CLIMATE RISK COUNTRY PROFILE

BOSNIA AND HERZEGOVINA

WORLD BANK GROUP

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This profile is part of a series of Climate Risk Country Profiles developed by the World Bank Group (WBG). The country profile synthesizes most relevant data and information on climate change, disaster risk reduction, and adaptation actions and policies at the country level. The country profile series are designed as a quick reference source for development practitioners to better integrate climate resilience in development planning and policy making. This effort is managed and led by Veronique Morin (Senior Climate Change Specialist, WBG) and Ana E. Bucher (Senior Climate Change Specialist, WBG).

This profile was written by MacKenzie Dove (Senior Climate Change Consultant, WBG). Additional support was provided by Fernanda Zermoglio (Senior Climate Change Consultant, WBG), Yunziyi Lang (Climate Change Analyst, WBG), and Jason Johnston (Operations Analyst, WBG).

Climate and climate-related information is largely drawn from the Climate Change Knowledge Portal (CCKP), a WBG online platform with available global climate data and analysis based on the latest Intergovernmental Panel on Climate Change (IPCC) reports and datasets. The team is grateful for all comments and suggestions received from the sector, regional, and country development specialists, as well as climate research scientists and institutions for their advice and guidance on use of climate related datasets.

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FOREWORD

Climate change is a major risk to good development outcomes, and the World Bank Group is committed to playing an important role in helping countries integrate climate action into their core development agendas. The World Bank Group is committed to supporting client countries to invest in and build a low-carbon, climate-resilient future, helping them to be better prepared to adapt to current and future climate impacts.

The World Bank Group is investing in incorporating and systematically managing climate risks in development operations through its individual corporate commitments.

A key aspect of the World Bank Group's Action Plan on Adaptation and Resilience (2019) is to help countries shift from addressing adaptation as an incremental cost and isolated investment to systematically incorporating climate risks and opportunities at every phase of policy planning, investment design, implementation and evaluation of development outcomes. For all IDA and IBRD operations, climate and disaster risk screening is one of the mandatory corporate climate commitments. This is supported by the Bank Group's Climate and Disaster Risk Screening Tool which enables all Bank staff to assess short- and long-term climate and disaster risks in operations and national or sectoral planning processes. This screening tool draws up-to-date and relevant information from the World Bank's Climate Change Knowledge Portal, a comprehensive online 'one-stop shop' for global, regional, and country data related to climate change and development.

Recognizing the value of consistent, easy-to-use technical resources for client countries as well as to support respective internal climate risk assessment and adaptation planning processes, the World Bank Group's Climate Change Group has developed this content. Standardizing and pooling expertise facilitates the World Bank Group in conducting initial assessments of climate risks and opportunities across sectors within a country, within institutional portfolios across regions, and acts as a global resource for development practitioners.

For developing countries, the climate risk profiles are intended to serve as public goods to facilitate upstream country diagnostics, policy dialogue, and strategic planning by providing comprehensive overviews of trends and projected changes in key climate parameters, sector-specific implications, relevant policies and programs, adaptation priorities and opportunities for further actions.

It is my hope that these efforts will spur deepening of long-term risk management in developing countries and our engagement in supporting climate change adaptation planning at operational levels.

Bernice Van Bronkhorst
Global Director
Climate Change Group (CCG)
The World Bank Group (WBG)

COUNTRY OVERVIEW

Bosnia and Herzegovina (BiH) is a lower middle-income country located in the Western Balkans of Central Europe. The country has a total surface area of 51,209 square kilometers (km), which is comprised of 51,197 km² of land and 12.2 km² of sea. BiH shares boarders with Croatia (931 km), Serbia (375 km) and Montenegro (249 km) and a coastline along the Adriatic Sea (25.5 km). Its location on the Balkan Peninsula places it within the Adriatic and Black sea basins. The country's topography is largely hilly to mountainous with an average altitude of 500 meters (m) and a maximum altitude of 2,400 m. The country's land areas is made up of 5% lowlands, 24% hills, 42% mountains, and 29% karstic regions (soluble rocks such as limestone, dolomite, gypsum, characterized by underground drainage and sinkholes).[1] BiH also has a large network of transboundary rivers, including tributaries of Drina, Neretva, Una, Korana and Glina, and rivers on its territorial boarders such as the Sava, Una and Drina.[2]

BiH has a population 3.3 million people (2020), but with a declining annual population growth rate of —0.6% (**Table 1**). BiH has experienced steady population decline since the mid-2000s due to previous conflicts, and migration.[3] The population is expected to reach 3.1 million and 2.6 million by 2030 and 2050, respectively.[4] The country had a Gross Domestic Product (GDP) of US$19.8 billion in 2020, with an annual growth rate of –4.3%%. The country is dominated by industry (including mining, construction, electricity, water, and gas) which contributes 23.2% to GDP, agriculture (6.4%) and the export (35.4%) and import (52.3%) sectors.[5] As of 2019, the unemployment rate fell slightly to 18.4%, though BiH continues to have one of the highest youth unemployment rates in the world.[6] While Bosnia and Herzegovina is a sovereign state with a decentralized political and administrative structure, it is comprised of two entities: the Federation of Bosnia and Herzegovina and the Republika Srpska; and the Brčko District. According to the Constitution of BiH, all matters of environmental and water management are assigned to the level of the entities. All strategies are also prepared at this level and then harmonized or combined and presented through the Ministry of Foreign Trade and Economic Relations of BiH as the strategies of the country.

TABLE 1. Data snapshot: Key development indicators[7]

Indicator	
Life Expectancy at Birth, Total (Years) (2019)	77.4
Population Density (People per sq. km Land Area) (2018)	64.9
% of Population with Access to Electricity (2019)	100%
GDP per Capita (Current US$) (2020)	$6,031.60

1 Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

2 Skøien, J. et al. (2018). Assessment of the capacity for flood monitoring and early warning in Enlargement and Eastern/Southern Neighborhood countries of the European Union, EUR 29073 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-79-77771-4, doi: 10.2760/18691, JRC108843

3 World Bank Data Bank (2020). World Development Indicators. Bosnia-Herzegovina URL: https://databank.worldbank.org/source/world-development-indicators

4 World Bank Open Data (2021). Data Retrieved April 2021. Data Bank: World Development Indicators, Bosnia and Herzegovina. URL: https://databank.worldbank.org/source/world-development-indicators

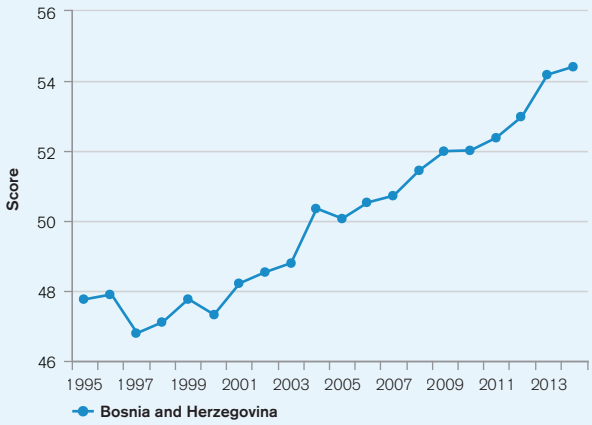
5 World Bank Data Bank (2021). World Development Indicators. Bosnia-Herzegovina URL: https://databank.worldbank.org/source/world-development-indicators

6 The World Bank Group (2017). Bosnia and Herzegovina Country Snapshot. April 2017. URL: http://pubdocs.worldbank.org/en/705141492622353847/Bosnia-Herzegovina-Snapshot13Apr2017.pdf

7 World Bank (2021). Bosnia and Herzegovina — Overview. URL: https://www.worldbank.org/en/country/bosniaandherzegovina/overview#1

The ND-GAIN Index[8] ranks 181 countries using a score which calculates a country's vulnerability to climate change and other global challenges as well as their readiness to improve resilience. This Index aims to help businesses and the public sector better identify vulnerability and readiness in order to better prioritize investment for more efficient responses to global challenges. Due to a combination of political, geographic, and social factors, Bosnia and Herzegovina is recognized as vulnerable to climate change impacts, ranked 79 out of 181 countries in the 2020 ND-GAIN Index. The more vulnerable a country is the lower their score, while the more ready a country is to improve its resilience the higher it will be. Norway has the highest score and is ranked 1st. **Figure 1** is a time-series plot of the ND-GAIN Index showing Bosnia and Herzegovina's progress.

