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IRRIGATION SECTOR IN EUROPEAN UNION: EVOLUTION, CURRENT STATE AND CHARACTERISTICS

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Abstract

The irrigation sector is a major issue in European agriculture considering the potential impact of climate change and increasing demand for food in areas undergoing economic development. The main objective of this paper has taken into account the analysis and description of trends and current status of irrigation in the European Union (EU) regarding a series of technological, economic and social factors. Achieving this goal involved literature review and analysis of databases dedicated to the subject. The data analysis targeted irrigable and irrigated agricultural areas, types of used irrigation and types of irrigated crops. Results of the analysis show a picture of the wide variety of irrigation sector in the EU. The development of this sector must consider the multifunctional role of agriculture in establishing a balance between economic, social and environmental variables in different European regions and countries.

Key words: *climate change, European Union, irrigable agricultural area, irrigated area, irrigation systems*

INTRODUCTION

Agriculture is an important economic sector in Europe thanks to its special contribution to the achievement of food security and employment of a large part of the rural population. According to demographic projections, future population growth is expected to be accompanied by an increase in food demand, with direct effect on water use for irrigation [15]. Water, the most important resource for life has been considered, for several decades, a mainly important issue on the international agenda since many areas of the world suffers from water shortage [1]. Moreover, since water scarcity and droughts have increased due to climate change, it is possible to increase the competition between water use for irrigation and its use in other sectors of the economy [8].

Over the last century, the average temperature in Europe has risen by 0.8^0C and it is expected to increase by 1^0C to 5.5^0 C in 2080 [7]. The negative aspects caused by climate change may significantly influence water management, particularly at regional and farms level [8]. The biggest impact will be seen on the arid and semi-arid Mediterranean region, frequently suffering from lack of water due to the high volume of evaporation and low soil moisture. On the other hand, regions in northern Europe could benefit from a rise in temperature, which could lead to the extension of the growing season [2][12]. Regardless of the possible gains or losses, an agricultural model change from south to north would involve complex processes and structural changes that are needed, increasing production technologies adaptation. Future climate changes could modify the conditions of agricultural production and, therefore, could adversely affect food production as agricultural technologies and practices are not adapted to predict regional impacts of climate change. The severity of climate change for agriculture, however, largely depends on the vulnerability of agricultural activities and technologies, and adaptive capacities of regions and farms [14].

Efforts at a European level over the years to expand irrigated agricultural areas and increase productivity per hectare have been

justified if it takes into account current food crisis and weather-dependence of agricultural production. The current and projected climate change at the European level will adversely affect agricultural production and consequently economic development and the living standards of the population. Irrigation is used to replace losses caused to crops evapo-transpiration and to achieve high yields in the same growing environment [3]. Irrigation can have two main purposes in relation to agricultural production: i) increases the amount of obtained products; ii) improves the quality of production - for example, by preventing damage caused by extreme temperatures; iii) improving the quality of production - for example, preventing damage caused by extreme temperatures, through frost protection of sensitive crops and applying nutrients dissolved in water etc. Irrigated agriculture is largely protected from climate variability by existing hydraulic infrastructure. However, the water needs of agriculture should be viewed in the context of diminishing water availability in regards to environmental issues, population growth, economic development, etc. In conclusion, irrigation water management must be interrelated, not only with traditional management of water resources, but also with food production, rural development and with natural resource management [6].

MATERIALS AND METHODS

This paper examines the trend and the current model of irrigation in the Member States and the European Union in order to provide a clear and comprehensive picture of its relevant characteristics useful for both policy makers and the academia. Bearing in mind the context described above, we can consider irrigation as vital to the sustainable development of rural areas both as a tool to mitigate climate risks and to obtain high agricultural production for insuring food security of the European population. This paper used both bibliographical and statistical material. Methods that have been used are specific to economic research - analysis and synthesis. Analyzed statistical data covered the period 1961- 2013 and came from international databases (Eurostat and Faostat).

RESULTS AND DISCUSSIONS

Irrigation facilities play an important role in the development of agricultural activities. The use of irrigation to increase agricultural production is a real necessity, in the context of the deep changes of the climate regime, revealed in recent years in Europe. Between Member States of the EU, there are wide variations in terms of irrigation need and implicitly the irrigable agricultural areas. Thus, there are several groups with different needs of irrigation: (i) the first group is comprised of countries in which the acquisition of high yields is dependent on irrigation. They are located in arid and semi-arid areas of southern Europe (e.g. Greece, Spain, Italy, Cyprus, and Portugal); (ii) countries where irrigation is necessary to complete the moisture deficit, which varies annually and is insufficient for productive agriculture (e.g. France, Romania, England, Germany, Holland, Belgium, Austria, Hungary). In these countries, the development of irrigation sector is trending upward aiming to reduce risk and increase yields in certain crops sensitive to drought; iii) countries where irrigation is considered a marginal factor of production, used only in certain areas and for special crops (e.g. Sweden, Finland, Ireland) [4]. Country groups can note this variation in the evolution of irrigable agricultural areas, in the period 1961 - 2011 (Figure 1).

