case study belonging to erritorial Administrative Unit Otelec, Timiș county, where is an Agricultural Cooperative in order to set up a systematic hazelnut plantation.
Keywords: drainage system, drip irrigation system, relocation of channels, irrigation water storage basin, hazelnut plantation

1. INTRODUCTION

The importance of land improvement works in agricultural activities is known since the dawn of civilization, there is undoubted evidence from archaeological research that man, since the Neolithic had to change the topography of the place where he lived, to ensure, on a part of the necessary water and also to protect itself from its wrath.

Of course, during its development as a species, due to changes, knowledge, experience and needs, man has diversified and developed new systems and technologies, this having extraordinary economic and social implications, positively affecting both direct production in agriculture and industry.

In the context of new climate change, specialists involved in maintaining and developing agriculture are facing a new challenge. For the productivity and safety of crops, in the current context, the sustainable management of land and water has become imperative.

Also, the change through modernization of the work technology and of the used equipment, made mandatory the change of the strategy in the short, medium and long term.

The old drainage systems, designed and built according to the conditions of that time (technological, potential and political), served the proposed purpose, but, due to several factors, they are no longer, partially or fully, functional.

Therefore, it is necessary to make fundamental changes most of the time, in order to align the new requirements with the state of affairs in the field.

2. CASE STUDY

We took as an example a plot of land of 260 ha, belonging to erritorial Administrative Unit Otelec, Timiș county, where an Agricultural Cooperative aims to set up a hazelnut plantation (Corylus avellana) (Figures 1 and 2) [1,4]. In Figure 3 are positioned the 5 wells [2, 3] for following in time the evolution of the groundwater level that must be maintained at the level imposed by the requirements of the hazelnut culture.

As with any newly established culture, it began with the mapping of the surface and the execution of a series of pedo-hydrological studies to find out the compatibility of the soil - all its characteristics of composition, texture, permeability and drainage - with that culture.

The existing drainage system consists of open, secondary and tertiary soil channels, dug taking into account the level curves (old technology), part integrated in a vast drainage system, comprising several thousand hectares.

For the most part, these channels meandering in shape and clogged totally or partially, could not cope to discharge the water resulting from precipitation, when the fell quantities exceeded 30-40 l / sq. / 24h, which led to ponding on significant surfaces and compromising agricultural production. In addition, due to the specifics of the planned new crop, it was absolutely necessary an intervention for land remodeling and execution of other canals, straight aligned (for a good and efficient technical systematization of the plantation), taking into account the geometry and hydraulic specifications of the old channels, as they are presented in the Regulation of operation of the Drainage System of which it is part.

[1] Politehnica University of Timisoara, Department of Hidrotechnical Engineering, Timisoara, Romania , e-mail: ilca_marin@yahoo.com

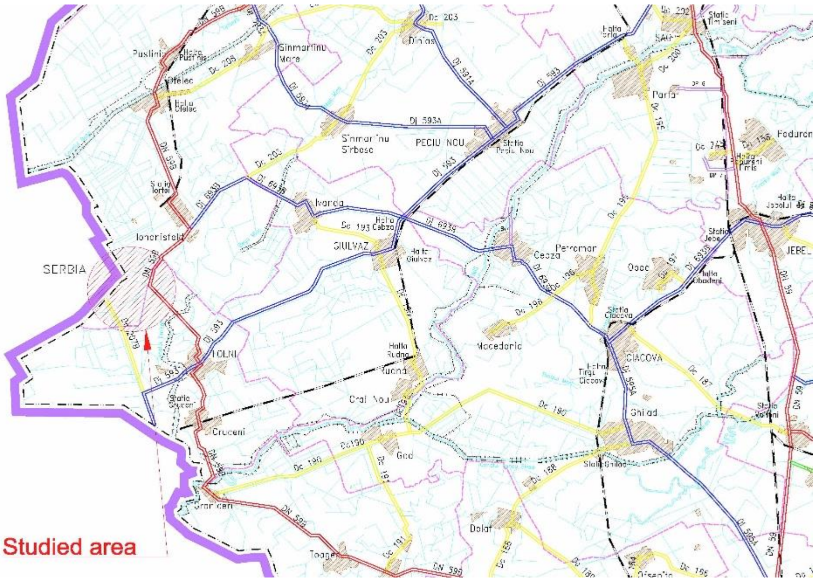


Figure 1. Area layout plan [4]

