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THE INFLUENCE OF IRRIGATION ON THE STRUCTURE OF CROPS ON ARABLE LAND, UNDER THE CONDITIONS OF ROMANIA'S PLANNED ECONOMY AND FREE MARKET

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Abstract

The paper describes the main criteria that were taken into account during the planned agriculture period, the communist period before 1990, compared to the current period under the conditions of the market economy. During the first period, at the beginning of each year, the Law on the socio-economic development of the country was published, in which the parameters which had to be reached by the end of that year were set. In terms of agriculture, the structure of the crops, livestock, plant and animal production, average yields per hectare and per head of livestock were planned. However, the structure of the crops was compulsory. Both the areas of the different crops and the level of yields were established according to the natural favorability of the land, but especially according to the extension of the areas equipped for irrigation. And during the second period, when the irrigated areas were drastically reduced, they were a major criterion for establishing the structure of the crop.

Key words: *irrigation, arable land, crops*

INTRODUCTION

The structure of the crops on arable land characterizes most faithfully the agriculture of a state during a certain period. The share of certain crops or groups of crops, their presence or absence is defining for the type of agriculture, the degree of intensity, the state policy, investments, profitability. The paper presents two distinct periods: the one prior to 1990, which reflects the period of the planned economy (1945-1989) and the market economy period, from 1990 until the present. During the first period, at the beginning of each year or even before, the *Law of the annual plan for the development of agriculture* was published, which stipulated the areas that had to be sown with each crop, the average yield per hectare, the total yield. If the average and total yields were rather desired and almost never met, the area to be cultivated with each species was mandatory [3]. Plans, or rather programs for the development of a certain economic branch or the whole of the economy existed - they still exist today - but they are indicative, rather than mandatory (laws). Moreover, the plan of crop structure also indicated which of the two categories of agricultural units was to cultivate each one.

The cooperative sector, for example, cultivated species with greater needs for manual labor, less mechanized: vegetables, medicinal plants, while the state agricultural enterprises were mainly allocated cereals, for which by the end of the period the mechanization was complete [3]. According to the plan, the state sector was allocated sugar beet [2] only in 1989, when due to the territorial supply plan the cooperative sector was not sufficient for this product. Also, during the last years of the totalitarian regime there was a plan also for the assisting plots of cooperative members' families, as well as for the non-cooperative private sector (about 10-12% of Romania's arable land) [1].

The situation is completely different under the conditions of market economy, in which the managers of the trading companies or even the peasants with small households decide for themselves what crops they cultivate and on what areas [2].

One of the main criteria for planning the crop structure during the planned economy was the evolution of areas equipped for irrigation. To these areas were allocated crops with higher

water needs, such as maize, sugar beet, potato, some species of vegetables.
The yields obtained from the set up areas were well below the planned ones [4, 8]. However, in the hope that the technologies specific to irrigated agriculture would improve, the crops with higher water needs were to a certain extent located according to the increasing pace of the area equipped for irrigation [8].
In various research studies regarding the yields obtained by various agricultural corps cultivated on irrigated and on non irrigated land proved the difference of production [5, 6]. Also, under various levels of fertilization which requires irrigations, the yields achieved by Romania are below the ones obtained by other countries [7].
During the four chronological reference points studied, the areas equipped for irrigation or irrigated were the following: 1968 - 530 thousand ha (3.5% of arable land); 1989 - 2,908 thousand ha (39.7% of arable land), 2008 - 288 thousand ha (3.1% of arable land) and 2017 - 307 thousand ha (3.2% of arable land) [9].

MATERIAL AND METHODS

The material used is extracted mostly from the statistical yearbooks of Romania, respectively the figures regarding the areas cultivated annually with different plant species and groups of plant species. To these are added the works of the authors on this topic or on topics related to the subject matter.
In order to highlight the tendency of the areas cultivated with different crops that reflects the changes in the crops' structure, the quadratic equation was used, which reflects most accurately the changes that occurred in the crops' structure.