The enlargement of irrigated areas in several European countries group, at least in the first part of the analyzed period, was influenced by agricultural policies that supported construction of irrigation infrastructure and subsidies for farmers to purchase equipment and to ensure low water prices for agriculture. The importance of socio-economic development of irrigated agriculture is considerable in southern Europe. Here are found the largest areas equipped for irrigation associated with a large number of very small farms. In this case, the availability of irrigation is critical for the viability of these farms. Regarding the countries of Eastern

Europe, since 1961 we can notice an increasing trend of irrigable agricultural areas that nearly overlaps with that of western European countries until the 1990s.

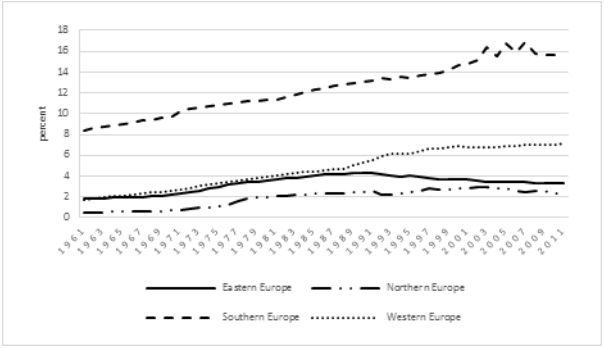

Fig. 1. Evolution of irrigable agricultural areas by European countries groups, 1961 to 2011
Source: authors' processing by Faostat; data extracted June 2015

For example, in Romania, starting with the 1960s, the trend was to fit larger and larger surfaces, so that in 1990 the irrigable area had 3.1 millions hectares (third place in Europe after Spain and Italy) [9]. After the collapse of communist economies their trend downward while the Western Europe maintained its upward trend.

In 2010, the total irrigable area in EU-28 was about 14.6 million hectares (8.4% of utilized agricultural area) of which about 10 million hectares (68.5%) were irrigated. The irrigable and irrigated agricultural area varies greatly within the EU Member States (Table 1).

In terms of area, the importance of irrigation is relatively insignificant in Ireland and Finland, modest in Sweden, Luxembourg and Denmark, growing regional importance in the UK, Belgium, Netherlands, Germany, Austria and France, and nationally significant in Portugal, Spain, Italy and Greece. Therefore, the southern European countries hold the largest irrigable areas both in absolute terms (3.7 million hectares in Italy, 3.6 million hectares in Spain) and as a share of total utilized agricultural area (UAA) (37.3% in Greece, 34.0% in Cyprus, 29.1% in Italy and 27.5% in Malta). The share of irrigated area in the UAA in 2010 also recorded significant values: 29.5% in Greece, 24.7% in Malta, 23.9% in Cyprus, 18.7% in Italy and 12.7% in Portugal.

The main purpose of agricultural irrigation in the wet climate areas is to compensate precipitation deficits during the vegetation period with artificial water supplies [10]. Groups of Central and Western countries, which use irrigation in complementarity to increase crop production in unfavorable weather conditions, recorded low values of irrigable and irrigated areas. The exceptions are Denmark and the Netherlands, which although holding 26.0% and 18.2% of irrigable area and 7.3% and 12.1% of irrigated areas (from UAA).

Irrigable area, considered the area equipped for irrigation, does not vary widely from year to year because the improvement of the new areas claim high costs. The exceptions are the Netherlands, Cyprus and Malta whose irrigated area increased in 2003-2010 by more than 4%, Romania, and Slovakia that have recorded in the same period a decrease of more than 4%. Irrigated area, considered area irrigated at least once a year, has however significant variations from year to year because for example of weather conditions or crop structure.

