

THE NECESSITY OF IRRIGATING CROPS IN THE WESTERN ROMANIA

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Abstract. *The necessity of crop irrigation in Western Romania is intimately linked to the region's agricultural sustainability. Varying topography and soil characteristics across this area demand tailored irrigation approaches to meet the diverse needs of different crops. Efficient water distribution systems, coupled with soil moisture management techniques, play a pivotal role in optimizing irrigation effectiveness. The imperative for irrigation intensifies during periods of prolonged drought, where the reliability of rainfall becomes uncertain, affecting crop growth and yield potential. Moreover, acknowledging the necessity of crop irrigation in Western Romania prompts the exploration of water-saving methodologies, emphasizing the importance of conservation and recycling practices. In this article, the water deficit of the last 10 years was analysed in the conditions of Timisoara. It was observed that the plants' water needs are not covered by the rainfall. In these conditions, it is necessary to supplement the water through irrigation systems. Recognizing the necessity of irrigation for crops in Western Romania is not solely an agricultural concern but also a pivotal factor in ensuring regional food security and economic stability. As climate change impacts continue to pose challenges, investing in irrigation infrastructure and sustainable water management becomes indispensable for preserving agricultural livelihoods and securing food production in this vital region.*

Keywords: *irrigation, water supply, the water requirement of the plants, agricultural production, food security*

INTRODUCTION

The agricultural landscape of Western Romania stands as a testament to the delicate interplay between nature's unpredictability and the imperative need for sustained and efficient crop production. Nestled within this region lies an agricultural sector deeply intertwined with the ebb and flow of climatic conditions, where the capriciousness of rainfall patterns often presents formidable challenges to crop cultivation. Amidst this environment of climatic variability and sporadic precipitation, the imperative of irrigation emerges as a crucial linchpin for agricultural sustenance and productivity (GARCIA ET ALL, 2018, MORENO-PÉREZ ET ALL. 2013).

Western Romania, endowed with diverse topographies and varying soil compositions, experiences a climatic tapestry characterized by irregular rainfall and intermittent droughts. These climatic fluctuations pose significant hurdles to the agricultural community, threatening the consistency and reliability of water supply vital for crop growth. In these arid and semi-arid landscapes, nature's rainfall alone becomes insufficient and inconsistent, failing to fulfill the water requirements essential for optimal crop development and yield attainment (SMULEAC ET ALL., 2020).

The agricultural expanse of Western Romania, a vital hub for cultivating a range of crops, grapples with the unrelenting challenges posed by nature's unpredictability. The necessity of irrigating crops in this region transcends mere agricultural requisites; it symbolizes a fundamental necessity for securing the sustenance of communities, fostering economic stability, and sustaining regional development (SMITH ET ALL., 2021).

Against this backdrop of climatic exigencies and agricultural dependencies, the necessity of irrigation stands resolute as the cornerstone of stability in an otherwise capricious environment. It represents an embodiment of resilience against nature's whims, offering a lifeline to farmers striving to nurture their crops amidst climatic uncertainties. The imperative

of irrigation in Western Romania becomes an emblem of agricultural fortitude, enabling the cultivation of crops vital for sustenance, trade, and regional economic growth (ROLDÁN-CANAS ET ALL., 2021).

Navigating the intricacies of water scarcity and irregular rainfall patterns, the necessity of irrigating crops in Western Romania becomes a narrative of resilience, resourcefulness, and agricultural ingenuity. It speaks of a symbiotic relationship between human intervention and nature's unpredictability, where efficient irrigation practices transcend challenges, ensuring a consistent and reliable water supply essential for sustaining crop growth and livelihoods (EU, 2023, FAO 2019).

In essence, within the undulating landscapes of Western Romania, the imperative of irrigation becomes a narrative etched with perseverance, as farmers harness technology, innovation, and resource management to navigate the terrain of climatic variability. This multifaceted necessity unfolds as a pivotal factor in ensuring agricultural sustainability, safeguarding food production, and fostering resilience in the face of nature's relentless fluctuations.

MATERIAL AND METHODS

Conducting field surveys and observations across various agricultural regions in Western Romania to assess the impact of irregular rainfall on crop growth and yield. Observing soil moisture levels, crop health, and growth patterns could provide valuable insights into the necessity of irrigation.