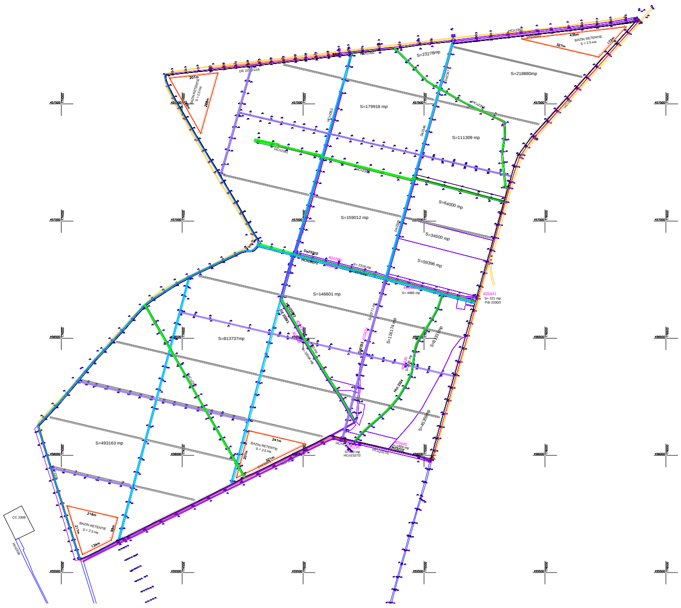


Figure 2. Planimetric topographic survey on studied area [1, 4]

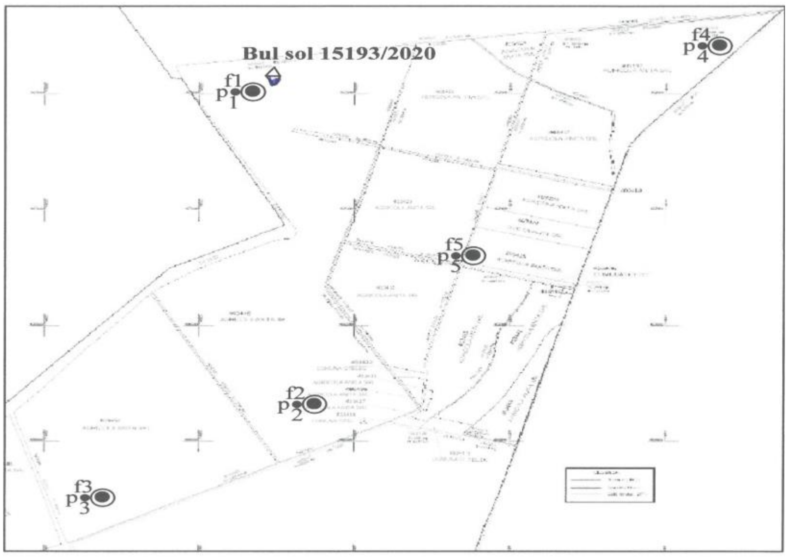
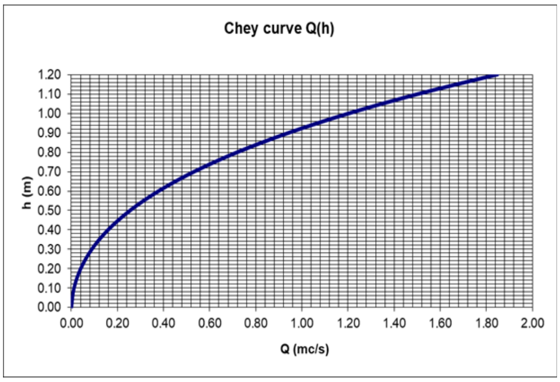


Figure 3. Situation plan with the location of the observation drillings (F1 - F5) [2,3]

During the relocation, their name was kept, according to the legal requirements, as well as the geometric and hydraulic characteristics and a hydraulic calculation brief was made for the elaboration of the hydraulic diagrams (Figure 4) [4], as well as cross sections (Figure 6), as an example for a drainage channel.



Through the hydraulic calculation patent [5,6], the verification of the drainage water transport capacity by the relocated canals and the dimensioning of the relocated bridges, respectively of the newly designed bridges were performed. , resulted in the following surfaces and volumes: Pool area - 2.5 ha, Water gloss area 2.4 ha and a pool volume 46.00 m^3 each.

