Concepts Regarding the Agricultural Use of the Danube Meadow. Antipa-Saligny Dispute

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Abstract

This paper synthesizes the ecological view of biologist Grigore Antipa and that of the noted engineer Anghel Saligny on the agricultural use of the Danube Floodplain. History gave satisfaction to Anghel Saligny's constructive conception. However, this conception proved to be ecologically unviable. The paper describes the key moments of this dispute, the evolution of the irrigated agricultural system in the Danube Floodplain, the effects on the environment, the financial aspects of Saligny's engineering concept. We have also assessed (in financial terms) the consequences of this concept, a damaging agricultural system for both the state and farmers. It is considered erroneous to continue the policy of rehabilitating old, expensive, energy-intensive and non-environmentally friendly irrigation systems. The author are concerned about the future of large-scale agriculture that concentrates economic power in the most favorable agricultural agrozone while the country's disinherited peasantry earns their living in an increasingly hostile external environment.

Keywords: Danube Floodplain, Romania, Grigore Antipa, Anghel Saligny, agriculture, irrigations, ecology.

Introduction

In the first half of the 20th century, two top personalities of Romanian science - a biologist and a builder - alternately imposed their conception on the most fertile agricultural area of Romania - the Danube Meadow. Today, the two great men of Romanian science belong to history, whereas their conceptions were exploited by their descendants in a different way and with ecological and economic consequences that are still the subject of disputes today.

At the beginning of the 20th century, the Kingdom of Romania, nicknamed the Granary of Europe due to the large share of grain exports, did not excel in terms of yields per surface unit. Compared to the agricultural countries of Western Europe where Romania exported cereals due to a higher production per capita, it obtained lower productions per hectare but close to France (Tab. 1).

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Crop	Romania (q/ha)	France (q/ha)	Germany (q/ha)
Wheat	11.8	13.4	19.8
Corn	11.4	12.0	-
Barley	9.8	13.0	18.6

Tab. 1. Source: Axenciuc V.- Romania's economic evolution, Vol.II Agriculture [Axenciuc '96].

Under these conditions, it is not surprising that attention was directed to the Danube Meadow where, thanks to the periodic alluvium, the productions per hectare were some of the richest. However, a permanent systematic agriculture could only be practiced on land permanently removed from the influence of water, which meant the need for damming. This is how the Dutchmen Dithmer and Langeweld, who 10 years before had failed in the Danube Delta at Mahmudia, dammed the area of 1,058 ha in Chirnogi in 1904, and the results were promising, so the damming of another 334 ha continued in 1905-1906 ha at the royal estate Mănăstirea, then another 3,150 ha at Giurgeni, and between 1906-1910 another 1,910 ha at the Spanţov state farm between Oltenița and Mânăstirea, reaching an area of 7100 ha in 1910, but the continuation of this action claimed the establishment of regulations and norms applicable to larger areas, possibly for the entire Danube Meadow. This was the moment when the two titans of Romanian science would enter the scene, at first the builder Anghel Saligny and then the biologist Grigore Antipa.

Materials and method

The materials used were primarily bibliographic ones, respectively specialized works that describe the activities in the field chronologically, the results obtained, both those presented in reference works and those confirmed by statistics. For the author, the long-term consequences of the conceptions of the two protagonists, the builder Anghel Saligny and the biologist Grigore Antipa, are primarily important. Naturally, the two totally contradictory conceptions were applied at the time within the limits of the decision-making power they had during their lifetime. After their death, it would be the turn of other decision-makers to adopt one or the other of the two concepts regarding the use of the Danube Meadow in accordance with

Results and discussions

The authors of the two concepts regarding the economic use of the Danube Meadow, Anghel Saligny and Grigore Antipa

In 1910, as head of the land improvement service in the Ministry of Agriculture and Domains, Anghel Saligny[1] initiates the Law for the enhancement of land in the Danube flood zone.

