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Renewable energy and the conundrum of the Romanian irrigation system

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Water, energy and food are inextricably linked. Therefore, a measure which affects one of these areas will inevitably have an impact on one or both of the remaining two.[1]

The water-energy-food nexus has become a familiar a concept, on which numerous important studies and analyses gave become available, especially in the last five to ten years. Some of the most relevant papers were produced by important associations and institutions, such as the World Energy Council (WEC), the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA) and, of course, the Food and Agriculture Organization of the United Nations (FAO). Most of these studies focus on the development of emerging economies and address the vulnerable populations typically located in African states. For this reason, such papers are often ignored in the usual literature of the energy industry. This is an unfortunate shortcoming.

Irrigation in Europe

Some say statistics lie and this is sometimes true. However, oftentimes statistical figures are so striking that underlying facts become obvious. At the European level, the irrigation systems differ a lot by technology, but also in terms of irrigable and irrigated areas. According to 2013 data provided by Eurostat, there are important discrepancies between member states[2]:

Country	Utilized Agricultural Area (UAA)	Total irrigable area		Area irrigated at least once a year	
	(1000 ha)	(1000 ha)	(% of UAA)	(1000 ha)	(% of UAA)
EU-28	**165,647.4**	**18,669.9**	**11.3%**	**10,235.3**	**6.18%**
EU-27	**164,355.1**	**18,644.0**	**11.3%**	**10,221.9**	**6.22%**
Belgium	1,307.9	19.2	1.5%	5.7	0.44%
Bulgaria	3,794.9	115.5	3.0%	98.7	2.60%
Czech Republic	3,491.5	34.1	1.0%	17.8	0.51%
Denmark	2,619.3	439.0	16.8%	242.0	9.24%
Germany	16,699.6	691.3	4.1%	365.6	2.19%
Estonia	957.5	0.4	0.0%	0.3	0.03%
Ireland	4,536.4	0.0	0.0%	0.0	0.00%
Greece	3,381.5	1,516.9	44.9%	1,164.6	34.44%
Spain	21,694.9	6,751.7	31.1%	2,899.0	13.36%
France	27,064.3	2,811.4	10.4%	1,423.6	5.26%
Croatia	1,292.3	25.9	2.0%	13.4	1.04%
Italy	11,813.6	4,004.5	33.9%	2,866.3	24.26%
Cyprus	109.0	38.1	34.9%	24.7	22.62%
Latvia	1,877.7	0.6	0.0%	0.4	0.02%
Lithuania	2,861.3	4.1	0.1%	1.6	0.06%
Hungary	4,589.3	259.0	5.6%	141.2	3.08%
Malta	10.9	4.2	38.6%	3.7	33.64%
Netherlands	1,847.6	499.4	27.0%	101.8	5.51%
Austria	2,524.8	119.8	4.7%	51.7	2.05%
Poland	14,409.9	75.8	0.5%	45.6	0.32%
Portugal	3,539.4	551.8	15.6%	477.2	13.48%
Romania	**11,509.3**	**230.4**	**2.0%**	**152.8**	**1.33%**
Slovenia	462.8	4.3	0.9%	2.5	0.55%
Slovakia	1,901.6	99.6	5.2%	24.6	1.29%
Finland	2,282.4	102.1	4.5%	9.5	0.42%
Sweden	3,035.9	155.5	5.1%	51.9	1.71%
UK	15,900.9	115.4	0.7%	49.1	0.31%

[1] http://www.unwater.org/topics/water-food-and-energy-nexus/en/

[2] http://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_irrigation

Although it is difficult to compare different states' figures, since some of them benefit from natural advantageous conditions (agricultural areas, water resources, lower elevation of the fields etc.), similar countries can be compared so as to allow for some important conclusions. It must be said from the onset that the present article does not focus on agriculture. But in order to assess the potential of irrigation systems in the energy sector, we must understand what Romania's actual resources are.

Europe's average of total irrigable area is around 11.3% of the utilized agricultural area (UAA), while the area actually irrigated at least once a year is somewhere around 6.2% of the UAA. Romania's case is a bitter one, considering the evolution of the irrigated land. In 2003, 10 years before the figures presented in the above table, Romania had a smaller available land for agriculture (11,445,800 ha) and a share of the total irrigable area of 13.2%. At that time, approximately 3.5% of Romania's UAA was irrigated at least once a year. Ten years later, the total irrigable area decreased dramatically, at 2% of the UAA, while the land irrigated at least once a year accounts now for 1.33%.[3]

Romania has currently one of the lowest shares of irrigable areas in Europe, despite the fact that the country's hydrologic capacity and climate conditions give are favorable. Even though Romania's UAA accounts for almost 7% of the total UAA in Europe, we can irrigate only 1.23% of Europe's irrigable areas.