RESULTS AND DISCUSSIONS

Table 1 shows the crop structure of Romania's arable land in 1968, 1989, 2008 and 2017. The first two chronological reference points belong to the planned agricultural system in which the crop structure was established at the highest level, by law.
The main criteria that were taken into account were the technological progress - rather a theoretical one - but especially the evolution of the areas equipped for irrigation (Fig. 1).
The zonal favorability of the land, as well as the social economic, state or cooperative sector were also taken into account.
The county-by-county breakdown was done in the presence of the agricultual directors and, obviously, the chief secretaries of the party.

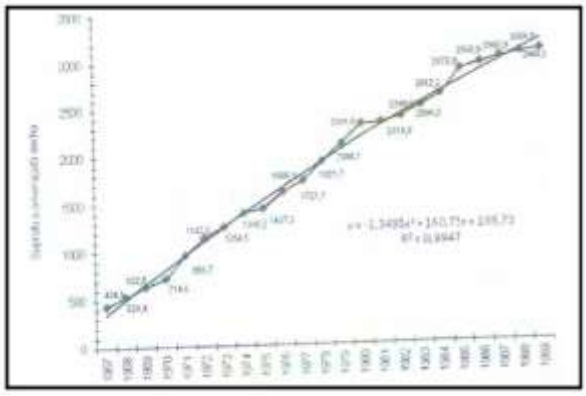

Fig. 1. Areas equipped annually for irrigation in Romania during the 1967-1989 period
Source: [9].

The discussions mainly concentrated on the level of average yields, by counties and sectors (state and cooperative).
The results obtained on the land equipped for irrigation were also taken into account. Some results were well below the planned level, between 3-4 tons/ha compared to 10 tons/ha projected [3]. This explains why the share of maize in the structure of the crops was lower in 1989 than in 1968 (Table 1 and Fig. 3), when the influence of irrigation was insignificant (about 500 thousand ha at country level). Instead, the increase of the share in the structure of crops with higher water needs, such as soybean, sugar beet, potato, rice, for which over 50 thousand hectares were set up, was forced.

The evolution of the areas cultivated with the main crops

Wheat and maize. Romania has always been a cereal producing country, and Romanian wheat, one of the most sought-after export products. Together with maize, it accounts for more than one third of the cultivated area. The two cultures are competitive, but also complementary, the difference being given especially by the need for water. Wheat, with

smaller water needs, is less sensitive to drought and as the areas equipped for irrigation increase, the cultivated - actually planned - areas decrease (Table 1 and Fig. 2), but not below the 2 million ha threshold. However, due to the inadequate exploitation of irrigation, the areas planned and cultivated with wheat increase again (during the 1963-1989 period).

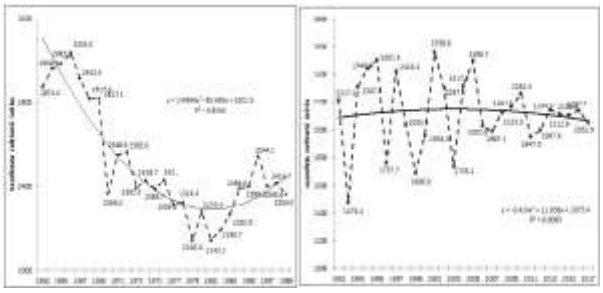

Fig. 2. Wheat cultivated area in Romania
Source: [9].

During the second period, 1991-2017, the area cultivated with wheat remained around 2.5 million hectares. During the socialist agriculture period, the maize cultivated area should have increased due to the extension of irrigation. However, this was not the case as a result of irrigation failure. During the last years the maize obtained was: 1985: 3,846 kg/ha; 1986: 3,811 kg/ha; 1987: 2,699 kg/ha; 1988: 2,781 kg/ha; 1989: 2,472 kg/ha, compared to the projected 8-10 t/ha. Such yields tempered the enthusiasm of the planners for extending the maize production and the cultivated areas were reduced to a necessary minimum (Fig. 3).

