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BOSNIA AND HERZEGOVINA

**CLIMATE CHANGE
IMPACTS AND RISKS**

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CONTENTS

ABBREVIATIONS	7
FOREWORD	8
EXECUTIVE SUMMARY	11
COUNTRY CONTEXT	13
Socio-economic context and political background	13
Table 1. BiH's major socio-economic statistics	14
Role of fossil fuels in the BiH Economy	15
Perception of climate change in Bosnia and Herzegovina	16
CLIMATE CHANGE WITHIN INSTITUTIONAL SETTING AND POLICY CONTEXT	17
Figure 1. Main entity and district-level institutions with the competence for climate change	18
Figure 2. Specific national-level GHG emissions reduction objectives, 2013–2025	20
BOSNIA AND HERZEGOVINA AND CHANGING CLIMATE	23
CLIMATE CHANGE IMPACTS AND VULNERABILITIES	26
Agriculture	27
Table 2. Main BiH droughts and their economic impact on the agricultural sector, 2000–2012	29
Water	32
Table 3. GDP change by quarter and category, 2014	33
Figure 3. GDP quarterly fluctuations, 2014	33
Figure 4. Unemployment trends in BiH, 2014	34
Energy	34
Public health	36
Tourism	37
Other relevant risks	38
CONCLUDING REMARKS	39
ACKNOWLEDGMENTS	43
ENDNOTES	44

List of abbreviations

BiH	Bosnia and Herzegovina
EBRD	European Bank for Reconstruction and Development
EU	European Union
FBiH	Federation of Bosnia and Herzegovina
FDI	Foreign direct investment
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse gas
LEDS	Low-Emission Development Strategy
NAMAs	Nationally Appropriate Mitigation Actions
NDC	Nationally Determined Contribution
NEEAP	National Energy Efficiency Action Plan
RS	Republika Srpska
SDGs	Sustainable Development Goals
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization
gCO ₂ eq/kWh	electricity carbon intensity
ha	hectare
kg/MWh	kilogram per megawatt hour
km ²	square kilometer
kWh/m ²	kilowatt hour annual heating demand
mm	millimeter
MW	megawatt
PM	atmospheric particulate matter
Q	quarter
US\$	United States dollar
°C	degrees Celsius

Foreword

Bosnia and Herzegovina has unsatisfactory practice of reacting to unlikely events with great impacts, such as floods, pandemics, protests, and the like. Strategic documents and action plans exist, as they are in most cases created under pressure from the international community, but implementation is lacking so that in the end they remain unimplemented. A glaring example of this is the National Plan to Combat the 2009 Pandemic of Bosnia and Herzegovina, in the context of the COVID-19 pandemic. It is this pandemic that has shown us that we cannot merely ignore objective reality, that is, its consequences, simply because it is not in the temporary focus of the political and wider public.

Due to all the above, the report entitled "Climate Change Impacts and Risks in Bosnia and Herzegovina" comes at the right time because it emphasizes one problem like COVID-19 with extremely high impact on the economy and society as a whole, but with periodic occurrences (with a trend of intensification in the future). The report addresses the direct and indirect impacts of climate change on Bosnia and Herzegovina, sublimating existing research, both domestic and foreign, and offering a unique contribution through the analysis of economic and other impacts.

Through a simple and understandable structure of the report, the authors present the key influences on areas such as the energy sector, agriculture, tourism, but also public health. It is important to note that the energy sector is the backbone of the modern economy of Bosnia and Herzegovina, while agriculture and tourism, although with relatively negligible share in GDP, record organic growth in recent years.

As written in the report, Bosnia and Herzegovina lacks awareness on the importance of climate change, as well as the financial and human resources to deal with the consequences of these changes. This can be partly explained by the underdeveloped economy, specifically, the GDP per capita of US\$5,690 in 2019, which is insufficient for the average citizen to think about global problems that (in)directly affect his or her life.

Namely, most citizens are concerned with their day to day needs and do not focus on long-term challenges like climate change. This is documented by the general lack of disposable income allocated to addressing climate and environmental concerns.

The uniqueness of this report is that it offers a series of solutions and steps regarding what should be done in the near

future in terms of responding to climate change. These solutions are adapted to different levels of government in Bosnia and Herzegovina, primarily state and entity. It is necessary, as stated in the report, to mobilize domestic and foreign resources systemically and strategically. The decarbonization of the economy is certainly one of the most important things due to the fact that Bosnia and Herzegovina rely mainly on fossil fuels in energy production. Energy efficiency is very low, while only 1 percent of energy is generated from renewable energy sources. The authorities have been ignoring energy efficiency for decades, while citizens are already paying the price in the form of impaired health parameters (in the urban areas of Bosnia and Herzegovina, clean air has long been perceived as a privilege, not a right).

The report indicates that there is not a single budget line within existing budgets at different levels of government that would address the challenges of climate change. The government is simply ignoring this problem, even though they are becoming visible, mostly through floods like the ones from 2014. The report rightly recognizes that the constitutional structure of the state is not the only obstacle, but that there is a serious lack of resources to address these issues.

Finally, it should be noted that the authors have made a remarkable effort to bring this publication to light and that this is a pioneering attempt to present the issue of climate change in the context of Bosnia and Herzegovina.

The greatest contribution is the transfer of the abstract concept of climate change into realistic frameworks understandable to citizens and decision-makers, even through the projection of economic effects (GDP in particular). The report is based on sound references, but still with a simple structure, written in understandable language, so I recommend it to both decision-makers and representatives of the academic community, and certainly to the general public. Hopefully, the report will launch a debate on this issue in Bosnia and Herzegovina and influence a change in policy practices related to such issues.