One method used is gathering historical climate data, including rainfall patterns, temperature fluctuations, and evaporation rates in the region. Analysing this data over an extended period could elucidate the extent of water scarcity and the frequency of droughts, emphasizing the need for irrigation. In order to determine the climatic conditions, the amounts of precipitation that fell in the last 10 years in Timisoara, as well as the temperatures recorded during an agricultural year, were analyzed. The water consumption of the plants was calculated with the Thornthwaite method, which determines the potential evapotranspiration.

The Ministry of Agriculture and Rural Development (MADR) developed the National Rehabilitation and/or Establishment Program of the main irrigation infrastructure and the drainage and drainage infrastructure (hereinafter referred to as the Program) which aims at adapting agriculture to climate changes and reducing their effects on production agricultural, mainly, but also on other environmental factors and the population, through the rehabilitation and/or establishment the main irrigation infrastructure and the existing drying and drainage infrastructure. The old irrigation facilities generate a high consumption of water and energy, which has a negative impact on the water reserves of Romania, a country included in the category of countries with low water reserves. The irrigation facilities are in an advanced stage of degradation and on 75% of the surface of these facilities, the irrigation systems are not functional, and the functional ones are inefficient from the point of view of water and energy consumption and expensive for farmers.

By employing a combination of these research methods, a comprehensive understanding of the necessity of irrigating crops in Western Romania can be developed, considering factors such as climate variability, agricultural productivity, water availability, and socio-economic implications.

RESULTS AND DISCUSSIONS

According to the National Agency for Land Improvement (ANIF), for the year 2023, the area prepared in Timis County for irrigation was 4,190 ha. The length of the filled irrigation canals was 60 km, and the irrigated crops were: wheat, corn, hazelnut, soybean, sorghum and sunflower.

From the total area prepared for irrigation, 3,600 ha were in Arrangement 1 Aranca, and 590 ha in Arrangement Checea Jimbolia.

In Arad County, the area contracted for irrigation in 2023 was 8,039 ha, of which 7,271 ha in the Smlac Pereg Arrangement, and 768 in the Paulis Horia Arrangement.

The Western region of Romania contends with climatic challenges characterized by erratic rainfall patterns and periods of intermittent drought. These unpredictable weather conditions pose a substantial threat to agricultural activities, often resulting in water scarcity that significantly impacts crop cultivation. Insufficient and irregular rainfall, especially during crucial growth phases, can severely hinder the development of crops, leading to diminished yields and compromised quality.

The evolution of the rainfall in Timisoara in the last 10 years, over the period of one agricultural year, was analyzed and is presented in figure 1. It is observed that the smallest amounts of water are in the summer months, when the plants' water consumption is high.

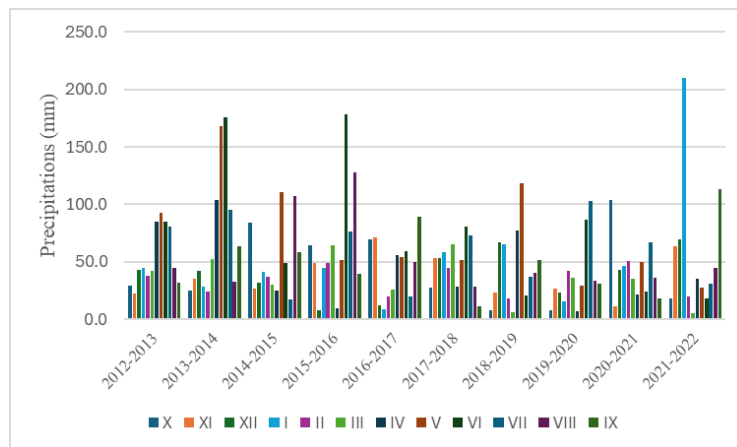


Figure 1. The evolution of precipitations at Timisoara

In such climatic conditions, the reliance on natural rainfall alone becomes insufficient to meet the water needs of crops, making irrigation an essential intervention. As it can be seen in figure 2, the amount of water required by the plants exceeds the amount of precipitations. As can be seen in figure 3, the amounts of precipitation falling in the period 2012-2022 do not cover the water needs of the plants in this period. Irrigation serves as a vital solution to counterbalance the deficiencies in natural precipitation. By providing a supplementary water source, irrigation systems ensure a consistent and reliable supply of water to cultivated lands. This consistent water availability becomes a lifeline for crops, especially during dry spells, enabling farmers to sustain optimal soil moisture levels necessary for healthy plant growth and development.