In Europe, the traditional method of irrigation is gravity - feed systems (surface water is transported through channels). In the EU-28, 37% of all farms apply this method of irrigation (Figure 2). Above the EU' average stands Bulgaria 93.7%, Portugal 62.5%, Slovakia 41.5%, Romania 39.3%, Spain 37.6% and Lithuania 37.6%. Drip irrigation holds second place in the EU - 28 with a percentage of 33.2%. Farms located in Southern part of EU practice this method, on top being Cyprus and Malta (above 50%). Drip irrigation systems are more efficient in water use, but they are often too expensive to be used by small farmers. Sprinkler irrigation is practiced by 29.8% of all EU-28 farms. The highest number of farms practicing this method of irrigation (75% of total) is located in Denmark, Netherlands, Germany, Finland, Sweden and England. Sprinkler and drip irrigation consume less water than surface irrigation.

Table 1. Evolution of irrigable and irrigated areas in the Member States of EU, 2003-2010

Country	2003				2010			
	Total irrigable area		Area irrigated at least once a year		Total irrigable area		Area irrigated at least once a year	
	(ha)	(% of UAA)	(ha)	(% of UAA)	(ha)	(% of UAA)	(ha)	(% of UAA)
EU-28	:	:	:	:	14, 635, 330	8.4%	9,998,810	5.8%
EU-27	16,443,280	9.5%	11,067,910	6.4%	14,612,060	8.5%	9,984,330	5.8%
BE	21,810	1.6%	1,850	0.1%	13,560	1.0%	4,260	0.3%
BG	124,480	4.3%	79,370	2.7%	137,510	3.8%	90,400	2.5%
CZ	49,090	1.4%	16,860	0.5%	32,230	0.9%	19,200	0.6%
DK	448,820	16.9%	201,480	7.6%	480,440	18.2%	320,180	12.1%
DE (1)	:	:	:	:	639,030	3.8%	372,750	2.2%
EE (1)	:	:	:	:	460	0.0%	330	0.0%
IE	0	0.0%	0	0.0%	0	0.0%	0	0.0%
EL	1,521,600	38.3%	1,294,400	32.6%	1,297,260	37.3%	1,025,210	29.5%
ES	3,828,110	15.2%	3,437,370	13.7%	3,587,770	15.1%	3,044,710	12.8%
FR	2,723,700	9.8%	1,938,730	7.0%	2,341,200	8.4%	1,583,610	5.7%
HR					23,270	1.8%	14,480	1.1%
IT	3,977,210	30.3%	2,732,730	20.8%	3,734,850	29.1%	2,408,350	18.7%
CY	44,930	28.7%	35,410	22.6%	40,310	34.0%	28,290	23.9%
LV	1,150	0.1%	0	0.0%	1,140	0.1%	710	0.0%
LT	740	0.0%	:	:	2,520	0.1%	1,530	0.1%
LU	0	0.0%	0	0.0%	:	:	:	:
HU	242,170	5.6%	148,690	3.4%	235,750	5.0%	114,550	2.4%
MT	2,300	21.3%	2,130	19.7%	3,150	27.5%	2,830	24.7%
NL	350,570	17.5%	62,190	3.1%	486,010	26.0%	137,310	7.3%
AT	90,420	2.8%	34,230	1.1%	91,970	3.2%	26,480	0.9%
PL	98,420	0.7%	46,910	0.3%	85,200	0.6%	45,530	0.3%
PT	674,800	18.1%	248,040	6.7%	540,880	14.7%	466,330	12.7%
RO	1,510,820	10.8%	400,520	2.9%	418,720	3.1%	133,460	1.0%
SI	1,880	0.4%	1,880	0.4%	5,210	1.1%	1,260	0.3%
SK	209,070	9.8%	104,560	4.9%	108,990	5.7%	14,840	0.8%
FI	103,800	4.6%	0	0.0%	68,560	3.0%	12,610	0.6%
SE	188,460	6.0%	53,440	1.7%	164,230	5.4%	63,250	2.1%
UK	228,930	1.4%	227,120	1.4%	95,110	0.6%	66,350	0.4%

Source: own calculations based on NIS data
Note: [1] – variable calculated with the formula: X=100*(xi/Xi)/(pi/Pi); [2] – variable calculated with the formula: X=xi/Xi*100

For drip irrigation, equipment is more expensive than other irrigation methods and therefore, this system tends to be concentrated in areas of high economic value crops.

The drop irrigation is one of the newest methods of irrigation. It has the advantage of administration of strict water in the root system in this way it avoid the degradation of the soil structure. Thereby, the maintenance works are not disturbed and the soil can be maintained at a constant level of optimal humidity [11].

Therefore, adopting the most efficient methods of using water tend to focus regions where farms are relatively large and cultivate crops of high economic value. The Institute for European Environmental Policy distinguishes four categories of crops by level of intensity, namely: extensive, semi-intensive, intensive and saturated [4].