FIGURE 1. ND-GAIN Index for Bosnia and Herzegovina



BiH submitted its Nationally-Determined Contribution (NDC) to the UNFCCC in 2016 in support of its commitment to the Paris Agreement[9] and submitted its Updated NDC in April, 2021. BiH also submitted its Third National Communication (NC3) and Second Biennial Update Report on Green House Gas (GHG) Emissions in 2016. Identified adaptation priorities focus on agriculture, hydrology and water resources, energy, transportation, health, forests and biodiversity, and tourism.[10] Adaptation plans in Bosnia and Herzegovina center primarily on coping with drought and flooding. Measures under consideration include modifications in crop rotation patterns, the application of new technologies to improve soils, the installation of windbreaks, and the establishment of a drought early warning system.[11] The country is committed to reducing its GHG emissions even as current BiH GHG emissions represent less than 0.1% of global total emissions.[12]

[8] University of Notre Dame (2020). Notre Dame Global Adaptation Initiative. URL: https://gain.nd.edu/our-work/country-index/

[9] United Nations Climate Change (2015). BiH Submits its Climate Action Plan Ahead of 2015 Paris Agreement. Announcement 30 September, 2015. URL: https://unfccc.int/index.php/news/ukraine-submits-its-climate-action-plan-ahead-of-2015-paris-agreement

[10] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. (NC3) URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

[11] ENVSEC (2012). Climate Change in the West Balkans. ISBN: 978-2-940490-06-6. URL: http://www.unep.at/documents_unep/ENVSEC/Climate_Change/Climate-change-west-balkans.pdf

[12] Bosnia and Herzegovina (2021). Updated Nationally Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Bosnia-Herzegovina%20First/NDC%20BiH_November%202020%20FINAL%20DRAFT%2005%20Nov%20ENG%20LR.pdf

Green, Inclusive and Resilient Recovery

The coronavirus disease (COVID-19) pandemic has led to unprecedented adverse social and economic impacts. Further, the pandemic has demonstrated the compounding impacts of adding yet another shock on top of the multiple challenges that vulnerable populations already face in day-to-day life, with the potential to create devastating health, social, economic and environmental crises that can leave a deep, long-lasting mark. However, as governments take urgent action and lay the foundations for their financial, economic, and social recovery, they have a unique opportunity to create economies that are more sustainable, inclusive and resilient. Short and long-term recovery efforts should prioritize investments that boost jobs and economic activity; have positive impacts on human, social and natural capital; protect biodiversity and ecosystems services; boost resilience; and advance the decarbonization of economies.

CLIMATOLOGY

Climate Baseline

Overview

BiH's size, varying topography and unique landscape, results in the country being characterized by several distinct climate types: temperate continental in the northern and central regions, colder climates for the sub-mountainous and mountainous, and an Adriatic climate and modified Adriatic climate along its coast. The country's climate varies from a temperate continental climate in the northern Pannonian lowlands along the Sava River and in the foothill zone, to an alpine climate in the mountain regions, and a Mediterranean climate in the coastal and lowland area of the Herzegovina region in the south and southeast. These climate characteristics are influenced by the Adriatic Sea as well as local topography, particularly the Dinarides Mountains, which are located along the coast and run from the northwest to the southeast parallel to the coast.[13]

BiH receives a relatively large amount of sun in its southern region, as compared to its northern zones. The country also has a particularly rich biodiversity (one of the largest in Europe). This is due in part to the three distinct geological and climatic regions: the Mediterranean region, the Euro Siberian-Bore American region, and the mountainous Alpine-Nordic region.[14] Historically, temperatures during the winter months (November to February) range from –6.0°C to 6.2°C and during the summer (May to September) from 9.8°C to 24.7°C.[15] Rainfall is largely constant throughout the year, however the seasonal onset and distribution of rainfall over the past two decades has reportedly been disrupted, causing unexpected flooding and periods of drought, along with high temperatures.

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[13] European Environmental Agency (2015). Country Profile — Distinguishing factors (Bosnia and Herzegovina). URL: https://www.eea.europa.eu/soer/countries/ba/country-introduction-bosnia-and-herzegovina

[14] Radusin, S. et al. (2013). *Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina.* UNDP-BiH. URL: http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

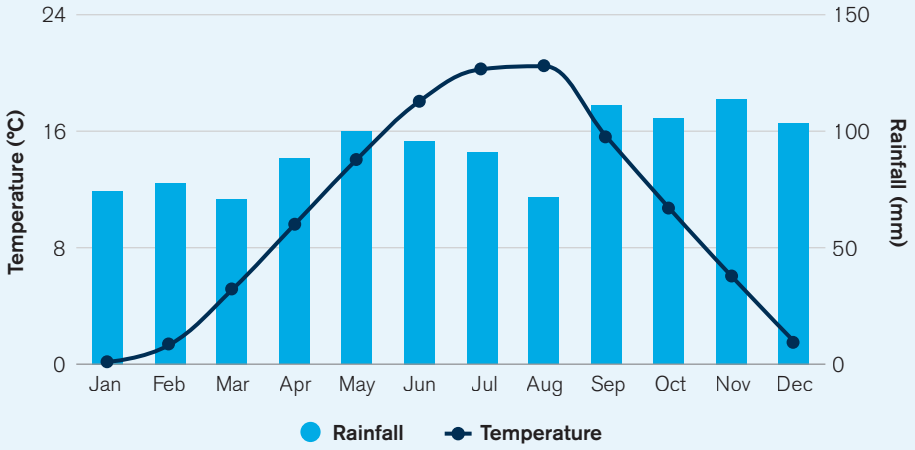
[15] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. (NC3) URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

According to the World Bank Group's Climate Change Knowledge Portal (CCKP),[16] (**Table 2**) the mean monthly temperature of the country ranges between 0°C (January) and 19.5°C (July and August). The mean monthly precipitation of the country varies from 70 millimeters (mm) in March to 112 mm in November, with an annual average rainfall of 553.3 mm. Precipitation falls predominately in summer to fall months (June to November); shown by the most recent climatology, 1991–2020, in **Figure 2**. **Figure 3** presents the spatial variation of observed average annual precipitation and temperature.

TABLE 2. Data snapshot: Summary statistics

Climate Variables	1991–2020
Mean Annual Temperature (°C)	10.24°C
Mean Annual Precipitation (mm)	1,109.24 mm
Mean Maximum Annual Temperature (°C)	14.99°C
Mean Minimum Annual Temperature (°C)	5.52°C

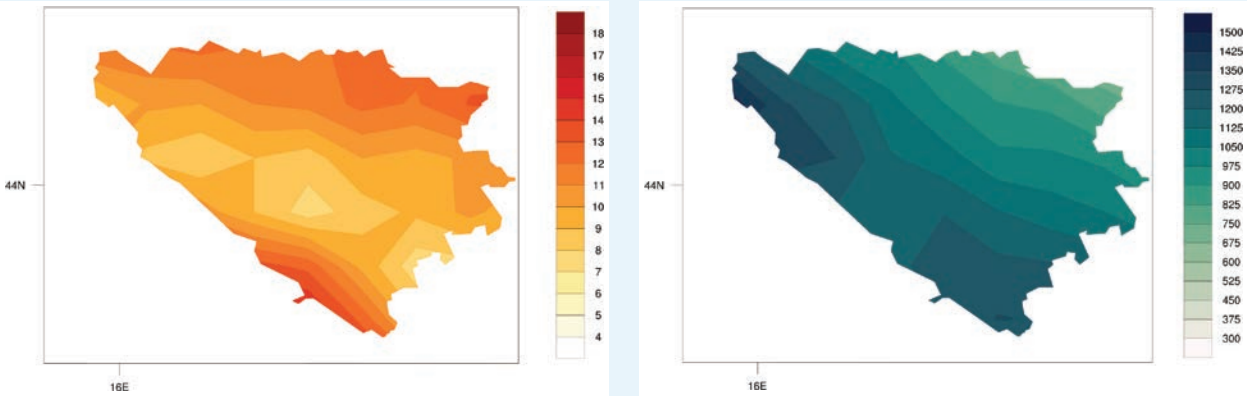
FIGURE 2. Average monthly temperature and rainfall for BiH, 1991–2020[17]



[16] WBG Climate Change Knowledge Portal (CCKP, 2021). BiH Historical Climate Data. URL: https://climateknowledgeportal.worldbank.org/country/bosnia-and-herzegovina/climate-data-historical

[17] WBG Climate Change Knowledge Portal (CCKP, 2021). BiH Historical Climate Data. URL: https://climateknowledgeportal.worldbank.org/country/bosnia-and-herzegovina/climate-data-historical

FIGURE 3. Map of average annual temperature (°C) (left); annual precipitation (mm) (right) of Bosnia and Herzegovnia,1991–2020[18]



Key Trends

Temperature

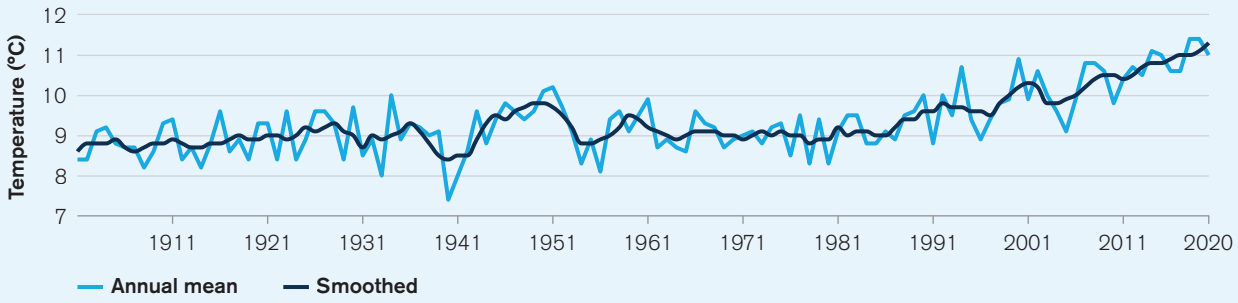
Bosnia and Herzegovina's climate experiences significant variability across the country's regions, and changing patterns are already observed for both temperature and rainfall (**Figure 4**). Since 1961, a steady temperature rise has been observed, with the most pronounced increases occurring over the past 30 years. Between 1981 and 2010, the country observed its largest temperature increases and temperatures, exceeding temperature norms in the summer months by 1.2°C and by 0.8°C in winter. Temperature increases have been more pronounced during the country's growing season (April to September, with increases ranging from 0.4°C to 1.0°C).[19] Additionally, the most significant temperature increases have occurred since the early 2000s, leading to important urban heat islands and their resulting impacts on human populations. Ongoing trends point to a future of increasingly hotter and drier summers. Extreme temperatures observed over winter and spring seasons have been found to be significantly related to the North Atlantic Oscillation index and Arctic Oscillation index, respectively.[20]