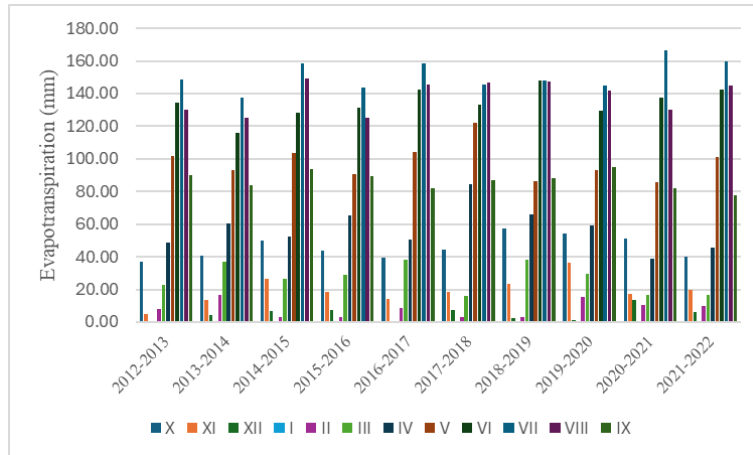


Figure 2. Evapotranspiration calculated for Timisoara conditions

Moreover, irrigation not only mitigates the adverse effects of water scarcity but also acts as a strategic tool to manage crop water requirements efficiently. It allows for precise control over the timing and quantity of water application, ensuring that crops receive the necessary hydration precisely when they need it most. This proactive approach minimizes the risk of moisture stress, enhancing the resilience of crops against the vagaries of unpredictable weather patterns.

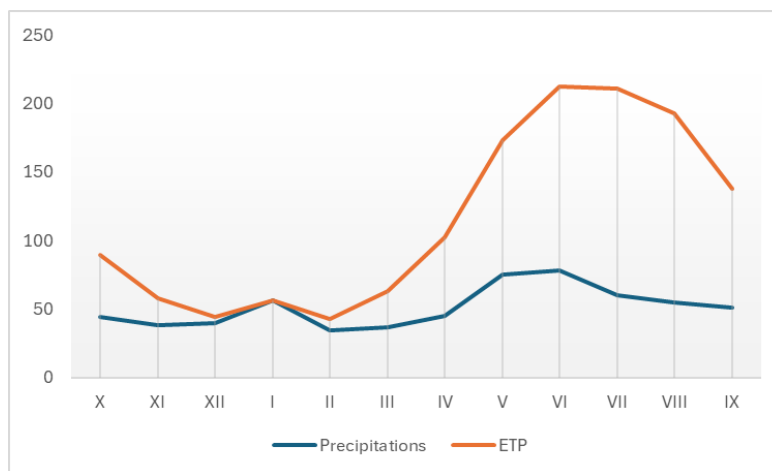


Figure 3. The water deficit (mm) analysed in the conditions of Timisoara (2012-2022)

Ultimately, in a region prone to irregular rainfall and intermittent droughts, the strategic use of irrigation emerges as a fundamental strategy to safeguard agricultural productivity. By compensating for inadequate natural rainfall and ensuring a consistent water supply, irrigation becomes indispensable for maintaining crop growth, preserving yields, and securing the livelihoods of farmers in the Western region of Romania.

Irrigation stands as a cornerstone practice in agriculture, pivotal for sustaining optimal soil moisture levels essential for robust and healthy plant development. By delivering a

consistent and controlled water supply directly to cultivated fields, irrigation becomes the bedrock upon which healthy crop growth thrives.

One of its paramount roles lies in nurturing crops through critical growth stages. During pivotal phases such as germination, flowering, and fruit development, plants require precise and consistent moisture levels to thrive. Irrigation ensures this essential moisture is available when nature's rainfall falls short or becomes irregular. This proactive approach mitigates the adverse effects of moisture stress, thereby shielding crops from the detrimental impact of erratic precipitation patterns.

Moreover, by providing a dependable water source throughout the growing season, irrigation helps buffer the fluctuations in moisture supply caused by unreliable rainfall. In doing so, it significantly reduces the susceptibility of crops to yield variations attributed to unpredictable weather conditions. This stability in water availability fosters a conducive environment for consistent plant growth, optimizing the potential for robust yields regardless of the vagaries of weather patterns.

