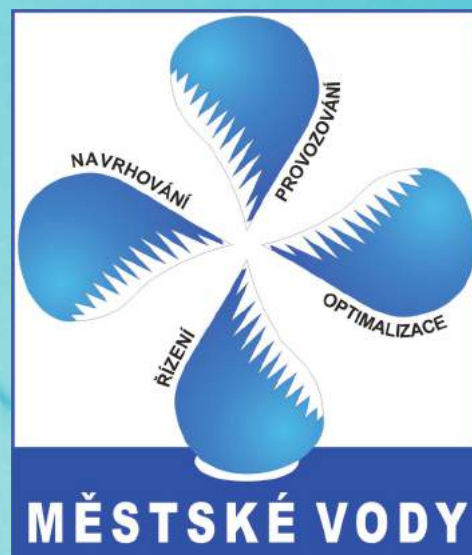


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# **MĚSTSKÉ VODY 2022**

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## SMARTWATER Project (H2020 Twinning)

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### Abstract

Management of water resources in BiH agriculture is a contemporary problem which causes environmental pollution, loss of yield, reduction of income and degradation of resources. Promoting SMART agricultural WATER management in Bosnia and Herzegovina (SMARTWATER) project is a H2020 project lasting 3 years (2021-2023), funded by the European Union, European Commission. SMARTWATER is coordinated by the University of Banja Luka (UNI-BL), Bosnia and Herzegovina. Partners are: Centro Internazionale di Altistudi Agronomici Mediterranei (CIHEAM.-AMB), Italy; Agencia Estatal Consejo Superior de Investigaciones Cientificas (CSIC), Spain; Instituto Superior de Agronomia (ISA-LEAF), Portugal, Sysman Progetti & Servizi Srl (SYS), Italy and University of Sarajevo (UNSA), Bosnia and Herzegovina.

The main objectives are to reinforce the networking, research and innovation capacities of the University of Banja Luka (UNI-BL), University of Sarajevo (UNSA) and other BiH institutions in the field of sustainable agricultural water management and to increase their competences and fund-rising skills for a successful participation in EU projects. Several activities are planned within the project as postgraduate studies, summer schools, advanced training courses, joint research activities in BiH, staff exchanges, workshops and roundtable debates on water use national strategies. The main achievements for the first 20 months of the project implementation has been presented. The overall outcome is to reinforce the capacity for optimizing the use of water, land, energy and fertilizers in agriculture and to promote climate change adaptation and mitigation strategies, as well as to raise competency and fund rising skills of BiH Universities for application and participation in similar EU funded projects.

### Introduction

The agriculture is a sector which is economically important for BiH and it is an integral part of the rural economy of the country (World Bank, 2020). The effects of climate change including long periods of drought and high variability of precipitation become a limiting factor in the agricultural production (Trbić et al., 2017; Popov et al., 2019; Čadro et al., 2019). The climate projections for BiH pointed out the reduced soil moisture content and increased evapotranspiration (Stričević et al., 2017).

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The mentioned climate changes and challenges could potentially increase the frequency and magnitude of droughts during the crop growth period and made an impact on the sustainable agricultural production and need of increase in the irrigation water requirement as already shown in the previous studies in the Bosnia and Herzegovina and region (Markovic et al., 2012; Stricevic et al., 2017, Knezević et al., 2018).

The investment in the field of irrigation in Bosnia and Herzegovina become an important issue for a sustainable agricultural production in the country. The importance of the new knowledge and technologies in the agricultural sector in Bosnia and Herzegovina is a need for a sustainable agricultural water management which requires reliable and easy-to-use methods to support real-time irrigation scheduling (Marković et al., 2021). However, the contribution of research to support the positive trend of this sector is currently poor. The scientific and technical capacities of Bosnian Universities and research institutes in the field of agricultural water management are limited and the institutions lack an effective link with farmers, agribusinesses, and internationally leading counterparts at the EU level.

The further steps require a comprehensive knowledge of weather, soil, crop and irrigation system characteristics in respect to the specific environmental conditions and management strategies based on the technical and scientific methods that are already applied in the Mediterranean region are very important for sustainable agricultural production (McCarthy et al., 2011; Romero et al., 2012; Stambouli et al., 2012; Lamaddalena and Khila, 2012; Zapata et al., 2017; 2018).

An increase use of decision support system as BluLeaf (Todorovic et al., 2016; Abi Saab et al., 2019), Irrigation tools (Todorovic, 1998), models for irrigation scheduling (Steduto et al., 2009; Čereković et al., 2010; Rosa et al. 2012), and remote sensing data as Sentinel-2 data in agriculture (Mateos et al., 2013; Pôças et al., 2015) shows an important tool for a scientific and technological achievements and innovation which could help in the crop water requirement management and used as an innovative tool to help in an improvement of the sustainable agricultural production in Bosnia and Herzegovina. Moreover, an increased need of assess the ratio between the economic benefit and produced environmental impact, especially in terms of global warming potential is an adaptation measure of eco-efficiency (Todorovic et al., 2018) has to be a mitigation point in the field of water management resources.