[1] Angel Saligny (1854–1925); b. Şerbănești village, Galați county; Romanian engineer and scientist. Academician (1897, university professor in Bucharest. President of the Romanian Academy (1907–1910); Minister of Public Works (1918–1919). He used reinforced concrete for the first time in the world in

Based on the engineering concept, the law stated the almost total damming of the meadow by means of continuous and unsubmersible dikes.

In order to test the results, the premises from Spanțov is declared experimental and transferred to the administration of the Land Improvement Service. Inside this enclosure, a module was built for the study of infiltrations, but the results were not published. The premises at Spanțov had a drainage network and the collected water was delivered over the dike through a pumping station [Botzan '91].

In terms of agricultural production, it was excellent due to the very fertile soil during the first years after the damming. The experimental results showed that the soil was so rich that the plants did not react to the applied fertilizers.

Instead, the results regarding the technical and economic efficiency of the drainage system have not been published, but it is known that the removal of water excess from the drained lands is the main problem of the lands reclaimed from water. Regardind this problem, Gh. Ionescu-Șișești, who had administered the experimental estate from Spanțov for several years, draws attention to the need for a continuous observation of the water movement in these premises and a collaboration between water improvement specialists and agronomists [Botzan '91].

The application of the provisions of the 1910 law regarding the non-submersible damming of the Danube meadow initiated by Saligny contradicted a long traditional exploitation of the Danube meadow for fishing, within which this annually flooded meadow, which offered ideal conditions for the reproduction and growth of fish fry in a natural regime, was thus considered a natural annex of the extensive ponds, fishponds, but also the ecological conception of the biologist Grigore Antipa[2], who even in the year of the appearance of the law initiated by Saligny had published a work in which he assessed the concept of excessive damming of the Danube Meadow as wrong.

Therefore, in 1912, Antipa made a memorandum in order to establish a Consultative Commission within the MAD in which the engineering and ecological conceptions are discussed.

Saligny supports the unsubmersible damming of the meadow between Giurgiu and Brăila, except for the large lakes, but does not exclude the damming of other sectors as well, and that the surfaces behind the dams be drained and returned to agriculture.

In the following, we consider it appropriate to quote directly from the Hydro-improvement Valorization of the Romanian Danube Meadow and the Delta published in 1991 under the editorship of a collective of authors (M.Botzan, C.Haret, I.Stanciu, I.Vișinescu and L.Buhociu) participants or supporters of the land improvement programs built in the second half of the 20th century under the communist regime.

the construction of grain silos (1884); he designed (1888) and directed the construction of the metal bridge over the Danube at Cernavodă (1890–1895), the longest in Europe at that time. He designed land improvement works, especially irrigation and floodplain reclamation.

[2] Grigore Antipa (1867–1944). Romanian biologist. Academician (1910). Founder of the Museum of Natural History in Bucharest, which was named after him. He elucidated the problems of the biological productivity of the Danube and the NW part of the Black Sea, he laid the foundations of the Romanian School of Hydrobiology, Ichthyology and Oceanology. Author of a modern ecological conception of biosociology and bioeconomy of the biosphere. The initiator of dioramas and one of the creators of modern museology. Member of several foreign academies.

Grigore Antipa, who also headed the State Fisheries Directorate, "proposed discontinuous damming of the meadow only on the higher beams, totaling about 130,000 ha of the almost half a million ha of meadow; the submersible breakwaters, crested at 8–8.5.0 hdg, were to be overpassed, on average, once in 10 years. It was argued that the damage caused to agriculture during the years of flooding of the enclosure was compensated by the lower cost of the works, without putting fish production into jeopardy" [Botzan '91]. The advisory committee, however, decided in favor of the immediately profitable perspective of Anghel Saligny. The beginning of the project consisted in the unsubmersible damming and drying of the land thus obtained on a large portion of the Danube, between Giurgiu and Brăila, excluding, however, the large ponds on the Domain of Brăila (Big Island of Brăila) and the large permanent ponds connected to the Dobrogean side of the River Danube. [Botzan '91].