[18] WBG Climate Change Knowledge Portal (CCKP, 2021). BiH Projections Climate Data. URL: https://climateknowledgeportal.worldbank.org/country/bosnia-and-herzegovina/climate-data-projections

[19] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. (NC3) URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

[20] Popov, T. et al. (2018). Recent trends in extreme temperatures indices in Bosnia and Herzegovina. *Carpathian journal of earth and environmental sciences.* DIO: 10.26471/cjees/2018/013/019

FIGURE 4. Observed temperature for Bosnia and Herzegovina, 1901–2020[21]



Precipitation

Between 1981–2010, precipitation increased in the country's central mountain regions, whereas decreases by as much as 20% have been recorded in the northern regions during the summer months. For the country as a whole, precipitation patterns have not changed significantly, the number of days per year receiving rainfall has decreased, but with more intense rainfall events and an increase in the likelihood of flooding. Rainfall has been increasingly more variable since the 1960s. Droughts are expected to become more frequent and projections suggest these will extend beyond the current impacted areas. Future rainfall patterns are likely to be highly varied across the country, with increasing seasonal variability.[22]

Climate Future

Summary Statistics

The main data source for the World Bank Group's Climate Change Knowledge Portal (CCKP) is the CMIP5 (Coupled Inter-comparison Project Phase 5) data ensemble, which builds the database for the global climate change projections presented in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). Four Representative Concentration Pathways (i.e. RCP2.6, RCP4.5, RCP6.0, and RCP8.5) were selected and defined by their total radiative forcing (cumulative measure of GHG emissions from all sources) pathway and level by 2100. The RCP2.6 for example represents a very strong mitigation scenario, whereas the RCP8.5 assumes business-as-usual scenario. For more information, please refer to the RCP Database. For simplification, these scenarios are referred to as a low (RCP2.6); a medium (RCP4.5) and a high (RCP8.5) emission scenario in this profile. **Table 3** provides CMIP5 projections for essential climate variables under high emission scenario (RCP 8.5) over 4 different time horizons. **Figure 5** presents the multi-model (CMIP5) ensemble of 32 Global Circulation Models (GCMs) showing the projected changes in annual precipitation and temperature for the periods 2040–2059 and 2080–2099.

[21] WBG Climate Change Knowledge Portal (CCKP, 2021). BiH Historical Climate Data. URL: https://climateknowledgeportal.worldbank.org/country/bosnia-and-herzegovina/climate-data-historical

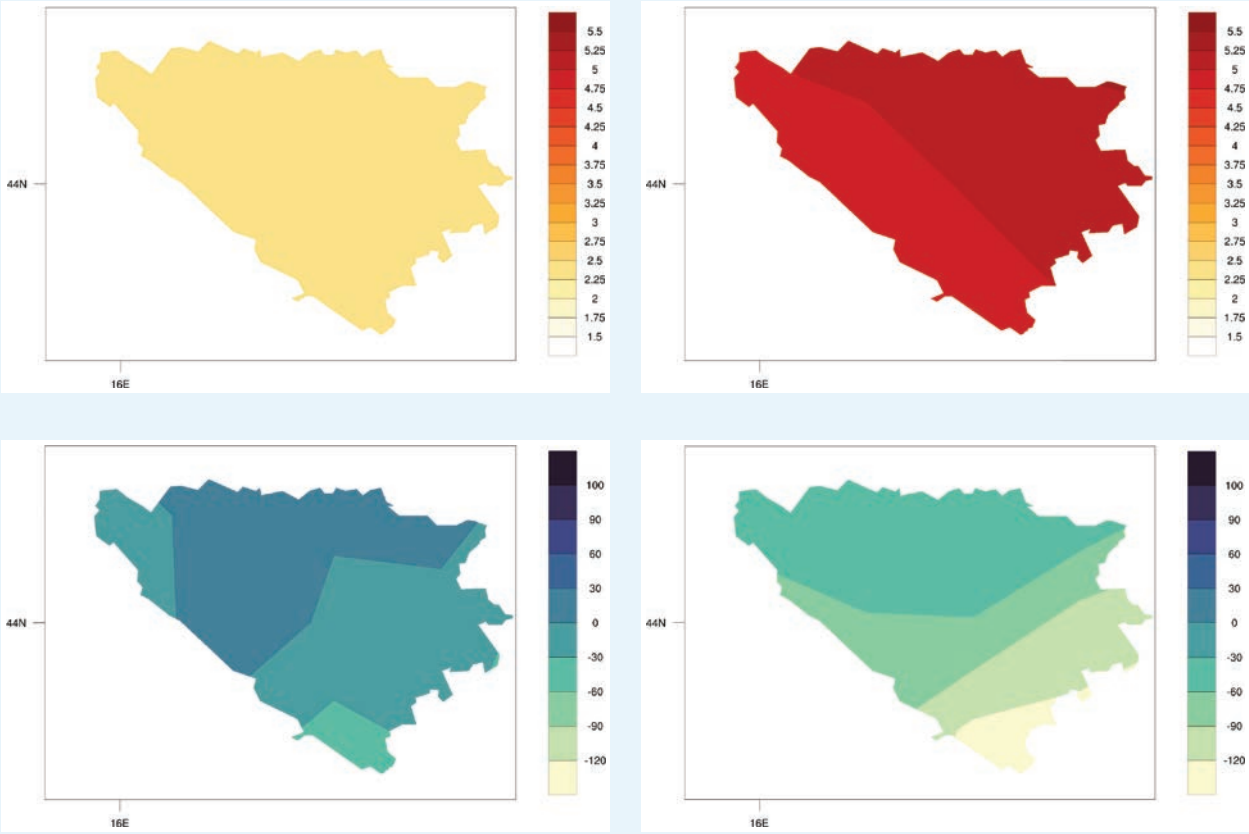
[22] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. p. 15 URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

TABLE 3. Data snapshot: CMIP5 ensemble projection

Cmip5 Ensemble Projection	2020–2039	2040–2059	2060–2079	2080–2099
Annual Temperature Anomaly (°C)	**+0.38 to +2.4** (+1.31)	**+1.0 to +3.5** (+2.22)	**+1.8 to 4.8** (+3.40)	**+2.7 to 6.4** (+4.44)
Annual Precipitation Anomaly (mm)	**–18.0 to +13.03** (–1.46)	**–23.0 to +14.9** (–1.64)	**–26.6 to +14.3** (+3.73)	**–30.1 to +13.3** (–7.73)

Note: The table shows CMIP5 ensemble projection under RCP8.5. Bold value is the range (10th–90th Percentile) and values in parentheses show the median (or 50th Percentile).

FIGURE 5. CMIP5 ensemble projected change (32 GCMs) in annual temperature (bottom) and precipitation (top) by 2040–2059 (left) and by 2080–2099 (right), relative to 1986–2005 baseline under RCP8.5[23]



[23] WBG Climate Change Knowledge Portal (CCKP, 2021). Bosnia and Herzegovina Projected Future Climate. URL: https://climateknowledgeportal.worldbank.org/country/bosnia-and-herzegovina/climate-data-projections

Key Trends

Temperature

Temperature increases are expected to be experienced throughout the territory, with the most pronounced along coastal areas as well as inland lowland areas, primarily during the summer months (May to September).[24] Rising temperatures will require costly adaptation investments and the rate of temperature increases are anticipated to exceed the current adaptive capacity of many of the country's unique ecological systems (such as high mountain and lowland oak forest areas). This could result in large-scale irreversible damage to these areas including the extinction of the country's significant number of endemic species.[25] The northeastern areas of BiH are projected to experience the most significant temperature increases.

Rising temperatures, are projected across all scenarios throughout the end of the century, as shown in **Figure 6**. Under a high-emission scenario, average temperatures are expected to rise rapidly even by mid-century. Across the seasonal cycle (**Figure 7**), temperatures will increase across all months of the year. Rising heat and extreme heat conditions will pose significant risks for human and animal health, agriculture, as well as ecosystems. As shown below, change is expected to occur throughout the year, peaking in the hottest summer period (May to October).