Admir Cavalic
Director, Multi

Earth's climate is changing rapidly, faster than ever before. This problem is the direct cause of the industrial revolutions and technological advancements that have occurred in the past two centuries. The global economy is heavily dependent on fossil fuels and yet there are glimpses of hope. Bosnia and Herzegovina, is a small economy but a moderate producer of energy per capita.

However, less than 1 percent of energy generated is supplied by renewable energy sources. While carbon pollution output contribution is minuscule in comparison to that of large economies such as China and the United States, we will equally suffer the consequences of climate change. The government of Bosnia and Herzegovina officially declared climate change a threat in 2010. However, the country's governance complexity has been the most significant obstacle in addressing the problem from a legislation perspective.

The country does not have a centralized institution that can act with confidence that advice will be acted upon uniformly. Currently, there is a myriad of government bodies that manage ecological matters with insufficient coordination. Therefore, the country's climate matters regulation requires internal cooperation and coordination efforts.

The report shows that the climate change threat to the country is underestimated both from an institutional and policy perspective.

There are serious socio-economic consequences if we continue to ignore and delay action. Climate change has profoundly affected Bosnia and Herzegovina, as seen in the last two decades, causing more than 2,000 landslides, killing dozens of citizens and disrupting the livelihoods of over 1 million.

This report attempts to provide an insightful overview of the impact climate change will have on different sectors of the Bosnia and Herzegovina socio-economic ecosystem. It is a must-read for all who want to have a better understanding of the holistic perspective of climate change within the borders of this small Western Balkan nation. Bosnia & Herzegovina Futures Foundation strongly supports the work of the authors as they highlight challenges climate change will pose all facets of life in our homeland. Our scholars are leaders of tomorrow and they will play an active role in creating a prosperous Bosnia and Herzegovina that can respond to the challenges of the twenty-first century, climate change being the ultimate one!

Dr. Edhem 'Eddie' Custovic
Founder, Bosnia & Herzegovina
Futures Foundation

Executive summary

Climate change represents a serious and growing threat to Bosnia and Herzegovina (BiH). Its effects are leading to a variety of negative impacts that could substantially decrease the country's gross domestic product (GDP) as well as the livelihoods and wellbeing of the majority population. The risks posed from worsening drought and flood events are leading to significant declines in productive capacity, employment opportunities, and public health across the agriculture, energy, water, and tourism sectors. In the agriculture sector, up to 100 percent of agricultural output, or about 6 percent of GDP, is at risk from extreme climate events with dire implications for short-term food security. In the energy sector, lower river levels from drought events threaten hydroelectric generation capacity, where just 5–10 percent decreases in water flow cause financial losses of US\$60 million for public electric utility companies. In the water sector, drought and floods both significantly limit public and private availability of this resource with negative implications for public health and water-dependent economic output. Declining snowfall and rising rates of forest fire events is threatening tourism with a variety of direct implications for ski resorts, outdoor attractions, hotels, restaurants, and local transportation. Furthermore, there are a variety of other inter-related climate related risks that exist across all major economic sectors.

Despite this range of threats however, climate change is still addressed in a fragmented and insufficient manner. BiH does not have a climate action plan and is lacking a coordinated effort to mainstream mitigation and adaptation efforts. Public and private investment is lacking in critical climate-risk areas across sectors exposing the country productivity risks and social stability. Due to BiH's administrative complexity, climate change is addressed simultaneously on both national and entity levels; however, on both levels, the topic lacks coordination and does not receive the attention it deserves. Furthermore, there is an evident policy gap as well as absence of domestic climate change-focused adaptation and mitigation financial resources. Hence, the country strongly depends on multilateral and bilateral aid to finance major projects and initiatives.

This report details the impacts of climate change in BiH and the implications for critically impacted sectors based on several interviews and a desk review of the most recent climate literature and even considers these in light of the ongoing COVID-19 pandemic. The report aims to thoroughly understand sectoral climate impacts and risks within a socio-economic context and makes recommendations for BiH to develop adaptive responses accordingly.

The report finds that institutional and policy gaps exist in addressing climate change challenges in BiH and overall visibility of climate risks need to be better addressed and communicated. BiH will need to support sectoral interventions that focus on mainstreaming climate resiliency measures alongside aims to increase aggregate output and social protection. A wise initial means for approaching this may include seeking financial and technical assistance from leading development partners. If left unchecked, climate change poses a serious socio-economic threat to the country.

Country context



Socio-economic context and political background

BiH is a middle-income country located in the western part of the Balkan Peninsula (see Table 1). Located in the north, Bosnia occupies 80 percent of the total BiH area and is a mountainous, inland territory with a moderate continental climate comprised of hot summers and cold and snowy winters. The southern region, Herzegovina, has a Mediterranean climate and plainer topography.

The present-day socio-economic context and political system are heavily influenced by the Bosnian War that occurred between 1992 and 1995 and resulted in 104,000 deaths, 1 million refugees fleeing the crisis and 60 percent of those who remained were internally displaced.[1] The war devastated economic output by 80 percent, resulting in massive unemployment. Prior to the war, the economy was centered on heavy industries such as metals, armaments, automobiles and energy. The war's impact, combined with industry mismanagement and corruption, eroded competitiveness across all sectors of the economy.