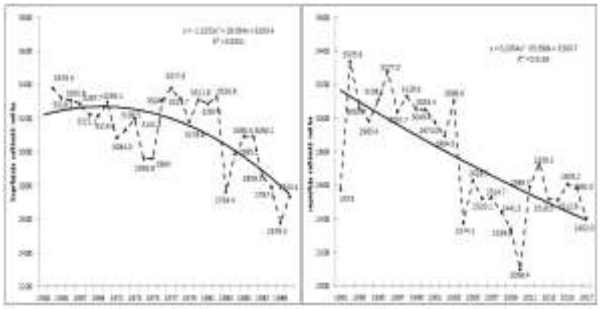

Fig.3. Maize cultivated area in Romania
Source: [9].

After the fall of the planned agricultural regime at the end of 1989, the areas cultivated with most crops did not constitute articles of law, the decision descending to the level of each new owner. But as the irrigation systems were abandoned, with the drastic reduction of irrigation, the maize cultivated areas reduced from one year to another, the curve becoming a downward line (Fig. 3).

Oleaginous crops. A special case is that of the sunflower. Along with wheat and barley, it was one of the few profitable crops during most years and this is precisely because they are satisfied with less irrigation. However, after a significant increase in the area cultivated in the late 1970s, the planning bodies reduced its extension in order to accommodate species with higher water needs: maize, sugar beet, potatoes and even soybean. After 1990, however, with the abandonment of irrigation, the sunflower expanded greatly (Fig. 4), sometimes exceeding even one million hectares. It seems, however, that the choice of new-old managers is also due to a more favorable market.

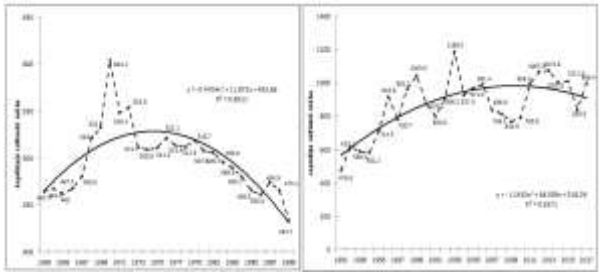

Fig. 4. Sunflower cultivated area in Romania
Source: [9].

Soybean was also a special issue. Considered rather a protein than oleaginous, but dependent on irrigation, it has expanded to an extent alongside irrigation, but also alongside large animal breeding complexes.

Cultivated on insignificant areas before 1970 (it is not even mentioned in the statistical yearbook) it reached over half a million hectares in 1989 (Fig. 5), although the yields per hectare were very small due to unjustifiable technological errors (1,228 kg/ha in 1986 - the highest yield and only 593 kg/ha in 1989, compared to the planned 3,000-3,500 kg/ha).

Table 1. Evolution of areas cultivated with different plant species and their share in Romania's arable land

	1968		1989		2008		2017	
	Area - thousand ha-	Arable share %	Area – thousand ha-	Arable share%	Area- thousand ha-	Arable share %	Area - thousand ha-	Arable share %
CEREAL GRAINS	6,657	67.9	6,027.1	61.2	5210.7	66.2	5,192.3	55.1
- Wheat and rye	2,861	29.2	2,359	23.9	2,123.3	27.3	2,062.7	21.9
- Barley and two-row barley	292	2.9	767.8	7.8	394	5.1	455.5	4.8
- Oat	132	1.3	105.7	1.07	200.4	2.6	165.8	1.8
- Maize	3,344	34.1	2,733.4	27.3	2,441.5	31.3	2,402.1	25.5
- Sorghum	0	0	10.5	***	8	***	14	0.1
- Rice	25	***	49.3	***	9.9	***	9.1	0.1
PULSE + TEXTILES	266	2.7	434.5	4.4	36.7	0.5	119.3	1.3
- Peas	111	1.1	96.9	1	18	0.2	106.6	1.1
- Beans	39	***	197.5	2	18.2	0.2	11.2	0.1
- Flex fibre	34	***	70.1	0.7	0	0	0	0.0
- Hemp	29	***	46.1	0.5	0	0	1.7	0.0
OLEAGINOUS PLANTS	616	6.3	1,070.6	11	1,239.4	15.9	1,766.3	18.7
- Sunflower	520	5.3	433.7	4.4	813.9	10.4	998.4	10.6
- Cole	2	***	19.8	0.2	365	4.7	598	6.3
- Soybean	49	***	512.2	5.2	49.9	0.6	165	1.8
- Flax oil	66	***	78.6	0.8	0	0	2.2	0.0
- Castor-oil plant	22	***	26.3	0.3	0	0	0	0.0
INDUSTRIAL AND MEDICINAL PLANTS	250	2.6	354.1	3.6	37.7	0.4	1,778.3	18.9
- Sugar beet	185	1.9	255.9	2.6	20.4	0.3	28.2	0.3
- Tobacco	36	***	34.4	0.4	1.2	0.02	0.8	0.0
- Chicory	2	***	6.4	0.06	0	0	0	0.0
- Medicinal crops	10	***	41.6	0.4	7.3	0.09	3.2	0.0
POTATOES + VEGETABLES	550	5.6	604.2	6.14	523.9	6.7	392.3	4.2
- Potatoes	316	3.2	351.4	3.6	255.3	3.3	167.4	1.8
- Vegetables	218	2.2	252.8	2.6	268.6	3.4	224.6	2.4
FODDER PLANTS	1,303	13.3	1,149.2	11.7	851.3	10.9	874.7	9.3
- Lucerne	445	4.5	361.4	3.7	321.4	4.1	391.1	4.2
- Clover	195	2.00	126.4	1.3	117.4	1.5	115.9	1.2