FIGURE 6. Historical and projected average temperature for BiH from 1986 to 2099 (Reference Period, 1986–2005)[26]

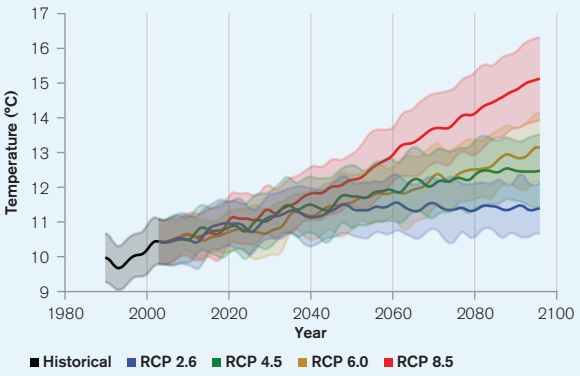
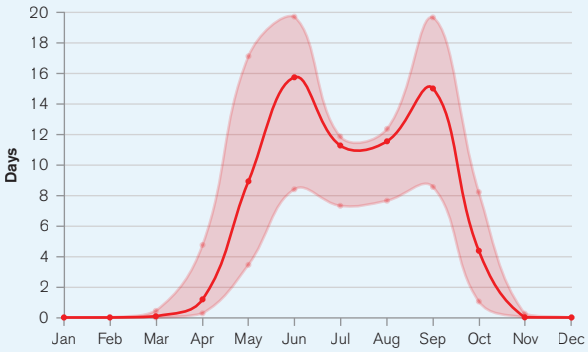


FIGURE 7. Projected change in summer days (Tmax >25°C) (RCP8.5, Reference Period, 1986–2005)[27]



[24] Goran, T., Tatjana, P. and Slobodan, G. (2017). Analysis of air temperature in Bosnia and Herzegovina. *Geographica Pannonica*. 21(2). URL: http://scindeks.ceon.rs/Article.aspx?artid=0354-87241702068T

[25] Radusin, S. et al. (2013). Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina. UNDP-BiH. URL: http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

[26] WBG Climate Change Knowledge Portal (CCKP, 2021). BiH Interactive Agriculture Dashboard. URL:https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=BIH&period=2080-2099

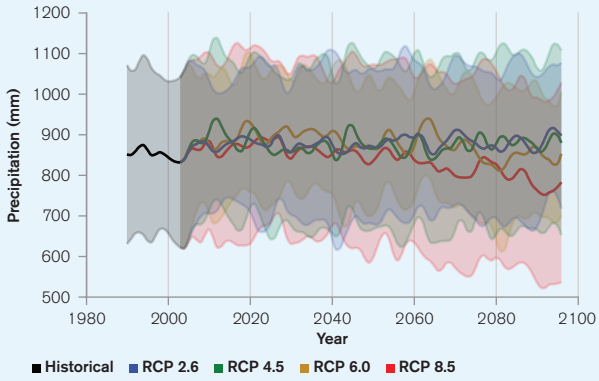
[27] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data — Projections, BiH. URL: https://climateknowledgeportal.worldbank.org/country/bosnia-and-herzegovina/climate-data-projections

Precipitation

The amount and distribution of precipitation has already changed across Eastern Europe. While there is significant inter-annual and decadal variability, under the RCP8.5 scenario, monthly precipitation is projected to steadily decrease through the end of the century; with an average annual reduction of 7.7 mm by the 2090s. The majority of BiH will, as a result, experience drying by mid-century, while a slight increase in precipitation is projected along coastal regions. Likewise, as rainfall becomes more variable, rising temperatures will translate into more severe drought conditions across the country.[28] Additionally, projections increase a distinct increase in the number and intensity of heavy precipitation events, particularly during winter seasons, which are expected to result in large impacts to both natural and socio-economic systems.[29]

Figure 8 shows the change in the number of days with at least 20 mm of rainfall. Understanding the changes in the number of days with at least 20 mm of daily rainfall helps to estimate how likely the impacts are of heavy rainfall. Water routing and storage and other management options, are often very different if the precipitation input comes as multiple light rainfall events or a series of heavy rainfall events.[30] As seen in the figure, the number of days with heavy precipitation, as aggregated across the country, will largely stay the same, with increasing variability through end of the century, across all RCP scenarios.

FIGURE 8. Annual average precipitation in BiH for 1986 to 2099 (Reference Period, 1986–2005)[31]



CLIMATE RELATED NATURAL HAZARDS

Overview

Bosnia and Herzegovina is at risk of natural disasters, which affect the agricultural sector and human health, through seasonal flooding and periods of drought.[32] The most common natural disasters are associated with heavy rainstorms that may cause mudslides and flooding of large areas of agricultural land, houses and industrial buildings, as well as lead to other changes in the environment. BiH also experiences and is at high risk to forest fires due to projected

[28] WBG Climate Change Knowledge Portal (CCKP, 2021). BiH Agriculture Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=BIH&period=2080-2099

[29] Tatjana, P., Slobodan, G., Goran, T. and Marko, I. (2017). Trends in extreme daily precipitation indices in Bosnia and Herzegovina. *Zbornik Radova.* URL: http://scindeks.ceon.rs/article.aspx?artid=1450-75521701005P

[30] WBG Climate Change Knowledge Portal (CCKP, 2021): BiH Water Dashboard. Data Description. URL: https://climateknowledgeportal.worldbank.org/country/bosnis-and-herzegovina/climate-sector-water

[31] WBG Climate Change Knowledge Portal (CCKP, 2021): Climate Data-Projections. BiH. URL: https://climateknowledgeportal.worldbank.org/country/bosnia-and-herzegovina/climate-sector-water

[32] GFDRR (2017). Disaster Risk Profile: Bosnia and Herzegovina. URL: https://www.gfdrr.org/en/publication/disaster-risk-profile-bosnia-and-herzegovina

climate change trends and increasing temperatures. The projected changes in climate will make BiH increasingly vulnerable to natural hazards: droughts, heat waves, heavy precipitation, landslides, and floods. BiH is located in south-eastern Europe, one of the most complex tectonic sectors in Europe. While no seismic risk assessment has been undertaken, earthquakes are also a hazard for the country.[33]

Bosnia and Herzegovina is ranked third in the world regarding its vulnerability to intense rain and prolonged rainfall events.[34] Since 2012, the country has dealt with multiple significant extreme climate and weather episodes, namely flooding, which causes substantial material and financial deficits, as well as human casualties.[35] Increasingly variable weather conditions and projected long-term climate changes are anticipated across all seasons and include delayed traditional seasonal onsets and periods of extreme cold to warm weather, resulting in more intense periods of rainfall as well as extended droughts. This is expected to have serious economic consequences for BiH and the region. Projected impacts are expected to occur in areas of the country expected to be hardest hit economically by climate hazards (floods, earthquakes, wildfires, landslides). Droughts may become more frequent in some areas due to river runoff decrease or drying in the country's lowland areas as well as from increased demand and consumption from economic development and population growth.[36] Flood impacts may be further exacerbated due to poor river training and riverbank practices.

Data from the Emergency Event Database: EM-Dat, presented in **Table 4**, shows the country has endured various natural hazards, including droughts, epidemic diseases, floods, and landslides.

TABLE 4. Natural disasters in BiH, 1900–2020[37]

Natural Hazard 1900–2020	Subtype	Events Count	Total Deaths	Total Affected	Total Damage ('000 USD)
Drought	Drought	2	0	62,575	298,000
Epidemic	Viral Disease	1	0	400	0
Extreme Temperatures	Cold Wave	2	6	10,347	0
	Heat Wave	1	0	0	0
	Severe winter conditions	1	1	10,000	0
Flood	Flash Flood	2	0	0	0
	Riverine flood	11	29	1,329,340	523,580
Storm	Convective Storm	1	4	0	0

[33] Ademovic, N., Sipos, T. and Hadžima-Nyarko, M. (2020). Rapid assessment of earthquake risk for Bosnia and Herzegovina. Bulletin of Earthquake Engineering. 18: 1835–1863. URL: https://link.springer.com/article/10.1007/s10518-019-00775-1

[34] Kreft, S. et al. (2016). Global Climate Risk Index 2016. Who Suffers Most from Extreme Weather Events? Weather-related Loss Events in 2014 and 1995 to 2014. German Watch. URL: https://germanwatch.org/en/download/13503.pdf

[35] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. p. 15 URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

[36] Wetterwald, J. and Kjaergaard, E. (2016). Towards Risk-Informed Development: Making Use of Geospatial Data in Development Planning in Bosnia-Herzegovina. GI-Forum, Vol. 2. pp. 90–108. DOI: 10.1553/giscience2016_02_s90

[37] EM-DAT: The Emergency Events Database — Universite catholique de Louvain (UCL) — CRED, D. Guha-Sapir, Brussels, Belgium. URL: http://emdat.be/emdat_db/

Key Trends

Climate change will increase the risk and severity of natural disasters in BiH, as temperatures rise and rainfall patterns are altered, as well as through prolonged heat waves, and water scarcity. In recent years, the number of natural disasters occurring in the region are considered to be catastrophic, causing fatalities and leading to significant economic losses.[38] This has included dry years (2003, 2007, 2008, 2011, 2012, 2013), coupled with increasingly dangerous and disruptive floods (2001, 2002, 2009, 2010, 2014).[39] The most common natural disasters are associated with heavy rainstorms that may cause mudslides and flooding of large areas of agricultural land, houses and industrial buildings. The World Bank Group estimated that weather related disasters cause economic losses of up to 1.5% of GDP per year for the region.[40] More than 20% of Bosnia and Herzegovina's territory is prone to flooding, which, on average, impacts annually approximately 100,000 people and about $600 million in gross domestic product (GDP). In 2014, unprecedented amounts of rainfall affected 25% of the population, severely disrupting the economy, with river floods inundating agricultural fields and 81 municipalities. It triggered more than 3,000 landslides, impacting nearly 15% of GDP. The country's mountainous geography, aging infrastructure, and high urbanization rate compound its seismic, and consequent landslide, vulnerability. Analysis of present-day exposure estimates the same earthquake would cause over 400 deaths and more than $4 billion in damages.[41,42]

