

Sustainable water supply and soil system for food production in the context of climate change in Bosnia and Herzegovina

M. Balaban¹, R. Cupac², G. Trbić¹, S. Pržulj¹, M. Ivanišević¹, S. Gnjato¹, D. Savić¹

¹Faculty of Natural Sciences and Mathematics, University of Banja Luka, Banja Luka, 78000, Bosnia and Herzegovina

²UNDP Bosnia and Herzegovina, Sarajevo, 71000, Bosnia and Herzegovina

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Presenting author email: milica.balaban@pmf.unibl.org

Direct agricultural production in the field is estimated to contribute approximately 15% to total greenhouse gas emissions. Also, related production and other economic activities including the production of fertilizers, pesticides, cultivation, irrigation and fertilization processes, as well as transport, packaging and storage of food, lead to the emission of an additional 15-17% of the total amount. On the other hand, changing climatic conditions caused by such volumes of emissions negatively affect the productivity of food production, nullifying the effects of increasing yields by applying advanced agricultural methods (De Schutter, 2014). However, agricultural production is under great pressure from climate change, which is manifested in the increasing frequency and intensity of droughts, floods, hail and other climate extremes (Trbic et al., 2021; Dejanovic et al., 2019; Stricevic et al., 2019). Planned and intensive agricultural production in Bosnia and Herzegovina requires more and more intensive use of agricultural resources that would prevent the side effects of climate change.

The Covid 19 pandemic has also had major negative effects on food and food supplies. Security of food and raw material supply in the future will have to rely more on own / domestic resources. In this regard, solutions will have to be sought in increasing domestic agricultural production, which would also condition the stabilization of food supply for the domicile population. Increasing agricultural production in Bosnia and Herzegovina will also require greater provision of water for irrigation. The largest share of agricultural land is in the north of Bosnia and Herzegovina, in the territory where there is enough water available for irrigation. The positive effects are that most of the precipitation in the mentioned territory is excreted in the months of May and June. Then it is possible to accumulate rainwater and use it during the summer period, when the drought is most pronounced.

Strengthening local food systems is presented as one of the most important steps forward in ensuring sustainable production during this century in securing the global transformational potential of food rights. According to the Strategy of Scientific and Technological Development of the Republic of Srpska 2017-2021 "Knowledge for Development" states that "Agriculture and food production are among our most important industries. However, our agricultural production is not profitable enough. In addition to poor technological equipment, our manufacturers - especially individual ones - do not know enough about new types of production and management of production processes. The Republic cannot match large agricultural countries in conventional food production, but it can provide enough "healthy food" to meet its needs and generate export earnings."

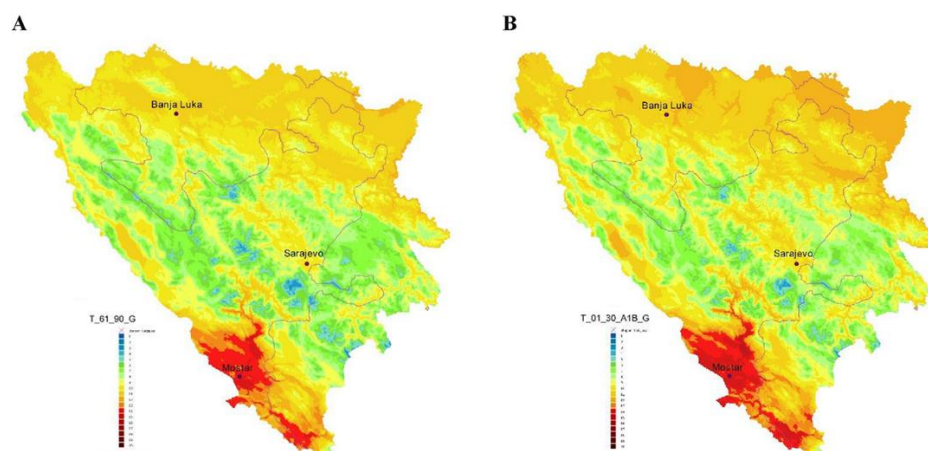


Figure 1. Average annual temperatures in Bosnia and Herzegovina, period 1961-1990 (A) and projected average annual temperatures in Bosnia and Herzegovina, period 2001-2030 (B) (Bajic and Trbic, 2016)

The aim of this research is to contribute to the model development of a sustainable and safe irrigation system on agricultural land plots of local food producer as a contribution to the establishment of profitable and sustainable production of healthy vegetables for the production of food and spices.