Table 1. BiH's major socio-economic statistics

Capital	Sarajevo
Official languages	Bosnian, Serbian and Croatian
Government type	Federal parliamentary constitutional republic composed of three semi-autonomous parts: FBiH (covering 51% of the territory and 63% of the population), RS (49% of the territory and 35% of the population), and Brčko District (1% of the territory and 2% of the population)
Area	51,129 km ²
Population	3.5 million (2013) – 2.7 million (2018)
Ethnic composition	50% Bosniaks, 31% Bosnian Serbs, 15% Bosnian Croats, 4% other ethnic groups and non-declared individuals
Life expectancy at birth	76.4 years; 74 years for men and 79 years for women
Currency	Convertible mark (BAM)
GDP	US\$20,162 billion (2018)
Main industries	Steel, coal, iron ore, lead, zinc, vehicles, textiles, furniture, armaments, domestic appliances
GDP by sector	65% services, 27% industry and 8% agriculture
Diaspora contribution to GDP	10%
Unemployment	15.7%
Major export commodities	Metals, electricity, wood products and clothing
Major import commodities	Crude oil, packed medicaments and automobiles
Major export markets	Germany, Italy, Slovenia, Croatia and Serbia
Major import countries	Serbia, Germany, Croatia, Italy and Slovenia
Top five FDI investors (2000–2017)	Austria US\$1.1 billion (24%), Serbia US\$0.95 billion (12%), Croatia US\$0.94 billion (12%), Russia US\$0.45 billion (6%), Slovenia US\$0.38 billion (4%)
FDI by sector (2000–2017)	32% manufacturing, 22% banking, 15% telecommunications, 11% trade, 5% real estate, 4% services, 11% other
Doing business ranking	90/190
HDI Index	0.769 (ranked as 75/189)
GINI Index	33

Source: Multiple sources, 2014–2018. [2][3][4][5][6][7][8][9][10][11][12][13][14][15]

The Dayton Peace Agreement that ended the war preserved BiH's external borders, existence and sovereignty, but created a complex multiethnic asymmetrical federal state. The complex politico-administrative and institutional setups foster ethnic favoritism and corruption across entities and impede reform of the country's socio-economic and political models.[16]

As a result, the state and its entities have had a negative impact on the decision-making processes efficiency and caused unnecessary authority duplication. Besides the ethno-political stalemate, BiH additionally faces a regional trend of depopulation due to the continued emigration of young and skilled labor to the West and low fertility rates within the country, which is reducing private sector competitiveness and productivity. [17]

In 2016, BiH applied for European Union (EU) membership and is currently satisfying the criteria to gain official candidate status. In 2018, the European Commission praised the country for making progress in the fight against organized crime and corruption as well as fulfilling the action plan on anti-money laundering. Concerning its economic development and competitiveness, the country has made good progress in improving its business environment and strengthening the domestic financial sector.[18]

Role of fossil fuels in the BiH economy

BiH greenhouse gas (GHG) emissions per capita are about half of the EU average, but its economy still suffers from energy inefficiency and is heavily dependent on fossil fuels. In 2014, fossil fuels represented 77.5 percent of total energy use.[19] In 2018 approximately 62 percent of electricity was generated from coal-fired power plants, 36 percent from large hydroelectric power plants, and 2 percent from renewable energy and other energy sources.[20] Less than 1 percent of electricity is supplied from renewable energy sources (i.e., solar, wind, small-scale and biomass). Coal produced in local mines is the country's main source of energy, including dark coal and lignite – an important export product. The country exported approximately US\$260 million of dark coal and lignite to neighboring countries in 2017.[21] In the last census in 2013, 73 percent of households stated that they use solid fuels (i.e., wood and coal) for heating. [22]

According to the International Energy Agency, the country is more than four times as energy intensive when compared with the EU member state average and has the highest energy intensity in the Western Balkans.[23] Fossil fuel use additionally dominates the transportation sector as the rail network is limited and the use of trains

for everyday transportation is insignificant. A similar situation is found in the industry sector, which relies on domestic coal and imported natural gas for energy use.[24]

Perception of climate change in Bosnia and Herzegovina

The population of BiH has started experiencing the adverse effects of climate change in the past few decades from heatwaves causing droughts and wildfires in the summer months and unpredictable spring rains, triggering floods and landslides.[25] However, the threat that climate change represents to the country is underestimated both in institutional as well as policy levels. Moreover, domestic research activities and capacity building have not been developed sufficiently to address the issue.

Climate change is a phenomenon that does not have high priority in BiH. According to the United Nations (UN) MY World global survey in 2015, action taken on climate change ranked second from the bottom, while better job opportunities were seen as a priority.[26]

Similarly, BiH respondents in the Life in Transition Survey II, conducted in 2010 by the European Bank for Reconstruction and Development (EBRD), considered more relevant to pay higher taxes if the money was used on education or helping the needy, versus paying higher taxes to combat climate change.[27]

BiH has taken various steps at international, regional and national levels to address climate change since it ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 2000. Additionally, the country is eager to become an EU member state in the future and is willing to implement reforms that will make its economy and society less carbon intensive. Nonetheless, not enough is done by the country to strengthen adaptation and mitigation efforts. Political stalemate, lack of finance, weak institutional linkages, incomplete knowledge base and capacity-building needs are the main challenges preventing the efficient integration of climate change from becoming a national priority.

Climate change within institutional setting and policy context



The complexity of the BiH state and its legislative framework prevents the country from initiating a comprehensive strategy to address climate change. Within the state apparatus, the legislative competence for the environment lies in two main entities, Federation of Bosnia and Herzegovina (FBiH) and Republika Srpska (RS) as well as Brcko District (see Figure 1). The two main entities additionally have an inter-entity environmental body that is charged with developing the inter-entity environmental protection plan and operates on an as-needed basis.