Source: [9].

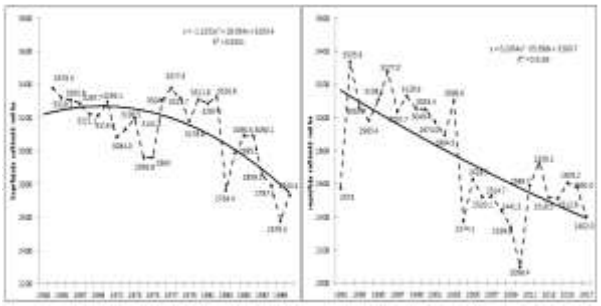

Fig. 5. Soybean cultivated area in Romania
Source: [9].

After 1989, the cultivated areas were drastically reduced (Table 1 and Fig. 5), both due to the reduction of irrigation, but also to the competition of grit imported from countries without GMOs (genetically modified organisms) restrictions.

It seems, however, that the need for the indispensable grit of the animal breeding complexes, as well as the revival of irrigation will be favorable conditions for the expansion of the crop.

Sugar beet. With smaller, but traditional zones of favorability, sugar beet was cultivated even before the '60s, on areas sometimes exceeding 200 thousand ha (Table 1 and Fig. 6).

With high water needs, the trend of cultivated areas has followed that of the extension of irrigation, the cultivated areas reaching over 280 thousand ha.

Introduced in the irrigation systems of the Romanian Plain it did not yield the expected results, but as *the law was the law*, in accordance with the famous *territorial self-supplying program* sugar beet was cultivated in

each county. After 1989, the reduction of irrigation, as well as the preferences of the processors for refining the imported raw sugar, resulted in a tenfold reduction in sugar beet cultivated areas [9].

The future of the crop will be decided by a variety of factors, such as the extension of irrigation, the market and the response of the new managers who will act according to the principles of the market economy, *the profit*.

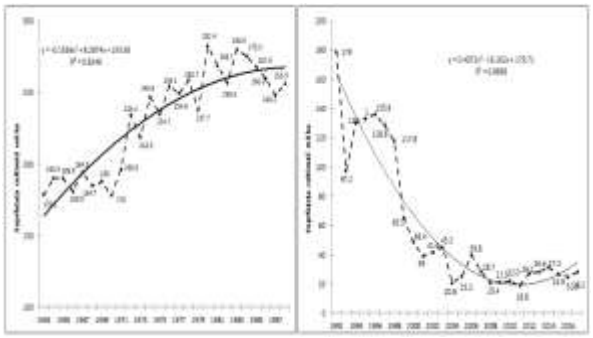

Fig. 6. Sugar beet cultivated area in Romania
Source: [9].

Potato. It is part of the group of perishable but necessary daily food products, which is why self-supply in a country still almost half rural was an unwritten law.