The sustainability of the proposed irrigation system was considered based on the assessment of natural water reserves in the immediate vicinity of the plot. In doing so, using the most contemporary models, projections of precipitation up to the end of the century, analysis of water levels and flows were given, taking into account the collected long-term meteorological data in the area.

In the observed area, an increase in temperatures has already been observed at the annual level, but also in all seasons (Bajic and Trbic, 2016). Also, there is an evident trend of increasing temperatures during the vegetation period, but an increase in days without precipitation (Trbic *et al.*, 2017; Popov *et al.*, 2019). Such generalized climate changes already require irrigation of agricultural areas, because the amount of precipitation excreted is not sufficient for optimal growth of agricultural crops.

Climate models and climate scenarios point to increases in the number of rain-free days in the near future. The paper will present the expected estimates of precipitation during the vegetation period according to the climate scenarios RCP4.5 and RCP8.5.

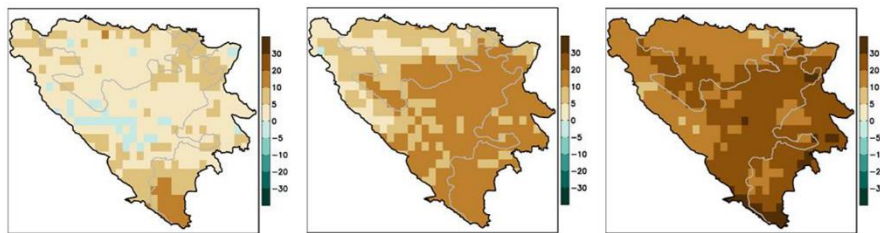


Figure 2. Changes in the number of dry days (days without precipitation) by the end of the 21st century for the territory of Bosnia and Herzegovina, according to the climate scenario RCP8.5

Also, the possibilities and ways of irrigating the observed areas will be defined in order to achieve optimal yields. Irrigation possibilities will be considered on the basis of all possible available water resources (rain, nearby watercourses and groundwater).

Maintaining the quality and ecosystem of agricultural soil, as, after the ocean, the second largest reservoir of organic carbon (Vargas-Rojas *et al.*, 2019) is key to curbing climate change, protecting human health, preserving biodiversity and ecosystems and ensuring food safety (European Commission, 2020). In this light, soil protection must also be comprehensively covered by the legal aspects of international trade in agriculture in times of climate change (Ruppel, 2022).

It was found that the yields of the most represented fruit crops in Bosnia and Herzegovina largely depend on climatic conditions, especially drought and water availability. High temperatures and long summer days with reduced precipitation will cause great risk and pressure in the fruit production sector in B&H. The biggest change, i.e., increase, in the number of summer days is in the northern and southern part of the territory. We mentioned earlier that the northern dip is a recognizable fruit region (plums, apples, pears, cherries and sour cherries), while the southern part is a typical Mediterranean region (grapes, peaches, and citrus fruits) (Trbic *et al.*, 2021).

This research model has been also extended by the simultaneous monitoring of several chemical parameters of agricultural soil and irrigation water to assess possible migration routes, in order to develop reliable rapid methods for assessing the chemical safety and security of the entire system.

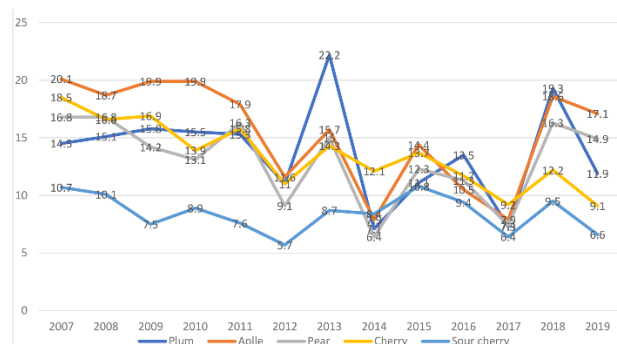


Figure 3. Fruit yields per tree in kg in the Republic of Srpska for the period (2007-2019).

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