Figure 1. Main entity and district-level institutions with the competence for climate change

FBiH	RS	Brcko District
<ul style="list-style-type: none"> • Ministry of Environment and Tourism • Ministry of Energy, Mining and Industry • Ministry of Agriculture, Water Management and Forestry 	<ul style="list-style-type: none"> • Ministry of Spatial Planning, Civil Engineering and Ecology • Ministry of Industry, Energy and Mining • Ministry of Agriculture, Forestry and Water Management 	<ul style="list-style-type: none"> • Department of Communal Works

Source: Authors, 2020.

At the state level, the main decision-making body is the Council of Ministers of BiH. The Ministry of Foreign Trade and Economic Relations is responsible for the coordination of activities and harmonization of individual entities' governmental bodies and institutional plans at the international level within energy, environmental protection, development and the exploitation of natural resources. The state acts as a mediator, but entities and the district manage local ecological issues through laws, regulations and standards. Therefore, the state's jurisdiction in climate matters is limited to international cooperation and coordination efforts such as participation in the international agreements dealing with GHG emissions mitigation.

Besides domestic institutions, multilateral institutions such as the World Bank, the EU and the UN agencies play an important role in the local context. They secure financial resources (e.g., loans and grants), facilitate training for governmental officials, sponsor research initiatives at universities and provide other expertise that promotes the integration of climate change within the legal, economic and socio-political domains of the country. Therefore, both mitigation of and adaptation to climate change are efforts driven by multilateral organizations (e.g., UN, EU, World Bank) operating within the country. Multilateral organizations help Bosnian state and entity institutions to build their capacity as well as fund different climate change-related projects (e.g., the Technology transfer for climate resilient flood management in Vrbas River Basin project).

The cities of Banja Luka, Sarajevo and Zenica have all joined EBRD's Green City Plan Framework. In the case of Banja Luka, the EBRD supported a public-private partnership for conversion technologies that helped transform a local district heating power plant from a costly and polluting heavy fuel oil generation facility to a cheaper and environmentally friendly locally sourced wood biomass facility.[28] In Zenica, the EBRD arranged US\$51 million financing package to replace a coal-fired plant with a cogeneration plant. The project is a joint venture formed by ArcelorMittal Zenica, the City of Zenica, KPA Unicon and Finnfund.[29] In Sarajevo, with help from the Embassy of Japan and Atkins, the EBRD launched the Sarajevo Canton initiative's "Green City Action Plan" that aims at tackling, among other environmental-related issues, smog pollution during the winter months.[30]

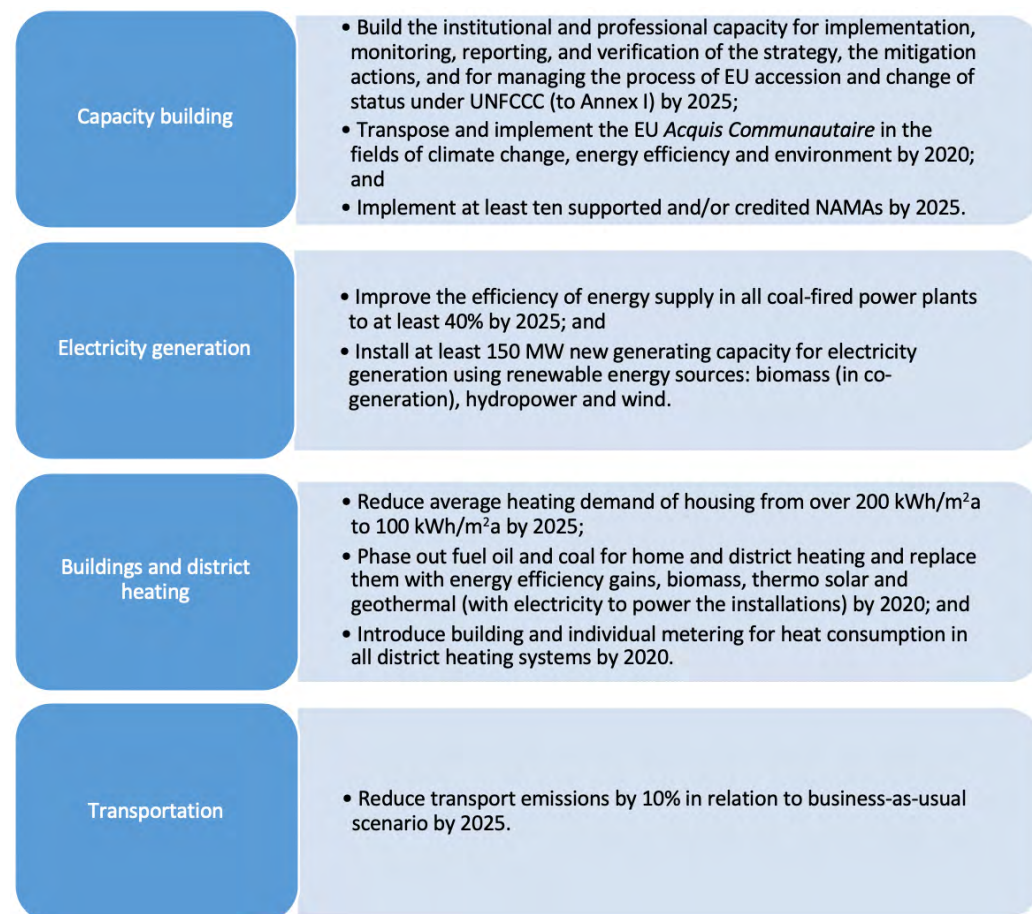
Bosnian entities and the district do not have documents that focus solely on climate change.[31] In FBiH, energy efficiency law indirectly refers to climate change by transposing three EU directives for energy efficiency end use.[32] In RS, the roadmap on spatial planning only discusses the issue of climate change. This prevents climate change from gaining prominence as a factor of influence that would lead to more concrete actions on the ground and inhibits the more extensive institutional understanding of its potential impacts on the Bosnian socio-economic fabric.