The First World War prevents the materialization of the Saligny plan, but in 1921 a work by I. Vidrașcu appears, which with hydrological arguments supports the Antipa conception. In support of the naturalistic conception, Vidrașcu also comes with examples from other countries (USA, Italy, France, Hungary) and draws attention to the danger that the hydraulic balance of the Danube will be changed through continuous damming, which, lacking the major riverbed, could cause large floods by breaking the dikes. Vidrașcu also brought other arguments, such as:

> *At the same time, it was foreseen the intensification of the alluvium of the mouths of the Danube and the increase of navigation difficulties on the Sulina channel. With the rapid decrease in fish production, in the ponds lacking the spawning and growth area and the soil fertility of the dammed enclosures, deprived of the fertilizing input of periodic alluvium, it was predicted that these enclosures would become overgrown by infiltrations that would be impossible to control by pumping stations for the discharge of water over the dykes.* [Botzan '91]

With all the arguments in favor of the Antipa variant, Eng. N.Georgescu, Saligny's successor at the head of the Land Improvement Service, continues the works on the Saligny variant, the damming program in the Danube meadow targeting an area of about 352 thousand ha.

The partisans of submersible dams, led by Antipa, would however win their case in 1929, when the conclusion of the Commission on Dams convened for this purpose concluded: *"the total damming of the Danube from Calafat to Brăila, with unsubmersible dams at the 1897 water level is completely excluded. However, in 1965, the area dammed on the Danube was more than 200 thousand ha."* [Botzan '91]

In 1929 (4 years after the death of Saligny) Antipa will impose his point of view by initiating the *Law for the administration of state fisheries and the improvements of the Danube flood region - PARID*, which will also include the Land Improvement Service. On this occasion, the Improvements Council that operated within PARID approved in 1929 a delimitation of uses by area: fisheries, forests, pastures and agriculture (arable), a division recognized later as *instructive and useful*. Antipa continues to support his conception and in 1932 publishes a general plan for the improvement of the Lower Danube, in which the submersible damming of a maximum area of 130 thousand ha was foreseen.

Regarding this program, Gh. Ionescu-Şişeşti will hold two conferences on Radio Bucharest in 1935, in which he makes some recommendations regarding agricultural technologies on floodplains once every few years. It should be noted that it is recognized that high yields are obtained in the first years, and also their decrease after 4-5 years due to the rapid drying up of the natural reserves of the soils, but also due to infiltrations at the dams, followed by swamping at the bottom of the old lakes and ponds. In conclusion, he recommends vigorous pumping and fertilizer applications .

The agricultural use of the Danube Meadow during the period of socialist agriculture

Among the criticisms brought to the ecological conception of the biologist Antipa, it is also the fact that the imperative of gaining new land for agriculture was underestimated, especially arable land [Botzan '91] and that 15 years after the end of the 2nd World War (in 1960 n.a.) this conception will be refuted. In 1960, nothing was denied, instead it was confirmed the communist regime's obsession with increasing the arable area to 10,000 thousand ha, although Romania had, and still has, one of the largest agricultural and arable areas per capita from Europe (over 0.4 ha/loc. arable land). It is true that, in terms of productivity per hectare, land improvements and irrigation in particular were supposed to correct this state of affairs.

This is how the Danube meadow with its water at hand and its historical lakes and ponds covering an area of over 400 thousand ha was the first to be attacked. Dewatering continued immediately after the 2nd World War, reaching at the end of 1989, 418 thousand ha of which 224 thousand ha were arranged for irrigation [RED '93]. During the intensive exploitation of these surfaces, the predictions from 1935 of the agronomist Gh. Ionescu-Şişeşti, energetic pumping and application of fertilizers, came true. The current director of the National Institute of Land Improvements INSPIF recently recognized (in 2008) that no less than 111 pumping stations are used to evacuate water, i.e. to discharge it over the unsubmersible dikes, and that their installed power and flow rate surpass the irrigation water supply stations in terms of these parameters and application of waterings in irrigation systems.