In 1987 Romania had a 30% share of irrigable area, with developed irrigation systems being exploited during the communist period.[4] At that time, efficiency standards and intensive energy consumers were not issues that concerned the authorities. It can be argued, though, that after the fall of the communist system, the high costs of electricity (in conjunction with the low energy efficiency irrigation systems) have become unaffordable by individual owners, this being the reason why most of them were dismantled.

An energy perspective on irrigation

As previously stated, this analysis neither addresses the agricultural aspect of the irrigation systems, nor does it attempt to dispute issues related to crop types, seasonality of cultures etc. However, from an energy standpoint, irrigations pose lots of interesting challenges. In Romania, most specialists admit that irrigations can bolster the energy industry and provide additional work for marginal energy producers, with measurable advantages to the economy as a whole. I only agree with the second part of the statement.

Assuming Romania invests in irrigation systems in order to reach at least the European average of 11.3% irrigable area in total UAA, then irrigation systems will have to be developed on additional 1,066,800 ha. Assuming that all of such systems will be developed in areas where the access to the electricity grid is not an issue, and that an usual irrigation system consumes approximately 37 KWh for a full water of 1 ha of crops, then some high-end estimation can be made.

Depending on the crop, level of precipitations and weather conditions, the number of times an area must be watered every season can range from 2 to 25-30 times.[5][6] For this analysis, let us assume a number of 10 irrigation processes per year (a 5-month season). Such assumptions lead to an

[3] http://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_irrigation
[4] http://www.stiri-economice.ro/Agricultura+Romaniei+1965+1989.html

[5] http://agrointel.ro/6659/fermierii-vor-sisteme-individuale-de-irigatii-eficiente-nu-unele-mamut-energofage/
[6] http://www.rainteq.ro/amortizarea-investitiei.html

additional energy consumption of 0.39 TWh per year, which is less than 1% of the total energy demand of Romania in 2015.

Assuming a 12-hour irrigation process in a 5-month agricultural season leads to an average hourly consumption of about 220 MWh. Given that most of the watering needs to be done during day time, a good part of the electricity surplus will likely have to be generated by coal-based producers.

Assuming that the demand for irrigated agricultural lands involves coal-based power plants, for every MWh supplied from the grid, an additional 2,600 liters of water will be used to produce it.[7] By adding this amount to the actual water resources needed to water the crops, we can understand the importance of the equilibrium between the two parameters: water and energy. Moreover, assuming that the total electricity needed for the irrigation systems in a year is 0.39 TWh, then coal-based power producer will generate at least an additional 356.850 tons of CO_2.[8]

Solar dripping irrigation systems

Thankfully, a solution to the above challenge has been found. More and more emerging countries are using dripping irrigation systems, a type of mechanism that directs water for the crops using a gravitational mechanism. Such water usage is much more resource-efficient. Sure, the water pump needs more or less the same electricity in order to work. But technology has evolved so that solar dripping irrigation systems are “the next big thing” in agriculture.

The energy-food-water nexus is also addressed through this solution. For a solar panel of 0.25 KW with a surface of 1.654 m², it takes about 1057.14 panels to water 1 ha (assuming electricity demand constant, at 37 KWh). These 1057,14 solar panels take up 1748 m², which comes to 17.48% of a hectare. Therefore, trying to save water by focusing the water stream and using renewable energy sources to pump the water may solve two parts of the problems. Nonetheless, it entails a reduction of 17.48% of the usable area, hence less food potential. For current circumstances, though, this sounds like a very reasonable trade-off.

Instead of conclusion

Irrigation systems are not the miracle solution to drive electricity demand in a healthy and sustainable manner. Yet by focusing on the energy side in the water-energy-food nexus, it emerges that a smart approach would be the mix of clean energy production and efficient use of water resources.

Moreover, although it is not properly acknowledged as a significant issue at the moment in our part of the world, the efficient use of agricultural land is an issue we will increasingly face in the years to come.

To prepare for the future you need to shape it.

[7] http://www.greenpeace.org/international/en/news/Blogs/makingwaves/World-Water-Day-NoWater4Coal/blog/52380/

[8] http://www.agerpres.ro/destinatie-romania/2014/04/15/destinatie-romania-gorj-complexul-energetic-oltenia-cel-mai-mare-producator-de-energie-pe-baza-de-carbune-din-tara-10-59-11