BiH is a member of the EU's Energy Community and has developed a National Energy Efficiency Action Plan (NEEAP). The NEEAP is designed to help the country develop strategies for increasing energy efficiency and decreasing GHG emissions.[33] During the pre-Paris Agreement period, BiH established a Designated National Authority for the implementation of Clean Development Mechanism projects under the Kyoto Protocol. In 2010, BiH submitted its Initial National Communication to the UNFCCC Secretariat. The Bosnian focal point for the UNFCCC is the RS Ministry of Spatial Planning, Civil Engineering and Ecology, the only institution in the administration explicitly mandated to the issue. In 2018, the Sustainable Development Goals (SDGs) Index and Dashboards initiative gave a negative score to the Climate Action SDG, ranking the country as 71 out of 156 countries - below the regional

average.[34] Notre Dame Global Adaptation Index ranked BiH 86 out of 181 countries, having medium exposure to climate vulnerabilities while at the same time requires improvements in readiness to respond to future climate impacts.[35]

In March 2017, the country ratified the Paris Agreement. As a part of its dedication to fighting climate change, BiH began to develop a Low-Emission Development Strategy (LEDS), which was foreseen by the Copenhagen Accord and focuses on mitigation measures to boost sustainable development, including the generation of international financial support. The LEDS provides a general roadmap toward EU membership in the area of climate change mitigation. Therefore, accession to the EU could represent one of the essential stimulators for stronger implementation of the climate change agenda in BiH. The capacity-building process of the LEDS combined with the implementation of the UNFCCC’s Nationally Appropriate Mitigation Actions (NAMAs) outline the specific objectives that the country should implement (see Figure 2) for greening the economy according to EU standards during the period 2013–2025.

Figure 2. Specific national-level GHG emissions reduction objectives, 2013–2025



Source: United Nations Development Programme Bosnia and Herzegovina, 2013.^[36]

However, the state's pledges to the UNFCCC are not binding but somewhat voluntary and do not outline the anticipated economic costs for the realization of its targets.[37] The BiH medium-term macroeconomic and fiscal framework does not contain any reference to climate change, and neither do the key strategies of climate-sensitive sectors such as agriculture, electricity supply and public health. Bosnian UNFCCC National Communications documents have scenario analysis for the future impact of climate change developed from UNFCCC modeling exercises, but they were never adopted into policy by authorities.[38]

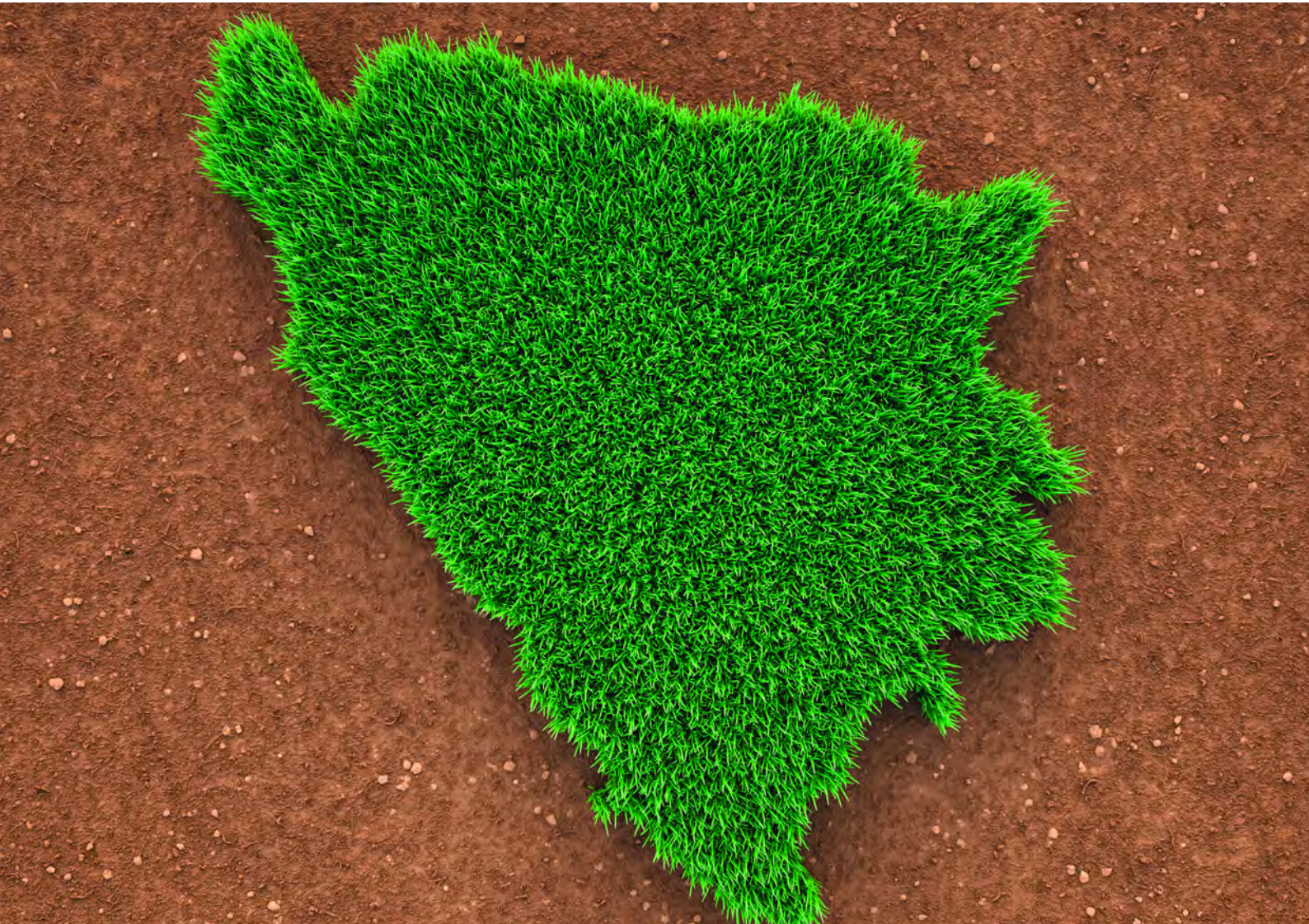
Climate risk and climate-linked disasters are not yet included in budgets neither at the state nor entity level. One of the critical obstacles for improved planning and understanding of the climate change risks is the lack of reliable information to enable the climate change assessment and its impacts and to enhance long-term adaptation planning.[39] To some extent, climate change has been a neglected point in the BiH administrative apparatus due to a lack of economic and financial resources. Nonetheless, state, entity and district governments have failed to mobilize domestic capital for that purpose. For example, in FBiH and RS there are emission fees charged to companies that emit air pollution, but these fees are operationally insignificant.[40], [41] There is a lack of oversight on the polluters' activities and associated environmental impacts due to different administrative and capacity-related limitations amongst both entities.