For this reason, the activities of the EU funded HORIZON 2020 Twinning project SMARTWATER has the main objective in the reinforcement of research and science and technology capacity of BiH institutions, adaptation of the modern strategies in the field of the sustainable agricultural production and implementation of new, networking, research and science and technology cooperation capacities of the University of Banja Luka (UNI-BL), the University of Sarajevo (UNSA) and other BiH institutions.

The specific objectives of the project are the following:

- a) Enhance the capacity building and human resources development of the UNI-BL, UNSA and other BiH institutions for research and science and technology improvement and cooperation in terms of sustainable agricultural water management, facilitating their access to competitive research funding;
- b) Strengthen networking between UNI-BL, UNSA, the EU institutions and other BiH and regional (Balkan) institutions through staff exchange, joint workshops/conferences, research themes/studies and exchange of knowledge, data and experts on specific topics of agricultural land and water management;
- c) Setting-up a smart scientific strategy in the field of sustainable agricultural water management for stepping up and stimulating scientific excellence and innovation capacity of UNI-BL, UNSA and other BiH institutions on the short and long-term basis; d) Adoption/accomplishment of an effective smart communication/dissemination strategy for

adequate promotion of twinning activities and ensuring the expected impacts at regional, national, EU and global level.

## **Materials and methods**

SMARTWATER relates to the topic: WIDESPREAD-05-2020 - Twinning, Coordination and support action-CSA funding scheme as set out in the call for proposal: H2020-WIDESPREAD-2018-2020, Spreading Excellence and Widening participation. The achievement of the project objectives is planned through a series of twinning activities, which will be carried out within a period of 36 months. The monitoring of project achievements will be done through a set of clear and measurable indicators for each specific activity.

The project addresses the specific challenges identified by the Twinning for improving the overall scientific and innovation capacity of low-performing associated countries by collaborating with internationally leading counterparts. These challenges include capacity building for research, S&T development and fund rising; networking and strengthening links with internationally leading research institutions in the EU countries; and setting of smart research strategy for the promotion of excellence and innovation in the field of sustainable agricultural water management.

SMARTWATER pursues sustainable agricultural water management strategies based on smart technological solutions and integration of technical (agronomic and engineering), socio-economic and environmental issues. SMARTWATER project activities has a role in the strengthening and involvement of early-stage researchers i.e., those who are at the beginning of their professional carrier and have not yet been awarded a doctoral degree.

The main research themes of SMARTWATER have been selected based on the most evident needs and the present strategy of the Ministries, the UNI-BL, UNSA and other institutions, and the necessity to achieve an immediate impact focusing on the use of innovative technologies and increasing the efficiency of agricultural water management at different scales. These topics are complementary and compatible with the overall national strategy, and include: cloud-based smart technologies and tools for agricultural water management, new generation of satellite remote sensing data (SENTINEL 2) for precision agriculture, Water-Energy-Food nexus optimization and climate change impact to agriculture and identification / development / testing of adaptation/mitigation strategies and measures. Training courses, meetings, workshops, summer schools, postgraduate studies and joint experimental studies are devoted focusing mainly on these themes. The important activities on networking are also workshops and roundtable debates on water use national strategies. The strategy will follow the principles of sustainable development, actual research and S&T achievements, and responsible research and innovation process that will step up and stimulate scientific excellence and innovation capacity of UNI-BL, UNSA and other BH institutions on the short and long-term basis. This will imply the engagement of a wide range of stakeholders, the design of a policy roadmap for decision makers and the establishment of a Scientific External Advisory Board for the review for existing strategy and monitoring of the quality of research conducted in the field of agricultural water management.

## **Results and discussions**

During 20 months of the SMARTWATER project, the networking and knowledge sharing activities have been done mainly through the promotion of the project and participation in various national and international scientific events.

The main project events were the First and Second Stakeholders Meeting (1<sup>st</sup> and 2<sup>nd</sup> SM), the First and Second Summer School of the SMARTWATER project (1<sup>st</sup> and 2<sup>nd</sup> SC) and the First Advanced Training Course of the SMARTWATER project (1<sup>st</sup> ATC). Moreover, the team

members of SMARTWATER project participated at several international conferences where the project activities and first achievements were presented.

The above-mentioned events started the initiation of the international network on sustainable agricultural water management that will be established with key institutions and researchers from the neighbouring countries and the EU. The purpose of the network is to enhance the exchange of research results and opportunities for scientific research and cooperation in agricultural water management. The network is promoted through the web page of the project and the official sites of the partners.

The workshop as a part of 1<sup>st</sup> SM was held on June 9, 2021, on Responsible Research and Innovation (RRI) which implied that societal actors (researchers, citizens, policy makers, business, third sector organisations, etc.) work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of society. This meeting was a part of the implication of stakeholders on research and innovation processes in BiH. The objectives of the workshop were to gather the vision of stakeholders on the following: the convenience of installing irrigation systems in BiH agriculture; the advantages and drawbacks of irrigated agriculture in BiH and the requirements on research and infrastructures for irrigated agriculture in BiH. As one of the main activities in project, we organized the second stakeholders' meeting.