At the debate on the problems of the Danube meadow that took place on 08-09 May 2008 under the high patronage of the Academy of Agricultural and Forestry Sciences - ASAS, there was a lot of talk about the need to keep the unsubmersible dyke at the rate of 1% (that is, the dykes could be overpassed once in 100 years, but the phenomenon of infiltration through dams 24 hours 24, 365 days a year was ignored. This is because large areas of the old lakes had their bottoms below the level of the Danube and the water from the infiltrations - including the wasted by irrigation could only be eliminated by throwing it over the unsinkable dykes. In a table with more statistical data regarding the complex developments in the Danube Meadow in the closed drainage column that would have solved the infiltration problem for the most part, the figure stands at 22,522 ha, i.e. the 10th part of the area arranged for irrigation or 5.3% of the dry area.

Little was said about the real problems, or about the difficulties of the hydro-improvement development of the Danube Meadow and its preparation for irrigated agriculture in the

period before 1989. The specialists in the field: researchers, designers, builders worked out - lately in global agreement - project after project, and the presidents of C.A.P. signed them "as mayors", being aware from experience that they would never pay their debts. After 1990, however, the same specialists recognized and wrote about the difficulties of developing the Danube Meadow and especially about the consequences of the partial realization of the projects. At the debate on 8–9 May 2008, the Director of INSPIF will acknowledge:

> *The desiccation-drainage works together with the application of the entire complex of hydro-ameliorative measures were expected to be carried out in 4 stages:*
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> 1. *Damming and evacuation of surface water through main drainage channels;*
> 2. *Elimination of surface water excess by abundant canal networks (collection canals, interception canals, etc.);*
> 3. *Water drainage from the soil profile and irrigation on dry ground;*
> 4. *Completion of complementary surface drainage works, rehabilitation of irrigation systems and improvement of saline and sandy lands.*
>
> *Due to the partial completion of the 3rd stage (tubular drainage was introduced only on 5% of the drained surface) and the failure to complete the 4th stage, the following deficiencies were reported in the drainage systems:*
>
> - *the appearance in wet periods of surfaces with excess moisture, especially in depression areas, which total almost 20% of the area of the enclosures;*
> - *on certain surfaces with mineralized groundwater, located at a shallow depth, due to high evapotranspiration, which creates a water deficit of 200-300 mm per year in the soil, processes of secondary salinization of the soil appeared, especially the depression areas where irrigation was applied without ensuring drainage.*
>
> *During the wet periods, the low lands in the Danube Meadow, and especially those at the base of the terraces, suffer from excess moisture. If in a wet period we also have high levels in the Danube, due to infiltrations through the body and foundation of the dikes, the excess moisture manifests itself in the enclosures and behind the defence dikes.*
>
> *Water evacuation from the premises is provided by 111 stations that have an installed flow rate of 419 mc/s. Pre-pumping stations were also built in some drainage systems. There are 79 of them and they add up an installed flow of 142 mc/s.* [RED '93]

The cost of land improvements in the Danube meadow

Defense works - dikes 1,158 km, drainage on 418 thousand ha and irrigation on 224 thousand hectares represent an investment of 2,200 million EURO. If we add the agricultural land preparation works - deforestation, deforesting, initial water evacuations, modeling -

leveling, the movable and immovable heritage of the approximately 400 agricultural farms, private property constructions, other infrastructure works and other goods, the total value of land and defense works is estimated at around 8.8 billion EURO or around 14 billion USD [RED '93].

This figure presented by ISPIF (Institute for Studies and Designs for Land Improvements) in the Debate on the problems of the Danube Meadow and the Delta in 2008, represents only part of the investments made by the Romanian state in land improvement works. The 224 thousand ha of irrigation facilities and 428 thousand ha of drainage in the Danube Meadow represent only about 7% and respectively 13.5% of the total development since the end of 1989, while according to World Bank estimates, Romania invested about USD 50 billion in land improvement works (ISPIF, 2009).