Several constraints impede the efficient integration of climate change into the political and socio-economic structures of BiH. First, the institutional complexity within BiH hinders vertical and horizontal cooperation among state, entity and district institutions to address climate change. Due to its multifaceted nature, climate change is a difficult topic to integrate into the political system that was designed to first and foremost protect ethnic interests. Consequently, it is given a peripheral priority. The second constraint is the availability of financial resources to tackle climate change. Available data on either state- or entity-level climate change-specific budgets are obscure, hard to track and widespread across several agencies. Information on external financing

sources for climate change, primarily from the international community, is fragmented. The Global Environment Facility (GEF) invested more than US\$170 million to support 44 projects in strengthening national climate change mitigation efforts since 1998.[42] More recently, the Green Climate Fund provided US\$17 million direct finance to project that attracted US\$105 million in co-finance to improve energy efficiency and reduce GHG emissions from public buildings.[43] Since the early 2000s, the World Bank and EBRD provided loans for mitigation and adaptation infrastructure development.

The third constraint is human resources. State, entity and district institutions mandated to address climate change do not have either the sufficient knowledge or capacity to implement and apply regulations at the canton or municipal levels. Internal funds for capacity building are not allocated. There is also a gap in research to better understand the impact of climate change in BiH. The country has a network of meteorological monitoring stations, but most of these stations are not modernized for analyzing climate impacts. Present country-wide funding for research and development, in general, is 0.5 percent of GDP, which further narrows local capacity to invest in better understanding mitigation and adaptation measures for climate change. [44] This gap is heavily filled with the help of the international community; the EU's Low Carbon South East Europe project aimed to develop climate strategy for all Southeast European countries and covers mitigation and adaptation.[45] The UN Development Programme has been crucial in drafting the "Climate Change Adaptation and Low Emission Development Strategy" together with its Bosnian counterparts. Also, the Embassy of Sweden in BiH organized a high-level SDGs Business Conference in 2018 and SDGs Business Week in 2019, both to raise awareness of the critical role of private businesses in delivering on the promise of sustainable development through the UN Agenda 2030.[46],[47]

Bosnia and Herzegovina and changing climate



BiH declared climate change a threat in 2010.[48] Several scientific studies conducted by local experts and multilateral organizations reported that the average temperature increased between 0.4 to 0.8°C across the country from 1961 to 2011.[49] The highest increase was found in the southern city of Mostar and the capital Sarajevo while the highest overall average temperature increase was recorded between the period 2005–2011.

Annual precipitation has also been impacted by climate change with the number of rainfall days per year decreasing and the number of intense rainfall days increasing; an average number of days with 1 mm of rain declined across the entire country through 1961–2010.[50] The most substantial increase in annual precipitation was observed in the central mountainous part of the country and northern lowlands where the majority of Bosnian rivers converge into Sava river, the largest local tributary. In contrast, the western parts of Herzegovina exhibited the most significant loss of soil moisture, which can play an essential role in the frequency and magnitude of droughts.

Increased climate variability has been recorded in the entire territory of BiH. Moreover, the variability has acted as a trigger for extreme weather events. The southern part of the country, Herzegovina, experienced a small increase in the number of tropical days (temperatures over 40°C).[51] The rise in temperatures in Herzegovina triggered heat waves that initiated wildfires, as well as heat-related health conditions and emergencies. Wildfires pose a particular threat to local fire brigades and the Bosnian armed forces due to the occurrence of chain explosions of landmines left from the war. The 2012 heat wave and subsequent drought reduced river levels, affected hydropower generation, destroyed crops and raised the prices for both meat and dairy products.