The workshop entitled "Promotion of sustainable agricultural water managements practices in Bosnia and Herzegovina" was held on June 20, 2022, in hybrid form as a part of 2<sup>nd</sup> SM. The main goal of the workshop was to bring together key actors, stimulate discussion on strengthening sustainable water management systems in BiH and validate results in line with current trends, as well as to provide a participatory analysis leading to the definition of a matrix with gaps and challenges that will underpin the design of the future research strategy.

The first workshop was oriented towards the assessment of farmers' perception about the possibilities and requirements of irrigated agriculture in BiH. The target participants were farmer organization leaders, agricultural cooperative leaders, individual farmers and farmers of irrigated areas (to share their experience). The second workshop was oriented toward a diverse group of stakeholders (representatives of the government, non-governmental organizations, development agencies, water associations, farmer associations, farmers, and academic staff) along the food value chain.

The 1<sup>st</sup> SC was held in Trebinje (Bosnia and Herzegovina), from August 30<sup>th</sup> to September 3<sup>rd</sup> 2021, according to the hybrid model of organization. The event was hosted by the University of Banja Luka, Faculty of Agriculture, Bosnia and Herzegovina (UNI-BL). The summer school focused on the "Integrated approach for agricultural water management". The main objective was to present and discuss basic and advanced topics focussing on integrated agricultural water management with particular attention to the use of innovations and advanced technologies.

The 2<sup>nd</sup> SC was held in Sarajevo (Bosnia and Herzegovina) from July 18<sup>th</sup> to July 22<sup>nd</sup>, 2022, in person, except one lecturer that participated online. The event was hosted by the University of Sarajevo, Faculty of Agriculture and Food Science, Bosnia and Herzegovina (UNSA). The main topic was "Smart technologies and best practices (technical and practical) for sustainable and environmentally efficient water management in agriculture".

The 2<sup>nd</sup> SC focused on the "Smart technologies and best management practices (technical and practical) for sustainable and eco-efficient agricultural water management". The main objective was to present and discuss basic and advanced topics with a focus on integrated agricultural water management with reference to the use of innovations and advanced technologies.

Both events gathered different stakeholders, including university staff, students, the agro-businesses sector, farmers, decision-makers, and agricultural extension and advisory service

officers. Main target groups were early-stage researchers (ESR) from two main BiH Universities.

The 1<sup>st</sup> ATC was organized and held in Lisbon (Portugal), from September 27 to October 1, according to the hybrid model of organization. The host of the first ATC was the School of Agriculture (ISA) / University of Lisbon (ULisboa). The advanced course focused on the "Advanced remote sensing technologies and tools for crop water requirements estimates and irrigation scheduling". The course objective was to present and discuss the basics of the evapotranspiration concept (reference and crop evapotranspiration concepts) and advanced topics on remote sensing techniques to estimate single and basal crop coefficient ( $K_c$  and  $K_{cb}$ ) and crop water requirements to propose water management of irrigation systems on agricultural lands, considering current scenario and future scenarios affected by climate change.

The experimental work has been performed since 2021 for maize crop on two locations in BiH under the different irrigation treatment to test the plasticity to cope with the adverse climate conditions of the local hybrid. The grain yield was assessed the response of the local maize hybrid BL-433 to three different water regimes, full irrigation (F), deficit irrigation (D) and rainfed (R), an experiment has been conducted for this crop in Bosnia and Herzegovina at two locations, Aleksandrovac (A) – UNI-BL and Butmir (B) - UNSA, characterized by different soil and climatic conditions. The results of this study demonstrated the understanding of the effect of water stress on maize crop grown under different water regimes, at two distinctive pedo-climatic locations in Bosnia and Herzegovina. A lower yield was found at both locations compared to the average yield for this hybrid and these changes may relate to the increased temperature and water stress in 2021. As a deeper understanding of pedo-climatic characteristics on crop water requirements is essential to accurately address the maize irrigation requirements in relation with the optimal yield, we had the experimental activities in 2022. A decision support system BlueLeaf and Irrigation tool were also used to follow the experimental and irrigation activities. Sentinel-2 data will be used to do further image analyses.

## **Conclusions**

SMARTWATER project has a lot of twinning activities which will boost the research and S&T capacity of the UNI-BL, UNSA and other BH institutions through a series of capacity building and human resources development actions like advanced training courses, joint MSc program, summer schools and R&I funding workshops. In this context, the project will particularly promote the involvement of early-stage researchers (ESR) and support their research and fund-raising capacities as well as those of other stakeholders interested to increase their competence in the field of sustainable agricultural water management.

SMARTWATER will address the networking gaps and deficiencies between the BH institutions and leading EU partners. The project foresees a series of joint activities promoting networking, joint experimental/demonstration studies on specific research themes, smart water management tools, and exchange of knowledge and experts on specific topics of agricultural water management. SMARTWATER foresees the publication of joint research documents at international conferences and peer review journals. This will raise the research reputation of UNI-BL, UNSA and other BiH institutions as well as the research profile of ESR and other staff.

SMARTWATER will provide technical assistance and expertise to improve the research and innovation systems of UNI-BL, UNSA and other BH institutions and to delineate adequate research strategies and policies for the future.



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