Furthermore, the controlled application of water through irrigation systems offers farmers greater precision and flexibility in managing crop water requirements. It enables the fine-tuning of irrigation schedules, ensuring that plants receive the necessary hydration precisely when and where it is most beneficial. This targeted approach minimizes water stress, allowing crops to flourish and reach their full potential, ultimately contributing to more stable and predictable agricultural output.

In essence, irrigation's pivotal role in maintaining optimal soil moisture levels is indispensable for fostering healthy plant growth. By providing consistent and reliable water access, especially during critical growth stages, irrigation becomes the linchpin in reducing the vulnerability of crops to the detrimental effects of erratic rainfall, thereby contributing significantly to stable and enhanced agricultural productivity.

Improving Food Security

The integration of irrigation systems in agriculture significantly bolsters the reliability and stability of water supply, fostering a robust framework for crop cultivation. This steadfast and consistent water accessibility plays a pivotal role in enhancing crop yields and fortifying the region's food production system, thereby amplifying food security in substantial ways.

Firstly, irrigation systems offer a dependable and regulated water supply essential for sustaining crop growth throughout the seasons. By mitigating the reliance solely on erratic rainfall, irrigation provides a consistent source of moisture critical for plant health. This reliability ensures that crops receive the necessary hydration, allowing them to flourish even during periods of insufficient or irregular precipitation.

The steady water supply facilitated by irrigation systems empowers farmers to optimize agricultural practices, enabling them to cultivate crops more efficiently and effectively. It facilitates the adoption of more diverse and intensive farming practices, allowing for multiple cropping cycles or the cultivation of water-sensitive crops that would otherwise be unviable in rain-fed conditions. Consequently, this leads to increased agricultural productivity and expanded crop yields, thereby augmenting the overall food production capacity of the region.

Furthermore, the dependable water supply afforded by irrigation systems plays a pivotal role in stabilizing food production. It minimizes the risks associated with weather-related uncertainties and seasonal variations, contributing to a more predictable and consistent output. This reliability in crop yields ensures a more secure and steady food supply, reducing vulnerability to fluctuations in weather patterns and other external factors that might otherwise compromise food availability.

Ultimately, by ensuring a reliable and consistent water supply, irrigation stands as a linchpin in bolstering agricultural productivity, amplifying crop yields, and fortifying the region's food production system. This steadfast contribution significantly enhances food security, assuring a more stable and sustained provision of food for the populace, thus underlining the critical role of irrigation in securing the region's nutritional needs.

Agriculture holds a paramount position within the economic landscape of Western Romania, serving as a vital sector that sustains livelihoods and drives regional development. The region's agricultural activities encompass a diverse range of crops and farming practices, contributing substantially to the local economy.

Efficient irrigation practices play a pivotal role in fortifying the agricultural output of Western Romania. By ensuring consistent water availability, irrigation systems enable farmers to optimize crop cultivation, maximize yields, and diversify agricultural production. This heightened productivity not only ensures a steady supply of quality produce but also enhances the region's competitive edge in domestic and international markets.

Moreover, the adoption of efficient irrigation techniques leads to economic stability for farmers. Consistent and reliable crop yields resulting from well-managed irrigation systems provide a stable income source for agricultural practitioners. The minimized risk of yield fluctuations due to water scarcity or irregular rainfall patterns serves as a buffer against income instability, offering financial security to farmers in the region.

Additionally, the agricultural sector's growth stimulated by efficient irrigation practices contributes significantly to the overall regional economy. Increased agricultural output translates into higher revenue streams, job creation, and increased trade opportunities. This, in turn, fuels economic growth, stimulates ancillary industries such as agribusiness, transportation, and food processing, and fosters a more robust and diversified regional economy.

Furthermore, a thriving agricultural sector supported by efficient irrigation practices bolsters rural development. It helps in sustaining rural communities, preserves traditional farming practices, and encourages innovation and investment in the agricultural sector. This, in turn, contributes to the overall socio-economic development of the Western region of Romania.

In essence, the implementation of efficient irrigation practices in agriculture serves as a catalyst for bolstering agricultural output, ensuring economic stability for farmers, and augmenting the regional economy. It not only secures livelihoods but also drives economic growth, positioning agriculture as a key contributor to the prosperity and sustainability of the Western Romanian region.