The rise in annual precipitation during the spring months has led to increased flooding in BiH. The most recent flooding occurred in 2014 when an average rainfall of two months occurred in under 48 hours. This disaster affected 30 percent of the territory, caused more than 2,000 landslides, killed 23 people and disrupted the livelihoods of 1 million inhabitants.[52] Flooding and landslides relocated several minefields further exposing the population further to the threat of unexploded mines. Even though the annual average snowfall has decreased as winters on average become warmer, extreme cold episodes still emerged. In February 2012, heavy snow and avalanches caused shortages in water, food, fuel and medicine. Outages in power and telecommunications as well as transportation system shutdowns occurred across the country. In January 2017, BiH experienced the coldest winter since 1963 with -20°C night temperatures lasting for almost two weeks.[53] In February and May 2019 heavy

rainfall caused flooding that had significant destructive impacts on infrastructure across the country, however this was a relatively lower magnitude when compared to the flood destruction in 2014.

As global temperatures continue to increase, so does the threat of climate change's impact on the socio-economic fabric. Agriculture, water supply and hydropower electricity generation are the economic sectors most vulnerable to climate change due to their exposure and sensitivity to natural variations. Massive flooding, extended droughts and extreme winter events present significant possible fiscal risks that the Bosnian state and society cannot address efficiently.

Climate change impacts and vulnerabilities



As climate change brings more extreme weather, floods, droughts and other disasters, it has a direct impact on the population, infrastructure and economy of BiH. A study published in 2015 by experts from Stanford University found that temperature change due to unmitigated global warming will lower the global GDP per capita by 23 percent in 2100.[54] The same study projected a 13 percent likelihood that climate change would reduce Bosnian GDP per capita by more than 10 percent and a 7 percent likelihood of the country's GDP dropping more than 20 percent as a result of climate change.[55] Finally, the report classified BiH as a medially affected country.

Agriculture

Agriculture has long been the backbone of the country's economy as it contributes significantly to overall employment and sustains food security for a large portion of the population. In terms of economic value, the agriculture sector contributes to approximately 6 percent of the country's GDP, a number that has steadily decreased in relative terms as growth from industry manufacturing, industrial, and service sectors materialized in recent years. However, the agricultural sector maintains significant socio-economic value as a primary channel for broad-level income generation and its contribution to food safety of the population.[56] Over half of the country's 3.5 million people live in rural areas and depend on agricultural activities to sustain their livelihoods.[57] It is estimated that around 20.5 percent of the population is officially employed in the sector and approximately 56 percent of all people working in agriculture are female. Cereal production, particularly wheat, represents the basis of food security for the population and corn production for livestock feed. Other significant crop produce includes fodder plants, potatoes, vegetables (i.e., cucumber, tomato, paprika, and cabbage), fruit (i.e., plum, apple, and pear), berries (i.e., raspberries and strawberries), grapes, and industrial crops (i.e., rapeseed, soybeans, and tobacco).[58] Dairy production is the leading and most important livestock product, followed by meat production, such as beef, poultry meat, pork and sheep meat, eggs, wool and honey.[59] BiH's ability to produce diverse agricultural products is attributed to its favorable agroclimatic conditions and availability of agricultural land, covering 46 percent of its territory.

The impact of climate change on the agricultural production is forecast to be largely negative as water regime changes and rising temperatures exacerbate existing challenges in agricultural land productivity. While increasing temperatures may have a beneficial effect on winter crops, changing rainfall patterns alongside rising temperatures throughout the spring summer and fall will negatively impact all other components of agricultural production. The country's changing rainfall pattern over the past decade includes decreased number of rainfall days per year and increased number of intense rainfall days per year.[60] This is likely to result in less soil moisture

(potentially increasing the frequency and magnitude of drought events) and an increased likelihood of agricultural land experiencing inundation events.[61] As this process intensifies over time in combination with greater summer heat stresses, agricultural soils' biophysical properties will likely weaken and facilitate a transition to significantly less fertile conditions. Such changes directly imply that drought and flood hazards will increase the likelihood of short-term crop failures, and continued soil fertility declines will lead to long-term crop yield declines. Such production shocks and yield declines further imply decreased productivity from the livestock sub-sector as well, as cattle feed remains highly composed of domestically produced maize and dependent on pasture yields.[62],[63]

BiH faces a major challenge in that the current structure of agricultural land is not suitable for rapid adaptation to water regime changes. Despite the abundance of water resources in the country, the total irrigated area is only 0.65 percent of arable land, which is considerably less than in neighboring countries, especially the EU.[64],[65] Furthermore, the country's high degree of land fragmentation, including frequent number of small farms and independent producers, makes it very difficult for promoting adaptive farming practices among producers, streamlining new resilient investment, and distributing resilient technologies (e.g., new varieties of drought/flood resistant maize seeds) to farmers.

Quantifying the future impacts of short-term crop failures and long-term yield declines is challenging to compute, due to limited research and data, yet empirical evidence related to recent events and yield trends indicates that serious risk to future agricultural productive capacity exists. In terms of droughts, recent evidence suggests that short-term drought events could threaten up to 100 percent of productive output during extreme event years. BiH has experienced five such major events in the past 14 years (see Table 2), ending with substantial economic losses in agriculture production. In particular, the drought of 2012 resulted in a water supply crisis due to lowered water levels of rivers and groundwater. It is estimated that this event alone caused losses of over US\$1 billion due to crop failure and yield reduction of up to 70 percent in

remaining crops.[66] The most affected crop was maize, which is the main raw material in production of animal feed. Similar losses were found in production of barley, soybeans, alfalfa, clover, beans, meadows and pastures, which led to a lack of fodder. [67] Lack of fodder influenced the reduction in the number of livestock, livestock production, production of milk and meat supply to the domestic market.[68] Given that the 2012 drought event resulted in up to US\$1 billion in production losses and up to 70 percent yield declines, it is not unreasonable to assume that future drought events beyond 2020 could lead to near 100 percent yield declines and close to a full seasonal loss in productive output. This implies that from agricultural production alone, the possibilities of future drought events leave up to 6 percent (the amount in which agricultural production contributes to the economy) of GDP at risk in an event year.