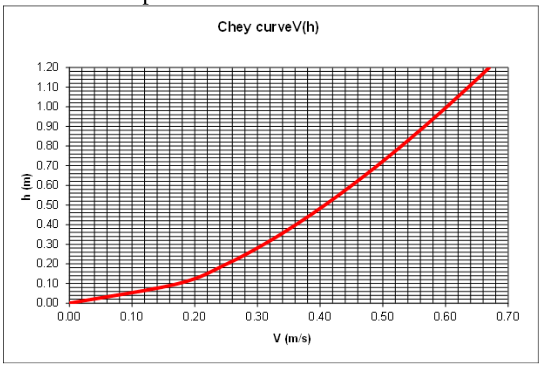


Figure 4. Key curves CT5 channel [4]

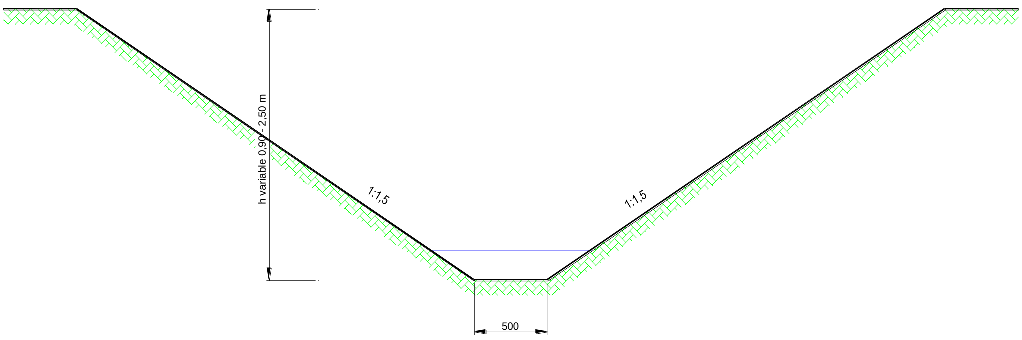


Figure 5 Cross section CT5 channel [4]

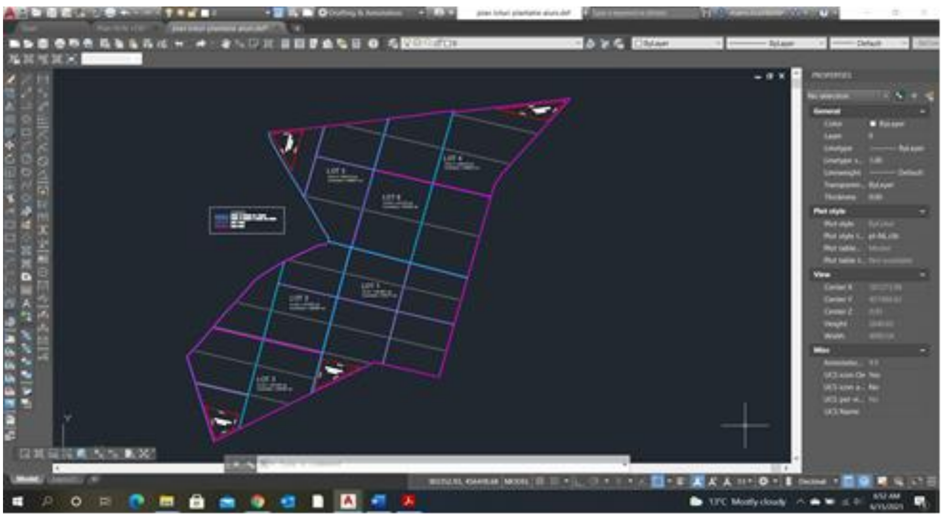
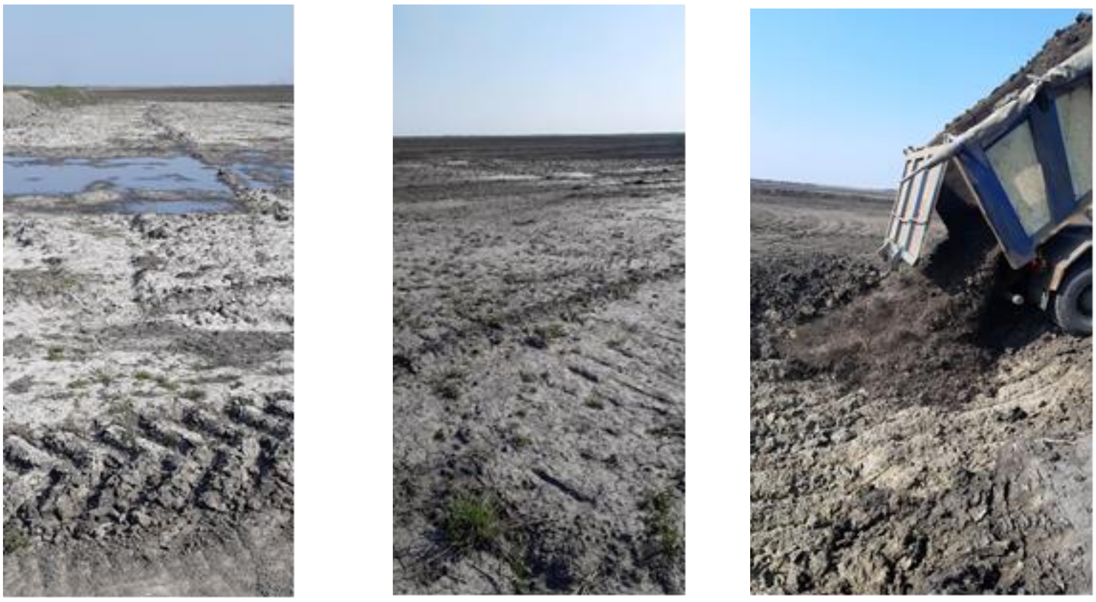