BiH's large number of rivers, catchments and aquifers mean that changes to precipitation can result in high-risk flood scenarios. Projected changes to the country's hydrologic regime is likely to result in longer-lasting droughts, high-intensity extreme rainfall events resulting in more destructive flooding.[43] Furthermore, land degradation and soil erosion, exacerbated by recurrent floods and droughts, adversely impact agricultural production, further affecting the livelihoods of the rural poor. Small rural farmers are more sensitive to impacts of disasters (floods, dry periods) because they have limited resources with which to influence and increase their responses to these risks. The gradual degradation of water, air, forests, and agricultural land in the country further increases the risk of catastrophic shocks, in addition to putting sustainable economic growth at risk.[44] The country's hazard for river flooding is classified as high, with potential for damaging and life-threatening river floods across the country, as shown in **Figure 9**. Landslides, particularly for the country's eastern border are also a significant risk for the country

[38] Radusin, S. et al. (2013). Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina. UNDP-BiH. URL: http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

[39] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. p. 15 URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

[40] Radusin, S. et al. (2013). *Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina.* UNDP-BiH. URL: http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

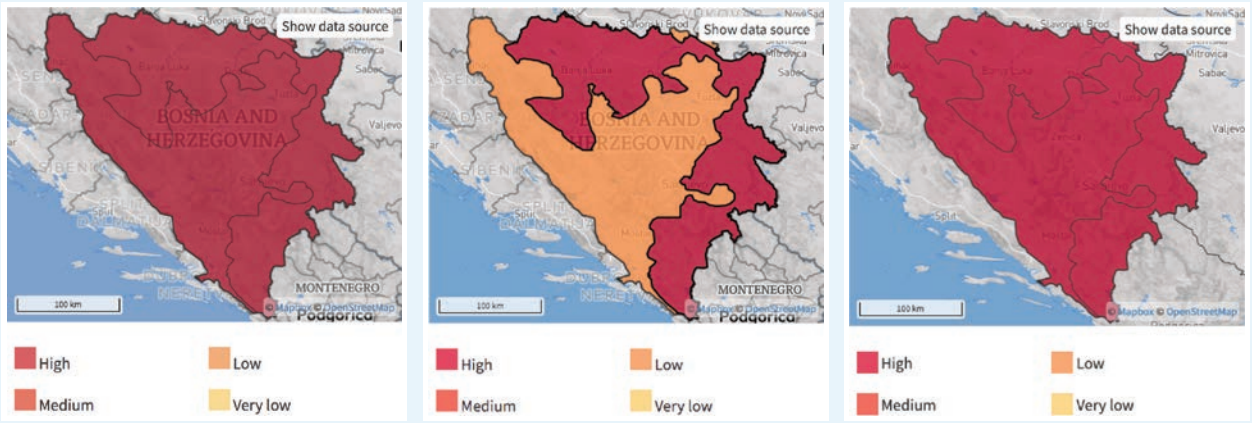
[41] GFDRR (2019). Bosnia and Herzegovina. Overview. URL: https://www.gfdrr.org/en/bosnia-and-herzegovina

[42] Ademovic, N., Sipos, T. and Hadzima-Nyarko, M. (2020). Rapid assessment of earthquake risk for Bosnia and Herzegovina. Bulletin of Earthquake Engineering. 18: 1835–1863. URL: https://link.springer.com/article/10.1007/s10518-019-00775-1

[43] Hadzic, E. et al. (2020). Natural Disaster Risk Management in Bosnia and Herzegovina. Natural Risk Management and Engineering. p. 41–61. URL: https://link.springer.com/chapter/10.1007/978-3-030-39391-5_3

[44] GFDRR (2019). Bosnia and Herzegovina. Overview. URL: https://www.gfdrr.org/en/bosnia-and-herzegovina

FIGURE 9. BiH river flood hazard (left);[45] risks of landslide (center);[46] risks of wildfire (right) [47]



Implications for DRM

BiH established its National Platform for Disaster Risk Reduction (2008) which works with the Civil Protection Department to support needed adaptation as well as emergency response to crises. While risk assessments have been undertaken, greater coordination is required with urban centers and municipal governments. The country is looking to improve its resilience to increased risk of natural hazards, reduce the vulnerability of local communities and institutions, while preparing them to mitigate and respond to natural hazards and the increased threats from climate change.[48] BiH is also working, in partnership with international donors, to strengthen regional collaboration in order to build resilience; improve existing hydro-meteorological services and early warning systems at multiple scales; and to increase investment in infrastructure and policies in order to shield the most vulnerable from natural disasters.[49] The government has also implemented regulations on flood Defense Plans in support of appropriate protective action against flooding and rebuilding efforts, post-flood events. Similar measures have also been enacted regarding defenses from flood and ice during winter seasons. Efforts are underway for the development and expansion of spatial monitoring and planning to improve understanding of flood plains and more detailed risk mapping.[50]

[45] ThinkHazard! (2020). Bosnia and Herzegovina Flood Hazard. http://thinkhazard.org/en/report/34-bosnia-and-herzegovina/FL
[46] ThinkHazard! (2020). Bosnia and Herzegovina Landslide Hazard. URL: http://thinkhazard.org/en/report/34-bosnia-and-herzegovina/LS
[47] ThinkHazard! (2020). Bosnia and Herzegovina Wildfire Hazard. URL: https://thinkhazard.org/en/report/34-bosnia-and-herzegovina/WF
[48] Gencer, E. (2014). A compendium of disaster risk reduction practices in cities of the Western Balkans and Turkey. UNISDR. URL: https://www.unisdr.org/we/inform/publications/39825
[49] GFDRR (2019). Bosnia and Herzegovina. Overview. URL: https://www.gfdrr.org/en/bosnia-and-herzegovina
[50] Hadzic, E. et al. (2020). Natural Disaster Risk Management in Bosnia and Herzegovina. Natural Risk Management and Engineering. pp. 41–61. URL: https://link.springer.com/chapter/10.1007/978-3-030-39391-5_3 n

Bosnia and Herzegovina is susceptible to the impacts of climate change more than other Eastern European countries, in part due to the country's limited capacity for adaptation. Financial constraints and limited institutional capacities have limited adaptation capabilities and effective response to climatic hazards. Increasing variability across all seasons makes increases challenges for the country and further threatens future adaptive responses, economic sustainability as well as rural development in the country.[51]

The impacts of climate change are already being experienced in the region, primarily in the agriculture and water sectors. While warming trends may lead to increased opportunity for agricultural productivity and expansion, more intense rainfall events and floods are expected to continue disruptions to the country's ecosystems and populated areas.[52] Climate change also threatens the country's growing tourism industry and may, in the long-term, cause financial losses for local residents for whom tourism is a main source of income.[53] However, rising temperatures are likely to have a favorable effect on the development of agriculture through extended growing seasons.[54]

Gender

An increasing body of research has shown that climate-related disasters have impacted human populations in many areas including agricultural production, food security, water management and public health. The level of impacts and coping strategies of populations depends heavily on their socio-economic status, socio-cultural norms, access to resources, poverty as well as gender. Research has also provided more evidence that the effects are not gender neutral, as women and children are among the highest risk groups. Key factors that account for the differences between women's and men's vulnerability to climate change risks include: gender-based differences in time use; access to assets and credit, treatment by formal institutions, which can constrain women's opportunities, limited access to policy discussions and decision making, and a lack of sex-disaggregated data for policy change.[55]

Agriculture

Overview

The agricultural sector is an important staple for the country's economy and food security situation. Due to its exposure and sensitivity to natural changes, the sector is among the most vulnerable to climate change. Agriculture remains primarily rainfed and irrigation infrastructure was limited to only 0.65% of arable land as of 2013. 46% of BiH is agricultural land and the sector employs nearly 20% of the population. As temperatures rise and rainfall and evaporation patterns change, farming systems in the Mediterranean areas and in the northern regions of the country will need to adapt to new conditions.

[51] Trbic, G. et al. (2017). Limits to Adaptation on Climate change in Bosnia and Herzegovina: Insights and Experiences. Limits to Climate Change Adaptation. pp. 245–259. [Climate Change Management]. URL: https://link.springer.com/chapter/10.1007/978-3-319-64599-5_14

[52] ENVSEC (2012). Climate Change in the West Balkans. ISBN: 978-2-940490-06-6

[53] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. p. 15 URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

[54] Radusin, S. et al. (2013). Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina. UNDP-BiH. URL: http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

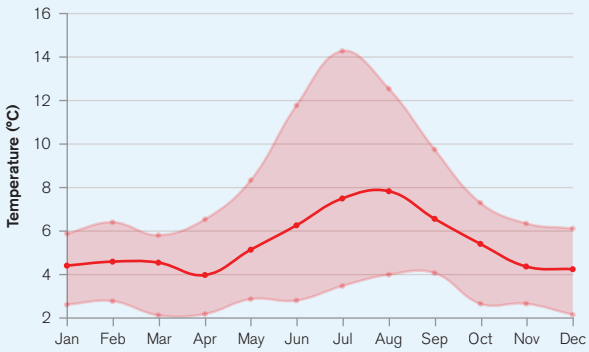
[55] World Bank Group (2016). Gender Equality, Poverty Reduction, and Inclusive Growth. URL: http://documents1.worldbank.org/curated/en/820851467992505410/pdf/102114-REVISED-PUBLIC-WBG-Gender-Strategy.pdf

Climate Change Impacts

As temperature increases, and rainfall continues to be more variable, the probability of droughts occurring in BiH will also increase. Major agricultural zones such as, Mostar, Bijeljina, Brod, and Tuzla, are areas which are most affected by soil-water deficits, which are likely to be exacerbated by changes in climate. Additional damage could be suffered through increased fire risks for cereal crop plantations as soil moisture content is reduced; as well as damage from hailstorms, which appears to be on the rise. Livestock will also be affected by higher peak and average temperatures, potentially leading to heat stress, and introduction or spread of livestock diseases.[56]

As rainfall patterns change and temperatures rise, crop production and expected yields are likely to be negatively impacted, resulting in higher food prices and negative implications for food security.[57] The record high temperatures and drought experienced in 2012 is estimated to have cost approximately US$1 billion in lost agricultural production, and destroyed almost 70% of vegetables and corn produced in inland areas of the country.[58] Increased heat and water scarcity conditions are likely to augment evapotranspiration levels, which could further contribute to crop failure and overall yield reductions. **Figure 10** shows the average daily maximum-temperature across seasonal cycle. These higher temperatures have important negative implications for soil moisture availability and crop growth and as seen in the graph below, high summer spikes in temperature.