Implementing appropriate irrigation methods, complemented by effective water management strategies, constitutes a cornerstone of sustainable agricultural practices. These practices play a pivotal role in promoting environmental stewardship and ensuring the long-term viability of farming systems in various ways.

Foremost, employing precise irrigation techniques and water management practices allows for the conservation of water resources. By optimizing the use of water through targeted irrigation, minimizing runoff, and employing technologies such as drip irrigation or precision watering systems, farmers can maximize the efficiency of water application. This approach mitigates water wastage and ensures that water is used judiciously, thereby conserving this precious resource for future agricultural needs.

Additionally, efficient irrigation practices contribute significantly to minimizing soil degradation. Proper water management helps prevent soil erosion, salinization, and nutrient leaching, all of which can degrade soil quality over time. Conserving soil moisture through

strategic irrigation methods assists in maintaining soil structure, fertility, and overall health, fostering a conducive environment for healthy crop growth.

Furthermore, adopting sustainable irrigation practices aids in reducing the environmental footprint of farming activities. By minimizing excessive water usage, runoff laden with fertilizers or pesticides, and soil erosion caused by inefficient irrigation, the overall environmental impact of agriculture is lessened. This proactive approach promotes a more harmonious relationship between farming and the environment, preserving natural resources and biodiversity.

Moreover, sustainable irrigation practices align with broader environmental conservation efforts. They support initiatives aimed at reducing greenhouse gas emissions, improving water quality, and protecting ecosystems. These practices contribute to the overall resilience of agricultural systems in the face of climate change, ensuring their ability to adapt and endure in the long run.

In summary, implementing proper irrigation methods and efficient water management practices is instrumental in promoting sustainable agriculture. By conserving water resources, preventing soil degradation, and reducing the environmental impact of farming, these practices contribute significantly to the resilience and sustainability of agricultural systems, ensuring their viability for generations to come.

CONCLUSIONS

The exigencies of cultivating crops in Western Romania within an environment characterized by irregular rainfall patterns and intermittent droughts underscore the critical importance of irrigation as a fundamental component of agricultural sustenance. Through an extensive exploration of various facets encompassing climatic unpredictability, agricultural dependencies, and the transformative potential of irrigation practices, several resounding conclusions emerge, illuminating the imperative role of irrigation in this region.

From the analysis of the evolution of precipitation in the last 10 years, it has been observed that they do not cover the plants' water needs calculated as potential evapotranspiration.

The necessity of irrigating crops in Western Romania epitomizes a resilient response to the capricious nature of rainfall patterns. In an environment where nature's precipitation fails to meet the consistent water demands of crops, efficient irrigation practices emerge as an indispensable tool, offering stability against climate-induced uncertainties.

The implementation of irrigation systems holds the key to enhancing agricultural productivity in Western Romania. By ensuring a reliable and consistent water supply throughout the growing seasons, irrigation becomes an enabler for maximizing crop yields, diversifying crop varieties, and harnessing the full potential of arable lands.

The necessity of irrigation extends beyond agricultural realms, permeating into socio-economic dimensions. Efficient irrigation practices contribute significantly to the economic stability of farmers, providing them with a dependable source of income and mitigating risks associated with crop failure due to water scarcity.

Irrigation represents a lifeline for farming communities in Western Romania, preserving livelihoods and sustaining rural economies. It stands as a catalyst for rural development, fostering innovation, and ensuring the continuity of traditional agricultural practices that form the backbone of local communities.

While meeting agricultural water demands, sustainable irrigation practices contribute to environmental conservation. By minimizing water wastage, reducing soil degradation, and

mitigating the environmental impact of farming, irrigation aligns with broader sustainability goals, preserving natural resources for future generations.

Embracing modern irrigation technologies and innovative water management strategies becomes imperative for the future of agriculture in Western Romania. Continuous advancements in irrigation systems, precision agriculture, and water-efficient techniques offer promising avenues for optimizing water usage and mitigating the effects of climate variability.

In conclusion, the necessity of irrigating crops in Western Romania transcends mere agricultural requisites; it represents a holistic approach to resilient, sustainable, and thriving agricultural practices. It signifies a confluence of human ingenuity, technological innovation, and environmental stewardship, ensuring the continuity of agricultural productivity, rural prosperity, and ecological balance amidst nature's unpredictable fluctuations. Thus, recognizing and addressing the imperative of irrigation emerges as pivotal for ensuring food security, economic prosperity, and environmental sustainability in the agricultural landscapes of Western Romania.