The economic efficiency of the irrigated farming system

Hydro-improvement development projects are actually investment projects, and their economic efficiency is evaluated according to the specific methodology, the net income or additional benefit being part of the economic category *differential rent II*. Design parameters were characterized by a high profitability rate obtained by designing high yields per unit area: 6,000 kg/ha wheat, 10,000 kg/ha corn, over 3,000 kg/ha soybean and sunflower, 30 t /ha potatoes or 50 t/ha sugar beet (levels obtained in experimental fields). At the same time the volume of expenses was projected at the lowest level.

In the exploitation phase, however, due to non-compliance with production technologies, harvests were much lower, which led to low efficiency or lack of efficiency (see Tab. 2).

The unsatisfactory economic results from the production units were obtained in the conditions where the state heavily subsidized the cost of irrigation water, delivering it to state agricultural production units, cooperatives, research or other beneficiaries at rates far below its cost. Over time, as the irrigated areas increased and the country's economic situation worsened, the gap between the real cost of water and the rates at which it was delivered to agricultural production units was expected to decrease.

A first attempt to increase the tariffs for the services offered to agriculture by the companies operating land improvement works, present in each county (IEELIF), was in 1978, when increased tariffs were established by State Council Decree no. 471/1978. For example, for 1,000 m3 of water delivered to agricultural units, a rate of 144 lei/1,000 m3 was proposed instead of 18 lei/m3 of water, which meant an 8 time increase of the old rate. A 2nd attempt to increase the tariffs took place in 1987, when by the State Council Decree no. 329/1987, increased tariffs were proposed for both the maintenance works of the irrigation infrastructure and for water pumping, this time on electricity consumption steps, the highest tariff being 397 lei per 1,000 m3. In both cases, DGEIFCA specialists performed calculations regarding the impact of the new tariffs on the production units' budgets, concluding that the cooperative units cannot bear them, so their application was abandoned. However, for the following years it was foreseen to reduce the gap as follows: in 1988 agricultural units were to bear 34% higher tariffs, in 1989 the increase was 60%, in 1990 the increase would have been of 80%

compared to the old tariffs , and for 1991 tariffs covering the cost of water were foreseen [RED 06].

Crop	Average production kg/ha		Value production lei/ha		Technological costs lei/ha		Profit/ loss lei/ha	
	S.A.E	A.P.C	S.A.E	A.P.C	S.A.E	A.P.C	S.A.E	A.P.C
Wheat	3509	3083	6364	5592	4723	5237	1641	355
Corn	3492	3816	5147	5827	7230	7005	-2083	-1178
Sunflower	1570	1603	5538	4955	5178	4584	360	371
Soy	1010	765	3774	2493	5350	3982	-1576	-1489
Sugar beet	-	23909	-	9007	-	10852	-	-1755
Potatoes	15024	10167	16815	9884	26587	17130	-9772	-7246

Tab. 2. Production per ha, value production, technological expenses, and the economic efficiency of some crops in zone I, irrigated in proportion to 65% in the period 1986–1988. SAE-State Agricultural Enterprise; APC-Agricultural Production Cooperative. Source: Ministry of Agriculture - Economic Directorate.

Let's not forget that these last years of the communist regime were those of the restitution of foreign debts when the state could no longer afford to subsidize irrigation. In the 19 years (1971–1989) in which a cumulative area of over 30 million hectares was irrigated, the state's losses were close to 20 billion lei, the average degree of subsidy over the entire period approaching 70% (see Tab. 3).

Period	Irrigated surface thousands ha	Water cost mill.lei	Revenue based on tariffs mill.lei	State losses mill.lei	The degree of water subsidy %
1971*-1975	4335.5	3175.7	771.7	2404.0	75.7
1976-1980	7097.8	5660.7	2292.6	3368.1	59.5
1981-1985	9388.0	10630.5	2891.5	7739.0	72.8
1986-1989	9424.3	9538.0	3157.1	6380.9	66.9
Total	30245.4	29004.9	9112.9	19892.0	68.6

Tab. 3. State costs for irrigation exploitation, revenues collected based on tariffs, state losses and the degree of subsidization of irrigation in Romania in the period 1971-1989. Source: A.Lup - Irrigation in Romanian agriculture.