FIGURE 10. Average daily max temperature for BiH (RCP8.5, Reference Period, 1986–2005)[59]



Adaptation Options

Both the sensitivity of the agricultural sector to the climate and the high reliance of this sector on the country's water resources have important implications for Bosnia and Herzegovina. The country has committed to supporting a wide range of adaptation measures, including, the implementation of improved water resources management systems, investments in irrigation, the improvement of irrigation-drainage systems, and new farming systems more appropriate for hotter and more arid climates. Introduction of different crop varieties may also help make the

[56] Radusin, S. et al. (2013). Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina. UNDP-BiH. URL: http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

[57] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. p. 15 URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

[58] Radusin, S. et al. (2013). Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina. UNDP-BiH. URL: http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

[59] WBG Climate Change Knowledge Portal (CCKP, 2021). BiH Agriculture. URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=BIH&period=2080-2099

agriculture sector more resilient.[60] Additionally, in avoidance of drought, planting may be able to begin earlier and support more drought resistant varieties. Projected climate change impacts is expected to have a positive influence on yields for most winter crops and adaptation actions could also include shifting production efforts in support of more winter crops and less summer crop production.[61] Improvements to irrigation schemes may support longer growing season is to be expected for some areas, and thus opening an opportunity to diversify crop production. Increased temperatures may be more conducive for the breeding of late crops such as winter wheat, thereby providing greater yields, although probability of crop failure from frost damage remains.[62]

Investments in research and extension services can enhance the capacity and delivery of information to the agricultural sector, with particular reference to climate change and the implementation of adaptation options.[63] Improvements should also be made to the weather monitoring network and associated weather information systems, including the publication and distribution of agriculture-specific weather forecasts on a frequent basis (e.g. short-term and seasonal forecasts, the monitoring of drought, etc.). To improve its resilience to climate change, BiH has invested in upgrading its hydro-agro meteorological monitoring networks and is in the process of conducting studies for the expansion of irrigated farming and modernized irrigation systems.

Water

Overview

BiH's water resources are dominated by two major river basins: the Sava river basin with the Una, Vrbas, Bosna and Drina catchment areas in the north, and the Adriatic basin with the Trebišnjica and Neretva river basins in the south. These resources provide an estimated average flow of 1,555 m^3/s.[64] However, the water sector suffers from poor and degraded infrastructure due to previous wars and a lack of investment. It is estimated that approximately 57% of water leaves the country unused.[65] Deteriorating infrastructure and poor resource and riverbank management is also resulting in the further reduction of quality and potable water.

[60] Bosnia and Herzegovina (2021). Updated Nationally Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Bosnia-Herzegovina%20First/NDC%20BiH_November%202020%20FINAL%20DRAFT%2005%20Nov%20ENG%20LR.pdf

[61] Trbic, G. et al. (2017). Limits to Adaptation on Climate change in Bosnia and Herzegovina: Insights and Experiences. Limits to Climate Change Adaptation. pp. 245–259. [Climate Change Management]. URL: https://link.springer.com/chapter/10.1007/978-3-319-64599-5_14

[62] Radusin, S. et al. (2013). Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina. UNDP-BiH. URL: http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

[63] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. p. 15 URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

[64] Bosnia and Herzegovina (2020). Danube Water Program, Water Snapshot. URL: https://sos.danubis.org/eng/country-notes/bosnia-and-herzegovina/

[65] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. p. 15 URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

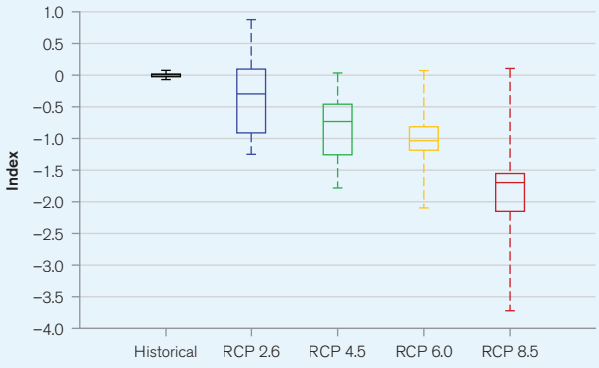
Climate Change Impacts

Projected changes in precipitation and rising temperatures will negatively impact current water management systems and water availability. While, information regarding watershed levels and thus total water availability for the country is available. Seasonal changes such as reduced rainfall in spring and summer seasons are expected to occur in increased frequency of aridity and droughts while an increased frequency of floods are expected for autumn and winter months.[66] Increased aridity will reduce river flows with potential to further impact availability and quality of potable water supplies.[67]

Climate change is likely to exacerbate and prolong periods of water scarcity and drought in regions that already experience water stress. Changes to rainfall and evaporation patterns will impact surface water infiltration and recharge rates for groundwater and low-water storage capacity increases the country's dependence on increasingly unreliable rainfall patterns. This has the potential to further reduce the reliability of unimproved groundwater sources and surface water sources during droughts or prolonged dry seasons. Water pumping mechanisms are facing increased strain and demand, as well as reduced availability, leading to breakdowns if maintenance is neglected. Additionally, temperature rise is increasing soil moisture deficits even under conditions of increasing rainfall. Vulnerability at the municipal scale from water stress show that municipalities located across the north are the most vulnerable, with a gradual decrease in vulnerability towards the central, north, and east of the country. Southern areas of the country are also highly at risk.[68]

Figure 11 shows the projected annual Standardized Precipitation Evapotranspiration Index (SPEI) through the end of the century. The SPEI is an index which represents the measure of the given water deficit in a specific location, accounting for contributions of temperature-dependent evapotranspiration and providing insight into increasing or decreasing pressure on water resources. Negative values for SPEI represent dry conditions, with values below –2 indicating severe drought conditions, while positive values indicate increased wet conditions. This is an important understanding for the water sector relating to quantity and quality of supply for human consumption and agriculture, use as well as for the

FIGURE 11. Annual SPEI Drought Index in BiH for the period, 1986 to 2099 (Reference Period, 1986–2005)[69]



[66] Skøien, J. et al. (2018). Assessment of the capacity for flood monitoring and early warning in Enlargement and Eastern/Southern Neighborhood countries of the European Union, EUR 29073 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-79-77771-4, doi: 10.2760/18691, JRC108843. URL: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC108843/kjna29073enn.pdf

[67] Radusin, S. et al. (2013). *Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina.* UNDP-BiH. URL: https://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

[68] Zurovec, O. et al. (2017). Quantitative Assessment of Vulnerability to Climate Chane in Rural Municipalities of Bosnia and Herzegovina. 9(7). DOI: https://doi.org/10.3390/su9071208

[69] WBG Climate Change Knowledge Portal (CCKP, 2021). BiH Water Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=BIH&period=2080-2099

energy sector as reductions in water availability impacts river flow and the hydropower generating capabilities. Assessed for the entire country, Bosnia and Herzegovina is projected to experience heightened dry conditions with increasingly more severe droughts, putting greater pressure on water resources.

Adaptation Options

Limited hydro-meteorological resource data is available to support climate change risk assessment on the sector at a county scale and increased efforts on data collection and analysis for the country's water sector would be beneficial. Adaptation approaches for BiH's water sector are currently limited by a lack of reliable data and poorly maintained existing infrastructure (both flood protection and water storage infrastructure). These investments are needed, along with mechanisms to better manage water supply and distribution.[70] Investment needs to be made to support structural adaptation changes in the country's water management structure, in particular to support agriculture and energy sectors.[71] Adaptation strategies should focus on reducing the environmental and socio-economic impact form catastrophic floods, mud-slides and riverbank erosion, specifically in settled areas.[72]

Energy

Overview

Bosnia and Herzegovina has the capacity to generate its own energy requirements. As of 2018, the country had approximately 2.076-Megawatt (MW) net installed hydropower capacity, 2065 MW of lignite, 159 MW of small hydropower, 51 MW wind power, and 18.15 solar. Generation levels continue to stay around two-thirds coal to one-third hydropower, depending on hydrological conditions.[73] BiH is a net exporter of electricity, although its electricity consumption remains relatively low as compared to other European countries.[74] The country's domestic coal is expected to remain a primary source of electricity generation and BiH's generating capacity could be increased more than two-fold given the country's significant reserves of coal and the sector's high employment. However, the competitiveness of the existing and new coal-fired thermal power plants in BiH on the open market remains questionable. Electricity generation was liberalized in January 2015, however domestic coal continues to be protected. Given the country's high aims for renewable energy, including a target of 34% energy composition set in 2016, questions remain as to the continued viability of its domestic coal and energy generation sector.[75] In March 2018 BIH's first wind farm, the 50.6 MW Mesihovina facility in Herzegovina, financed by Germany's KfW – began operating.

