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THE IRRIGATED AREA OF ROMANIA, HOW IT EVOLVED AND WHAT CAPABILITIES EXIST FOR THE FUTURE

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Abstract: Romania has a wide variety of water resources, but these have a very high variability during the year, depending on the rainfall and provide a relatively low flow. The most important water resource for irrigation is the Danube River, the other inland rivers, summed up, barely rising to its level. Even if after 1989 Romania's irrigated area has steadily decreased, we have remained ahead of other countries in the region (such as Bulgaria, Serbia and Hungary). However, according to the scenarios presented in the paper, we still need at least 10 years to catch up with countries like France.

• Introduction

Effective water management includes proper water allocation, efficient irrigation techniques, and measures to prevent water pollution and soil degradation. Despite its importance, irrigation in Romania faces challenges such as water scarcity, outdated infrastructure, and environmental concerns. Climate change also poses risks, potentially altering rainfall patterns and increasing the frequency of extreme weather events.

Romania has a wide variety of fresh water resources, but they have a very high variability during the year, depending on the precipitation, ensuring either a relatively low flow or representing a flood hazard. Regarding precipitation, in recent years, it were rarely been sufficient and at the right time, most of the time we are faced with either periods of prolonged drought or a too high level of precipitation. As water resources for irrigation, the most important was and is the Danube River with a water volume of 85 billion cubic meters (of which approximately 30 are used), the volumes of water offered by the other inland rivers, combined, rising almost at the same level. Inland rivers are supplied mainly from rains and snows, and less from underground springs, which leads to a high degree of fluctuation of the flows during the year, so with great dependence and vulnerability to seasonal climatic conditions. The hydrological resource is unevenly distributed on the country's territory having a large variation not only seasonal (annual) but also from year to year (multiannual). At the national level, in the period before 1989, the irrigated area was about 3 million hectares, and currently the irrigated area is 1 million hectares.

• Material and method

In this work, various data related to the irrigated land area from several European countries, including Romania, were retrieved, sorted and studied. Based on these data, were determined regression functions as close to reality as possible and then were made forecasts, in order to see the time interval required for Romania to reach a level of irrigated land comparable to that of developed countries.

• Results and discussions

In the period 2005-2021, in Romania, both the agricultural and the arable area did not undergo significant changes, the agricultural area varying between 1.4 and 1.3 million hectares, and the arable area between 9.2 and 8.5 million hectares. The same cannot be said, in the specified period, about the irrigated agricultural area. The lowest value was approximately 0.33% in 2005, and the highest was 3.63% in 2020. Between these years, and even after, it recorded countless ups and downs, the only relatively constant period from the point of view of the trend (increasing) being the one between 2010-2020 (figure 1).

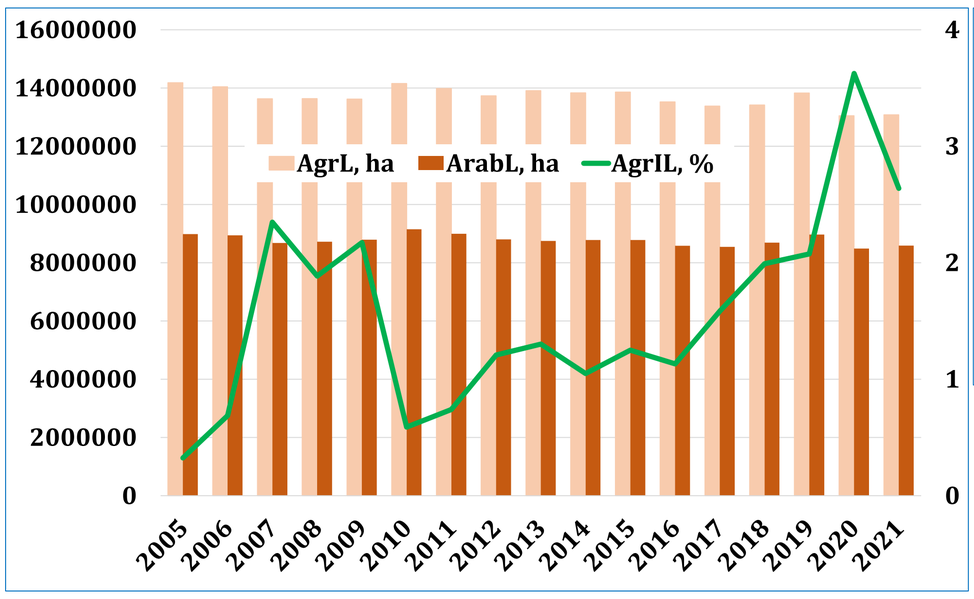

Figure 1. The evolution of agricultural (ha), arable (ha) and irrigated agricultural land (%) in Romania, 2005-2021

In Romania, due to the large variations from year to year in the irrigated areas, it is quite difficult to predict their evolution in the future. However, we tried several scenarios (figure 2), to see if by the year 2031 (10 years from the last statistical data), we can get closer to the irrigated area of France (about 6.5%).