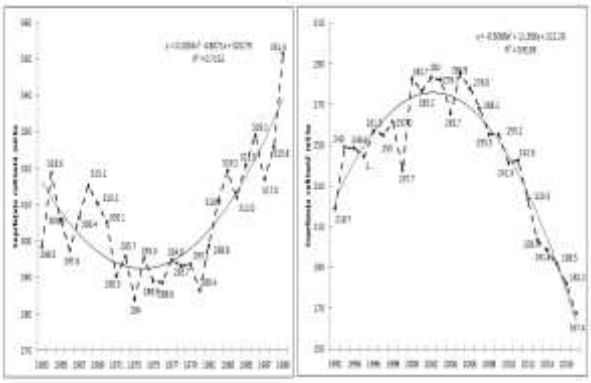

Fig. 7. Potato cultivated area in Romania
Source: [9].

Before 1990 (Fig. 7), with the irrigation, but also with the implementation of the principles of the planned economy, the potato cultivated areas increased even if the yields per hectare were far from the planned parameters and the results of the research in the field, or precisely because of this.

Rice. A somewhat traditional crop in Romania, it came to the attention of specialists especially during the '60s, when rice plantations were arranged on 50,000 ha, of which 42,136 ha in the Danube Floodplain on the occasion of its drainage.

During the last 5 years of the planned agriculture, the rice cultivated areas and the yields per hectare were, as follows:

- 1985 ..... 37,600 ha ..... 3,643 kg/ha
- 1986 ..... 43,200 ha ..... 3,533 kg/ha
- 1987 ..... 44,300 ha ..... 2,586 kg/ha
- 1988 ..... 49,000 ha ..... 2,686 kg/ha
- 1989 ..... 49,300 ha ..... 1,422 kg/ha

In 1992 and 1993, rice was still cultivated on 16,400 ha and, respectively, 12,000 ha in the state's rice plantations in the Danube Floodplain, then the areas cultivated with some variations were reduced to 1,000 ha in 1993 (Fig. 8).

The interest in rice will increase, but the cultivated areas will not exceed 20,000 ha taking into account the average consumption of 4-5 kg / capita.

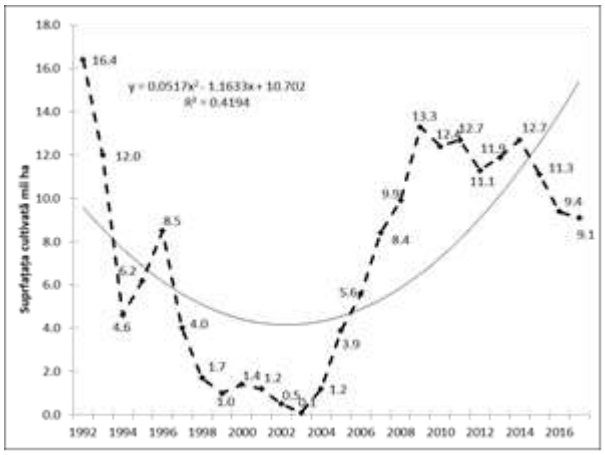

Fig.8. Rice cultivated area in Romania
Source: [9].

CONCLUSIONS

The mutations that occurred in the structure of crops in the arable land was largely influenced by the programs of extension of areas equipped for irrigation, but also by the small yields obtained on the so-called irrigated land.

The dictatorial regime prior to 1990, invested a great deal in irrigation, considering it one of the main factors of agricultural intensification.

The huge investments in projects related to development works, apart from the fact that the simplest solutions were used, and the irrigation systems of immense size remained practically unfinished, were not accompanied by other factors of production, such as fertilizers or pesticides. Moreover, from the research in the

field it turns out that not even watering was done, the energy for pumping water being used for other purposes. This explains why species such as maize have been cultivated in the last decade on smaller areas precisely because of the unsatisfactory results obtained on areas equipped for irrigation, but in an inadequate way.

During the second period, the decision to restrict the areas of some crops is also due to the irrigation practiced on very small surfaces. In the conditions of the market economy, the managers of agricultural enterprises correctly oriented towards crops more resistant to drought, such as sunflower, which in some years exceeded one million cultivated hectares. The biological material created along the way, the favorable market, the orientation towards biofuels were also favorable factors.

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