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[70] Radusin, S. et al. (2013). *Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina.* UNDP-BiH. URL: http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

[71] Bosnia and Herzegovina (2021). Updated Nationally Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Bosnia-Herzegovina%20First/NDC%20BiH_November%202020%20FINAL%20DRAFT%2005%20Nov%20ENG%20LR.pdf

[72] Trbic, G. et al. (2017). Limits to Adaptation on Climate change in Bosnia and Herzegovina: Insights and Experiences. Limits to Climate Change Adaptation. pp. 245–259. [Climate Change Management]. URL: https://link.springer.com/chapter/10.1007/978-3-319-64599-5_14

[73] CEE Bankwatch Network (2021). The energy sector in Bosnia and Herzegovina. URL: https://bankwatch.org/beyond-coal/the-energy-sector-in-bosnia-and-herzegovina

[74] IEA (2018). Bosnia and Herzegovina Country Profile. URL: https://www.iea.org/countries/bosnia-and-herzegovina

[75] Bosnia and Herzegovina (2016). National Renewable Energy Action Plan (NREAP BIH). URL: http://climatepolicydatabase.org/index.php/National_renewable_energy_action_plan_Bosnia_herzogovina

Climate Change Impacts

Electricity generation in BiH is primarily via hydropower and thermal (coal powered) powerplants; biomass burning at household level is also common.[76] Climate change is expected to exacerbate problems related to low river flows. The expected reductions in summer precipitation in inland areas could lead to a fall in the production of hydroelectric power, which could also jeopardize energy security as well as critical electricity exports. Prior experience points to reductions in hydro-electric power generation during periods of drought, which could be offset through the use of thermal energy or by importing power.[77] The hydropower infrastructure and power generation facilities face an additional impact in the event of floods: more frequent, intense rain events will lead to increased runoff and peak river flows, all at a time when there is a risk to infrastructural damage.[78]

Cooling Degree Days show the relationship between daily heat and cooling demand, typically sourced through a form of active cooling or an evaporative process (**Figure 12**). The change in cooling degree days provides insight into the potential for extended seasons of power demand or periods in which cooling demand (power demands) might increase. Seasonal increases for cooling demands are expected to increase over an extended summer period (May to October). The Warm Spell Duration Index represents the number of days in a sequence of at least six days in which the daily maximum temperature is greater than the 90th percentile of daily maximum temperature. As shown in **Figure 13**, warm spells are expected to sharply increase in the second half of the century.

FIGURE 12. Change in Cooling Degree Days (65°F) in BiH for the period 2040–2059 (Reference Period, 1986–2005)[79]

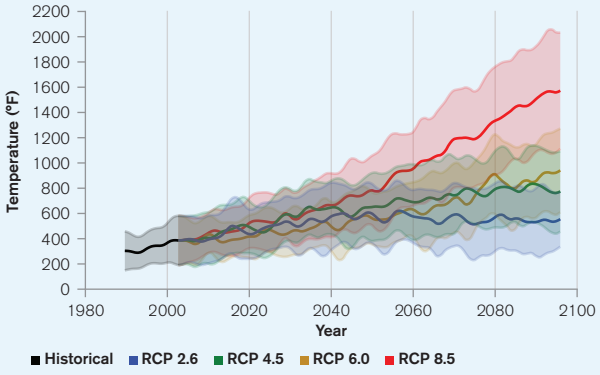
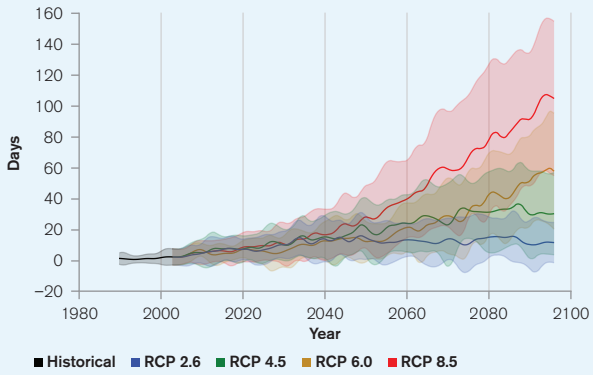


FIGURE 13. Warm Spell Duration Index in BiH for the period 1986 to 2099 (Reference Period, 1986–2005)[80]



[76] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. p. 15 URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

[77] Radusin, S. et al. (2013). *Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina.* UNDP-BiH. URL: http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

[78] Skøien, J. et al. (2018). Assessment of the capacity for flood monitoring and early warning in Enlargement and Eastern/Southern Neighborhood countries of the European Union, EUR 29073 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-79-77771-4, doi: 10.2760/18691, JRC108843. URL: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC108843/kjna29073enn.pdf

[79] WBG Climate Change Knowledge Portal (CCKP, 2021). BiH — Energy. URL: https://climatedata.worldbank.org/CRMePortal/web/energy/oil-gas-and-coal-mining?country=BIH&period=2080-2099

[80] WBG Climate Change Knowledge Portal (CCKP, 2021). BiH Energy Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/energy/oil-gas-and-coal-mining?country=BIH&period=2080-2099

Adaptation Options

River flows in Bosnia and Herzegovina are likely to become increasingly erratic, creating significant challenges for the hydropower sector, particularly during the low-water periods (June to September). This should be addressed through improved management of water resources. Additional hydropower plants could be a promising source of renewable energy and a long-term adaptation strategy for the sector. The sector offers significant opportunities for 'green economy' development, with the potential involvement of small and medium-sized enterprises (SMEs) in their construction and operation.[81]

To ensure the resilience of energy infrastructure to current variability and projected future climate change, the government has committed to support and improve continued provision of basic services to the public.[82] The government and individual departments need to understand the inherent vulnerabilities in its water and energy sector and develop flexible adaptation strategies for existing and planned infrastructure, and thus more research is needed to support future planning and adaptation efforts.

Health

Overview

The health of the population has deteriorated due to a number of socio-economic factors such as, high unemployment, migration and high numbers of displaced persons, smoking, poor diet and high levels of post-traumatic stress disorder. Cardiovascular disorders and cancer are highly prevalent, and common communicable diseases include respiratory ailments (influenza), childhood infectious diseases (varicella), and bowel diseases (enterocolitis). Health implications related to climate change impacts, such as heat stress are also expected to have adverse consequences for the population, particularly more vulnerable populations.[83]

Climate Change Impacts

Significant health effects caused by climate change are possible, primarily from rising temperatures, more frequent heat waves, and floods. As river flows are reduced, water-borne illnesses could rise. Furthermore, abnormally high temperatures are particularly dangerous for vulnerable groups such as the elderly, children and those suffering from cardiovascular problems. Higher temperatures can also contribute to the spread of vector-borne diseases and may also result in increased frequency of exacerbations of cardiovascular diseases, and in summer, the temperature rise and long periods of hot weather can lead to an increase in mortality due to overheating and the associated worsening of chronic diseases.[84] As winters become milder, cold-related mortality and illnesses could decrease.

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[81] Bosnia and Herzegovina (2016). National Renewable Energy Action Plan (NREAP BIH). URL: http://climatepolicydatabase.org/index.php/National_renewable_energy_action_plan_Bosnia_herzogovina

[82] Bosnia and Herzegovina (2021). Updated Nationally Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Bosnia-Herzegovina%20First/NDC%20BiH_November%202020%20FINAL%20DRAFT%2005%20Nov%20ENG%20LR.pdf

[83] WHO (2014). Bosnia and Herzegovina. URL: https://www.who.int/medical_devices/countries/bih.pdf?ua=1

[84] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. p. 15 URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

The country's annual distribution of days with a high heat index provides insight into the health hazard of heat as well as seasonal changes. Rising temperatures continue to be of increasing concern. The annual distribution of days with a high-heat index offers insight into the health hazards potentially posed by heat. **Figure 14** shows the expected Number of Days with a Heat Index >35°C for 2090s. This indicates a sharp increase in the number of very hot days, under a high-emission scenario by end of the century.[85] Tropical Nights (**Figure 15**) represent the projected increase in nighttime temperatures (>20°C) across different emission scenarios to demonstrate the difference in expected numbers of tropical nights. These rapidly increasing night temperatures could reduce natural cooling cycles, posing a risk to the most vulnerable.