In the first case, we tested a linear regression function, of the type y=a*x+b. This gave us a squared correlation coefficient (r^2) of approximately 0.31. Taking into account that a value of r^2 greater than 0.5, i.e. as close as possible to 1, shows us that the regression line approximates the real data quite correctly, we tried other models, in order to obtain a value as high as possible for this coefficient.

Also, a linear growth is unlikely to be achieved in real life, but it was basically a test to see where we will be in 2031. Anyway, this growth model brings us to a value of just over 3.2% in 2031, that is, less than half of France's current value.

The second regression model was an exponential one, of the form $y=a*e^{b*x}$, where we obtained a higher r^2 coefficient than in the previous case, namely almost 0.37. This model brings us to a value of almost 5% in 2031, much closer to the 6.5% that France has now.

Finally, since many evolutions can be approximated by polynomial functions, in the third case we used such a function, namely one of the 2nd degree, of the form y=a*x2+b*x+c. With this model, we obtained an even higher r^2, of almost 0.43%, very close to that 0.5, which means a 50% chance of this happening. However, despite the rather high coefficient compared to the previous ones, it is unlikely that this prediction will be the real one, namely that in approximately 8-9 years we will reach the current level of France. This is also based on the fact that after 2020, Romania's trend was a decreasing one.

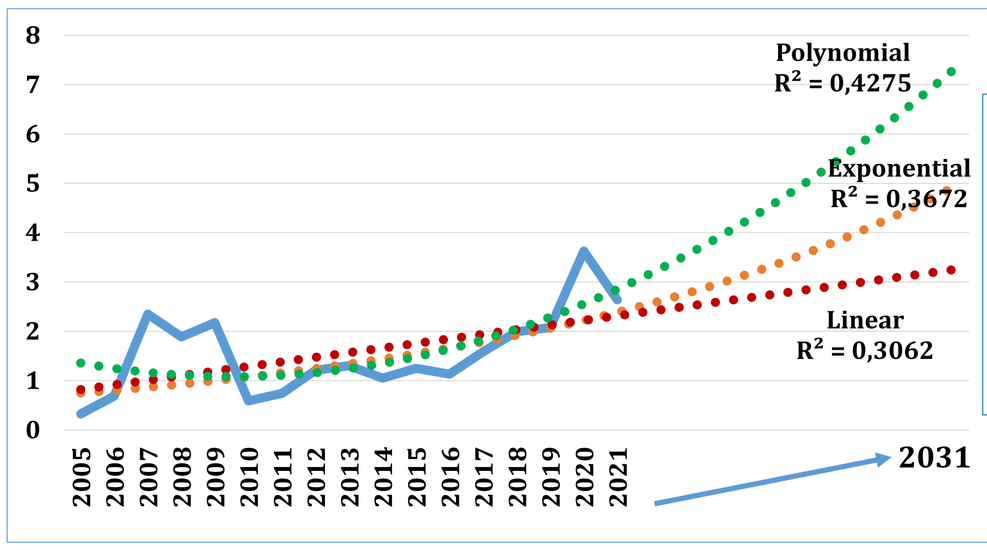

Figure 2. The number of localities with a water distribution network out of the total number of localities, %

• Conclusions

The conclusion would be that the second model presented, the one based on an exponential curve, even if it has a smaller square root than the polynomial one, is the most likely to happen, or the evolution will be between the exponential and the linear.

However, this also depends on the solution of some existing weaknesses at the present time. The data studied showed us a series of weaknesses of the irrigation system in Romania, which directly and negatively affect the farmer, such as:

- **due to the dependence of production on climatic conditions, which are more and more unpredictable and changeable, there is uncertainty and a high variability of earnings from agricultural activity;**
- **the old irrigation system is mostly destroyed and what is left from the period before 1989 is in poor conditions, is expensive to use and has little coverage of the agricultural area that need to be irrigated (those located in areas with drought or excessive drought);**
- **in the equipment of the farms there are no local weather systems for analyzing and storing information, which would provide a history of regional climate and environmental conditions and help in decision-making by farmers;**
- **low productivity and efficiency, low added value (especially for export), as well as the low prices of primary agricultural products lead to insufficient incomes and even to the abandonment of agricultural activity, especially by young people;**
- **reducing the share, or even giving up the use of native and adapted varieties in culture.**

These attract a series of threats to the rural population and farmers and implicitly to agricultural production:

- **the migration of the population from the rural area due to low incomes, the inefficiency of the activity in agriculture, the lack of support, the price policy that disadvantages the producer and encourages the intermediary, the insecurity and instability of incomes due to weather dependence**
- **the more and more visible climate changes, the accentuation of extreme phenomena, heatwaves, droughts, storms and precipitations, floods, etc., have led to the worsening of favorable plant growth conditions, also having a negative effect on farmers' incomes.**

In order to solve these problems, respectively for the expansion or rehabilitation of the irrigation infrastructure, a strategy for combining agricultural land is necessary, because there are no effective drip irrigation systems on 50 or 100 hectares. Also, in Romania there is a structural problem, because, in many places, the water is pushed from the valley to the hill in order to create mini-accumulation areas and which are only sustainable for the first two stages, not for five, six, seven pumping stages, as many as are provided. In addition, a short-term irrigation subsidy could help farmers accumulate capital, with which they can then build their own irrigation systems.