Southern countries - Cyprus, Greece, Malta, Italy, Portugal, and Spain irrigate particularly intensive crops with high economic value, such as potato and sugar beet. Moreover, both grain corn areas and green corn areas are irrigated (over 75%) in all countries located in southern Europe - Greece, Portugal and Spain. Cereals (without maize and rice) are irrigated to a lesser extent: only Denmark and Spain have just over 10% occupied areas with irrigated cereals (Figure 3).

Crops with high economic value offer farmers the opportunity to achieve both revenue growth and an increase in stability farm. It is believed that expanding areas under this group of crops would represent a development opportunity for poor rural communities [5].

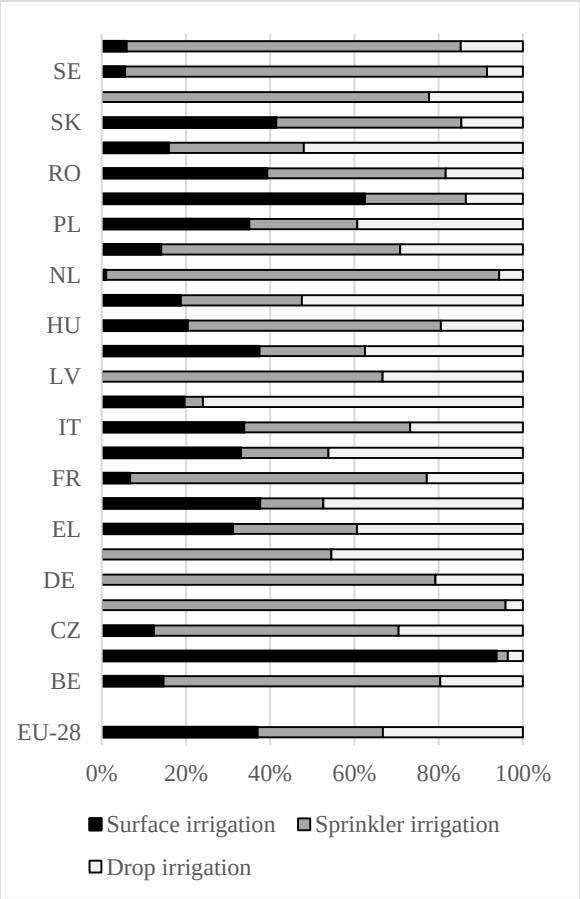

Fig. 2.Share of holdings applying different irrigation methods, EU-28, 2010, (%)
Source: Eurostat; data extracted May 2015

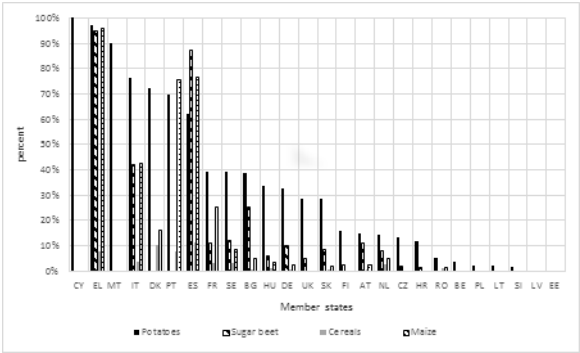

Fig.3. Share of irrigated area with intensive (potatoes and sugar beet) and semi-intensive crops (cereals and maize) in total crop area, in EU-28, 2010, (%)
Source: Eurostat; data extracted May 2015

These crops could help small farms to reduce their dependence, in particular by cereals, and facilitate their transition from subsistence to market-oriented agriculture [13].

CONCLUSIONS

The analysis of the EU' irrigation sector shows a clear trend of increasing the irrigated area in the southern and western Europe in the past 50 years, In Eastern countries, there are an increasing trend up to 1990 followed by a downward trend that has as main cause the collapse of communist regimes with associated social and economic transformations. Between 1961 -2011, in the EU the irrigated area increased significantly. In arid and semi-arid regions of the EU' irrigation allows agricultural production in areas where water is a limiting factor. In many wet and temperate zones, irrigation provides water for adjusting the local amount and seasonal availability to suit agricultural needs. Therefore, it reduces the risks that can arise unexpectedly and damage crops. Agricultural policy should support European agriculture adapting to climate change by encouraging flexible crop irrigation. In this regard, it is necessary to consider the multifunctional role of agriculture in establishing a balance between economic, social and environmental variables in different European regions and countries.

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