FIGURE 14. Days with a Heat Index >35°C (Reference Period, 1986–2005)[86]

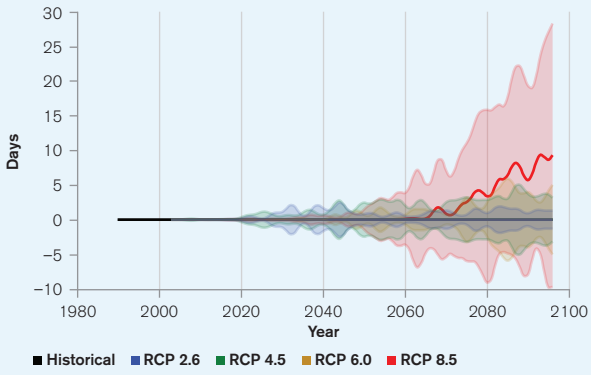
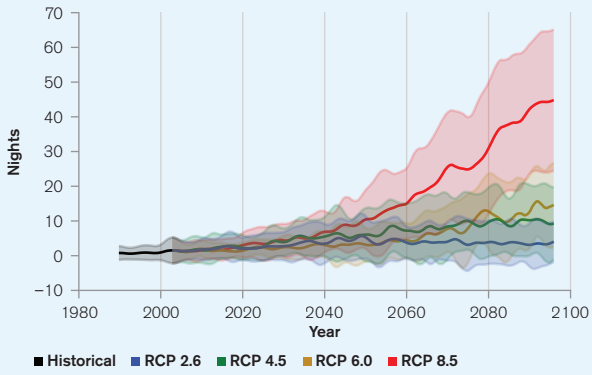


FIGURE 15. Number of Tropical Nights (Tmin >20°C) (Reference Period, 1986–2005)[87]



Adaptation Options

The country's health-care infrastructure needs to be upgraded to support more systemic climate change resilience. Capacity should be built to support adaptation to extreme weather events and the necessary response capacities to address these risks. Health care system personnel should receive more training as to the relationships between climate and health impacts. Specific training of personnel in regard to adaptation and climate change is needed. Improvements in training and capacity can augment the requisite knowledge and skills to properly diagnose diseases associated with climatic factors. However, this knowledge remains relatively limited.[88] Additionally, monitoring and surveillance systems need to be improved to provide information on the associations between critical health hazards and climate.[89] Increased investment, coupled with a targeted climate-health-adaptation research agenda can support

[85] Radusin, S. et al. (2013). *Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina.* UNDP-BiH. URL: http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

[86] WBG Climate Change Knowledge Portal (CCKP, 2021). BiH Health Sector Dashboard. URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=BIH&period=2080-2099

[87] WBG Climate Change Knowledge Portal (CCKP, 2021). BiH Health Sector. URL: https://climatedata.worldbank.org/CRMePortal/web/agriculture/crops-and-land-management?country=BIH&period=2080-2099

[88] Trbic, G. et al. (2017). Limits to Adaptation on Climate change in Bosnia and Herzegovina: Insights and Experiences. Limits to Climate Change Adaptation. pp. 245–259. [Climate Change Management]. URL: https://link.springer.com/chapter/10.1007/978-3-319-64599-5_14

[89] Skøien, J. et al. (2018). Assessment of the capacity for flood monitoring and early warning in Enlargement and Eastern/Southern Neighbourhood countries of the European Union, EUR 29073 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-79-77771-4, JRC 108843. URL: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC108843/kjna29073enn.pdf

the identification and analysis of trends and develop indicators to improve health sector capacity to react. The development of a disease-specific Health Early Warning System could save lives, particularly with regards to heat.

Strategic investments should be earmarked to improve active cooling solutions (air conditioning) as well as water purification. General awareness campaigns regarding climate change and its impact to human health is critical, especially for most vulnerable groups such as children and the elderly. Additional research on the climate change impacts on population health would help to inform and prepare healthcare providers as well as policy makers.[90]

ADAPTATION

Institutional Framework for Adaptation

Bosnia and Herzegovina adopted its Updated Nationally Determined Contributions (NDC) to the UNFCCC in 2021 and published its Third National Communication (NC3) and Second Biennial Update Report on Green House Gas Emissions in 2016. The country's climate change adaptation and planning mechanisms are executed by the Ministry of Foreign Trade and Economic Relations is responsible for coordination of climate change adaptation and mitigation activities as well as coordinating with governmental bodies and institutions at the international level in relation to climate change commitments and environmental protections.[91] The country's adaptation plans are also in line with the submitted application (February 2016) to ascend to EU membership. BiH is aiming to have an established green economy by 2025 to support its membership to the EU.[92] Bosnia and Herzegovina institutions are facing significant challenges to develop and implement strategies, plans and programs of adjustment to climate change. The federal government is working to introduce stronger institutional and legislative frameworks for support various sectors approach complex climate change challenges and integrate needed work within sectoral strategic plans.[93]

Policy Framework for Adaptation

BiH has adopted a number of documents and strategies associated with the regulation of actions and implementation of measures in the areas impacted by climate change and has seen tangible success achieved towards the implementation of the Kyoto Protocol mechanisms. BiH aims to build a resilient, interdisciplinary governance structure to manage and adapt to the country's changing climates and its related impacts. According to the

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[90] Radusin, S. et al. (2013). *Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina.* UNDP-BiH. URL: http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

[91] Bosnia and Herzegovina (2021). Updated Nationally Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Bosnia-Herzegovina%20First/NDC%20BiH_November%202020%20FINAL%20DRAFT%2005%20Nov%20ENG%20LR.pdf

[92] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. p. 15 URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

[93] Trbic, G. et al. (2017). Limits to Adaptation on Climate change in Bosnia and Herzegovina: Insights and Experiences. Limits to Climate Change Adaptation. pp. 245–259. [Climate Change Management]. URL: https://link.springer.com/chapter/10.1007/978-3-319-64599-5_14

country's Constitution, all matters of environmental and water management are assigned to the level of the entities. Environmental responsibilities lie with the Ministry of Foreign Trade and Economic Relations (MOFTER) and climate change efforts are coordinated through the MOFTER and Council of Ministers.

In regards to adaptation, there is need to further build platforms for disaster risk reduction in order to systematically support coordination and risk response. BiH is currently developing sectoral Nationally Appropriate Mitigation Actions (NAMAs) and a related sectoral registry to track progress. NAMAs have been proposed for Transport, Capacity Building, and Energy Generation sectors. Submission and oversight of NAMAs are through the Ministry for Spatial Planning, Civil Engineering and Ecology. Bosnia and Herzegovina made investment to increase its adaptive capacity through the establishment of additional hydrometeorological stations, a database to collect, store and analyze observed weather data, and an agro-meteorological early warning system is currently under development.[94]

National Frameworks and Plans

- Updated Nationally Determined Contribution (2021)
- Second Biennial Update Report (2017)
- Nationally Determined Contribution (2016)
- Third National Communication (2016)
- Second National Communication (2013)
- Initial National Communication (2010)

Recommendations

Research Gaps

- Improve science-based understanding of the nature and magnitude of physical and biophysical climate change impacts under different scenarios across Bosnia and Herzegovina
- Increase spatial mapping of flood zones and geographic, which are particularly susceptible to flooding and resulting landslides
- Strengthen capacity in meteorological and climatological skill for improved monitoring and predictive capabilities; this includes the installation of more weather stations, climate bases and early notification systems[95]
- Widen the participation of the public, scientific institutions, women and local communities in planning and management, accounting for approaches and methods of gender equity
- Strengthen environmental frameworks and related legislative priorities for strengthened and more effective environmental management[96]

[94] Bosnia and Herzegovina (2021). Updated Nationally Determined Contributions. URL: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Bosnia-Herzegovina%20First/NDC%20BiH_November%202020%20FINAL%20DRAFT%2005%20Nov%20ENG%20LR.pdf

[95] Trbic, G. et al. (2017). Limits to Adaptation on Climate change in Bosnia and Herzegovina: Insights and Experiences. Limits to Climate Change Adaptation. pp. 245–259. [Climate Change Management]. URL: https://link.springer.com/chapter/10.1007/978-3-319-64599-5_14

[96] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. p. 15 URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

Data and Information Gaps

- Improve observational data through the additional of weather stations and hydro-meteorological and riverine instrumentation
- Improve technical capacity to analyze hydro-met data
- Develop early warning systems about dangerous hydrometeorological phenomena and climate risk management
- Address the technical constraints in Bosnia and Herzegovina, specifically for agriculture and irrigation needs[97]
- Increase awareness of long-term groundwater risks and need for improved water resource management
- Conduct detailed health risk assessments to better define increased vulnerability potential for public health in the face of changing seasonal patterns and infectious and communicable disease transmissions
- Increase modelling capabilities of renewable energy demand and generation and transportation infrastructure capabilities

Institutional Gaps

- Prepare and implement a *Roadmap for Reform of Environmental Management in Bosnia and Herzegovina*
- Improve the alignment of environmental priorities with BiH's development agenda, i.e. green economy and hydro-energy generation
- Apply EU requirements to environmental management, delineate responsibilities, and subordination and coordination in the sphere of environmental management of central government units (including MENR, ministries, agencies, and so forth); regional government; regional branches of central government units; and local government (city, settlement, and village
- Develop and integrate a country-wide environmental strategy goals in sectoral and regional plans
- Implement cross-sectoral climate-smart solutions at country, entity and sector scales
- Implement regional-scale cooperation among countries in the Western Balkans to emphasize the benefits of collaboration and institution building in the region[98]
- Establish a National Steering Committee on Climate Change to ensure the integration of low-carbon, climate-resilient considerations into development planning by providing overall guidance, political support, and leadership, ensuring adequate resource allocation and monitoring the results related to efforts to address and adapt to climate change

[97] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina (2016). Third National Communication and Second Biennial Update Report on Greenhouse Gas Emissions of Bosnia and Herzegovina under the UNFCCC. p. 15 URL: http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/News/E&E%20Sector/TNC/TNC%20Report%20ENG.pdf

[98] Radusin, S. et al. (2013). *Climate Change adaptation and low-emission development strategy for Bosnia and Herzegovina.* UNDP-BiH URL: http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html

CLIMATE RISK COUNTRY PROFILE

BOSNIA AND HERZEGOVINA

WORLD BANK GROUP