Figure 6. Plan of hazelnut plantation lots and water accumulation basins [12]

Figure 6 shows the plan of the lots of the future hazelnut plantation and the water accumulation basins for irrigation [4]. From a pedological point of view, the biggest problem in the field was the surfaces (around 5 ha) with salted soils (Figure 8), unsuitable for agricultural crops. In order to remedy this deficiency, the affected soil was replaced by digging to a depth of 1.2 m, disposing of the resulting land and transporting it to a tailings dump (Figure 7). As soil improvement works, fermented manure, fertile soil and gypsum were added, mixed in the ground, using a three-claw scaler (Figure 9)



a b c

Figure 7**.** Images during the execution of the embankment works for the replacement of the salted soil and the leveling of the land (a. and b.- initial situation, c. - fertile soil deposition) [Foto. Ilca M.V.]

Figure 8. Highlight salty areas (white portions) [Foto. Google Earth]

Within the technical project for the relocation of the channels, four retention basins with an area of 2.5 ha each were provided, each with the capacity to accumulate a water volume of 46,000 m^3, in order to store the surplus water from the drain, surplus that will be used for irrigation, in perspective, in case of need.

The excavation works of the new drainage channels were carried out in tandem with the closure of the old ones, with the mention that in the new ones, the fertile layer (the first 0.45m) was deposited to be relocated at the surface closure of the old ones rendering in the agricultural circuit of the respective surfaces.

Figure 9. Image during the execution of earthworks [Foto. Ilca M.V]

At the junction between the channels, passages and tubular bridges were built using high density corrugated pipe (HDPE), necessary to withstand the passage of heavy equipment, with which the beneficiary works. The hydraulic sizing of these bridges was done to ensure the transport capacity of the drain flow for each drain channel.

Due to the natural conformation of the land (with higher areas in some parts and valleys in others), it was absolutely necessary the intervention for leveling, a superficial remodeling operation of the land surface.

In kneaded areas (with random level differences), the pond phenomenon due to excess water, which cannot be discharged, causes great economic damage, destroying the culture and generating large losses. Ponding long weakens the quality of the soil over time, many of the microorganisms involved in chemical exchanges between soil and plants not being able to survive.

Also, by leveling, slopes were obtained for the drainage of excess water from the precipitations, which lead it to discharge, in the new drainage channels.

With the relocation of the new channels, a systematization of the surface in soils with regular geometric shapes was obtained, this being very helpful in facilitating the execution of specific agricultural technological works of the respective land, generating important savings of time, fuel and last but not least, diminution production costs and a more environmentally friendly attitude.

Another benefit brought by the optimization of the drainage system by relocating / redesigning the drainage channels, is the possibility to use the channels and basins for water accumulation, as natural reservoirs for irrigation, thus saving large amounts of water and energy.

The most important aspects in the design of this channels relocation work were -certainly- compatibility with the old remaining system, in which the preservation of geometric and hydraulic characteristics was integrated ensuring at the same time, an optimal functioning of the existing drainage arrangement.

3. CONCLUSIONS

For a modern, sustainable agriculture, in the actual conditions of climate and technological changes, it is often necessary to rethink and redesign the drainage and irrigation systems, including them in the already existing complex compartments, without modifying their functionality, in order to support the continuous development strategy.

The optimization of an existing drainage system required its systematization, in order to prepare the land for the establishment of a hazelnut plantation and to obtain the technical agreement from National Land Improvement Agency, the approvals from the Banat Water Basin Administration and from the Timiș Environmental Protection Agency.

By carrying out this project, it is ensured the establishment of a systematic hazelnut plantation, having ensured the drying of the arranged surface and the possibility of carrying out the irrigations if necessary, which will ensure in the future a high productivity of this land surface.

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