During the period in which damming, drainage and irrigation works were carried out on the cultivated areas in the first years after draining, large productions were obtained, and the calculations showed a high profitability.

The economic efficiency of the land improvement works executed in this unit is high, allowing large increases in production and net income, as well as reductions in the cost price. Thus, the value of global vegetable production increased in this unit (Borcea Island) after damming, drying and the introduction of irrigation on part of the protected area (3760 ha) from 2,200,000 lei in 1950 before the damming, to 45,700,000 lei in 1967. The net income

increased accordingly, from 1,100,000 lei to 18,800,000 lei. The cost price in lei/kg decreased, in the same situations, from 0.84 lei/kg to 0.40 lei/kg for corn and from 1.29 lei/kg to 0.62 lei/kg for sunflower [Hâncu 09].

"It seems interesting to us that the richness of the soils of the Danube Meadow due to the accumulation of organic matter during the floods is ignored, but also the well-known fact that with the damming and drainage this fabulous fertility will become a legend" as expressed by the pedologist I. Munteanu who - dedicated many years to soil research in Lunca and the Danube Delta. The same author thus summarizes the effects of the drainage of the Danube Meadow:

- Aridification of the climate and over-drying of soils;
- Increase in soil salinity;
- The rapid depletion of organic matter and the decrease in fertility, the impoverishment of soils in organic matter, favored by the hot and dry hydrothermal regime of the area and the low degree of humification of organic matter;
- The formation of the crust, the dusting of the surface horizon and the appearance of the risk of wind erosion;
- The risk of bringing to the surface the sandy or less fertile substrate that can be exposed to deflation;
- Reduction of biodiversity [RED '93].

In conclusion, the pedologist appreciates that through a rational exploitation, under an irrigated regime, the negative effects can still be avoided, which did not happen, just as it did not happen in other parts of the world either.

According to FAO statistics, approximately 50.0% of irrigated lands worldwide are affected by salinity, to the point of becoming unproductive. In Iran, Iraq, Egypt, Pakistan, over 70% of agricultural land is affected by salinization. The phenomenon is mainly attributed to the neglection of drainage on the lands exploited under irrigated regime. Due to the very high costs, it is appreciated that restoring the fertility of these soils is a difficult problem and is questioned.

In India, the area affected by salinization and siltation is estimated at 7 million ha. There are annual losses of 200–300 million ha of agricultural land worldwide due to salinity. The total area of irrigated salty perimeters is estimated at 50 million hectares, the most affected being the facilities in Asia and Africa [RED 06].

All these things being known, the Danube Meadow is the first area scheduled for rehabilitation due to the installation here of the large national and transnational neolatifundia whose purpose is not to combat the drought but to maximize a profit whose destination is unknown.

Conclusions

The fight between the two conceptions regarding the agricultural use of the Danube Meadow, the ecological one of the biologist Grigore Antipa and the engineering one of the builder Anghel Saligny, that had lasted for almost the entire first half of the 20th century, ended with the victory of the latter, a victory largely due to the agrarian politics of the communist regime for which the quantity, respectively the extent of the agricultural surface prevailed over the quality of the land resource.

Tens of billions of USD were spent to transform hundreds of thousands of hectares into arable land, never recovered. Instead, the forests have disappeared - although wood is more expensive than wheat - the ponds full of fish have disappeared, and the lands reclaimed from the water have degraded.

The projects to restore the natural balance in the Danube Meadow are considered shallow and are rejected by the followers of the expensive engineering concept. Instead, in the name of profit maximization, productive technologies are promoted with the risk of further degradation of the land resource.

The specialists - designers and builders - do not rule out some adjustments to the constructivist programs, but for an uncertain future, while currently the destructive and damaging land policy of the old regime continues.

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