BIBLIOGRAPHY

- AGRICULTURAL TECHNOLOGY REVIEW, 2021 - Advancements in Crop Irrigation Technologies." Journal of Agricultural Engineering, Volume 52
- AQUASTAT—FAO's Global Information System on Water and Agriculture. Water Use. Available online: www.fao.org/nr/water/aquastat/water_use/index.stm
- BROWN, L., 2018 - Impact of Climate Variability on Agriculture in Semi-arid Regions, Journal of Agricultural Sciences, Volume 156,
- CARLO INGRAO, ROSSANA STRIPPOLI, GIOVANNI LAGIOIA, DONALD HUISINGH, 2023 -Water scarcity in agriculture: An overview of causes, impacts and approaches for reducing the risks, Heliyon, Volume 9, Issue 8
- EUROPEAN COMMISSION, 2023 - Water and agriculture in the EU, https://agriculture.ec.europa.eu/sustainability/environmental-sustainability/natural-resources/water_en
- EUROPEAN UNION AGRICULTURE DEPARTMENT, 2019 - Water Management Policies for Sustainable Agriculture." Report.
- FAO, 2019 - Water Scarcity – One of the greatest challenges of our time, <https://www.fao.org/fao-stories/article/en/c/1185405/>
- GARCÍA, M. A., VICTOR HUGO DURAN ZUAZO, 2018 - Water Scarcity and Sustainable Agriculture in Semiarid Environment, ISBN: 9780128131640
- IVANOV, R. D. ET AL., 2017 - Impact of Droughts on Crop Yields in Western Romania, Journal of Water Resources Planning and Management, Volume 143
- MORENO-PÉREZ, M.F.; ROLDÁN-CAÑAS, J., 2013 - Assessment of irrigation water management in the Genil-Cabra (Córdoba, Spain) irrigation district using irrigation indicators. Agric. Water Manag., 120, 98–106
- POPESCU, A. B., 2016 - Challenges and Opportunities of Irrigation in Western Romania." Journal of Environmental Management, Volume 182
- ROLDÁN-CAÑAS JOSÉ, AND MARÍA FÁTIMA MORENO-PÉREZ. 2021 - Water and Irrigation Management in Arid and Semiarid Zones, Water 13, no. 17
- ROMANIAN AGRICULTURAL RESEARCH INSTITUTE, 2020 - Irrigation Practices in Western Romania
- SMITH, S. M., & EDWARDS, E. C., 2021 - Water storage and agricultural resilience to drought: historical evidence of the capacity and institutional limits in the United States. Environmental Research Letters, 16(12), 124020.
- ȘMULEAC L, RUJESCU C, ȘMULEAC A, IMBREA F, RADULOV I, MANEA D, IENCIU A, ADAMOV T, PAȘCALĂU R., 2020 - Impact of Climate Change in the Banat Plain, Western Romania, on the Accessibility of Water for Crop Production in Agriculture. Agriculture, 10(10):437
- UNESCO, UN-Water. United Nations World Water Development Report 2020: Water and Climate Change; UNESCO: Paris, France, 2020

- UNITED NATIONS FOOD AND AGRICULTURE ORGANIZATION, 2018 - Water Scarcity and Agriculture: Sustainable Solutions, Report.
- UNITED NATIONS, 2023 - Water Scarcity, the Climate Crisis and Global Food Security: A Call for Collaborative Action, <https://www.un.org/en/un-chronicle/water-scarcity-climate-crisis-and-global-food-security-call-collaborative-action>
- WESTERN ROMANIA AGRICULTURE FORUM, 2017 - Irrigation Strategies for Sustainable Crop Production
- WORLD BANK, 2016 - Enhancing Agricultural Productivity through Effective Irrigation Systems, Report.
- WWAP (UNESCO World Water Assessment Programme), 2019 - World Water Development Report 2019: Leaving No One Behind; WWAP: Paris, France,
- XAVIER, T. S. ET AL., 2019 - Assessment of Water Requirements for Crop Cultivation in Western Romania, Journal of Irrigation and Drainage Engineering, Volume 145
- <https://www.anif.ro/irigatii/>
- <https://www.madr.ro/docs/agricultura/fond-funciar/2022/hg-793-2016-aprobare-PNI-actualizata-07.09.2022.pdf>