Table 2. Main BiH droughts and their economic impact on the agricultural sector, 2000-2012

Year	Impact
2000	The worst drought in 120 years, which destroyed or severely affected 60% of domestic agrarian output.
2003	A drought that affected 200,000 farmers and their families, causing US\$230 million damages in agriculture.
2007	Intense forest fires affected 250 ha and spread to agricultural lands, plummeting agricultural production by 40%.
2011	Precipitation reduced by 50%, which resulted in historically low river water levels in all major rivers across the country and destroyed wheat production by 20% and corn by 30%.
2012	The most radical drought in recent history, which reduced vegetable and grain yields by 70% generating estimated loss of US\$1 billion.

Source: United Nations, 2013. ^[69]

Beyond drought, flooding has caused agricultural hazards as well. Severe flooding occurred in 2004, 2006, 2009, 2010 and 2014. In 2004, floods destroyed 20,000 ha of farmland, washed away several bridges (trafficked heavily by agricultural transport), and contaminated agricultural ground water and livestock water wells.[70] However, the most destructive flooding occurred in 2014 and affected the agriculture sector in 53 of the countries' 143 municipalities.

The result was the destruction of 70,000 ha of arable and planted land, 80 percent of poultry lost and an estimated US\$142 million in damages to farm infrastructure and equipment.[71] This shows that floods, compared to drought, impact relatively less

area and overall loss to the sector, but impose substantially more damage on a per hectare basis due to the agricultural equipment and infrastructure damage. The World Bank's Global Facility for Disaster Reduction and Recovery concluded that flooding in the magnitude of the 2014 floods has a 10 percent probability of occurring again by 2025.[72] Extrapolating upon this evidence suggests that every decade flood-prone agricultural regions could expect one or more severe flooding events amounting to damages in the hundreds of millions of dollars each time. While this is substantially less economically damaging than the overall economic threat of a nation-wide severe drought, it is reasonable to assume that agricultural producers in such zones would be hesitant to invest in new productivity improving equipment and infrastructure. This could hamper the potential gains from future agricultural development that these zones could otherwise realize.

The long-term yield declines resulting from climate-driven soil erosion and fertility loss also poses significant threats to agricultural production. Empirical evidence from, soil and crop data, the estimated average yield reduction in rain-fed agriculture for the six most common crops in the region for past five decades was 3.8–20.6 percent and 9.3–27.7 percent on loamy and heavy soil, respectively.[73] There are substantial changes in yield production across all common crops just in the past decade due to increased air temperature, precipitation, wind speed and lower relative air humidity, however maize yield reduction in the past decade was 184 percent higher compared to historical reference levels.[74] Current projections of the impact of climate change on soil fertility and crop yields remain uncertain due to a lack of research in this area.[75]

However, based off of the aforementioned recent historical studies, it seems reasonable to assume that in a business as usual case scenario, where soil fertility management practices and resilient crop varieties are not improved, crop yield reductions could increase by an additional 10 percent per decade. The economic risks of this impact would be significantly less than that of an extreme drought or flooding event. Nevertheless, it should be noted that yield declines from soil erosion and soil

fertility loss would be expected on an annual basis, potentially aggregating each decade to losses greater those amounting from droughts and floods combined.

The impending climate-driven production threats facing the agricultural sector creates further downstream socio-economic risks in BiH – such as market and human risk emanating from the sector’s strong influence on household food security, rural income, and employment. As a result of an extreme event, such as drought, market risks due to crop failure are likely to be seen, especially affecting the entire region of South Eastern Europe, as it was experienced in the 2012 drought.[76] BiH’s food price index is relatively low for the region, however it relies on around 30 percent cereal import dependency, which is the second highest of all of the former Yugoslav republics.[77] Furthermore, the country remains a net food importer.[78] A single season severe drought would put the country in competition with neighbors for importing needed cereals to support household food consumption demands. While prices would be highly dependent on import market conditions, national food reserve levels, and international support at the time of the event, it still constitutes a high risk of constraining the stability of affordable food supply.

A sudden and severe flooding event would also pose food security challenges; however this would likely be more acute in the localized zone of the flooding event, with less market risk and higher risk of limited food access. As experienced during the 2012 flood, inundated or destroyed transportation infrastructure (namely access road and bridges) would hamper the government’s ability to deliver emergency food resources to the impacted rural population. The long-term yield declines resulting from climate-driven soil erosion and fertility loss will not have relatively serious market implications for food security, but rather pose financial and health risks to rural households. The decreased output from small farms and associated unemployment could over time increase the proportion of household expenditures on food, decreasing disposable household income over time have, and having potentially negative nutritional consequences on low income rural households. Given that there are a substantial amount of variables that would have to factor into computing these risks

and lack of published research in this space, it is best to understand qualitatively rather than quantitatively how the socio-economic risks associated with agricultural production challenges could be equal or greater than those posed to the overall economy.

Water

BiH has considerable water resources that could, if correctly managed, underpin economic development and a new “green economy”.[79] Water resources comprise 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 Trebisnjica and Neretva river basins in the south. The predicted changes in precipitation and air temperature will negatively impact the current water management system in BiH. Although there is watershed level information available on water flows, which has been used for determining the total water availability, there is extremely limited country-level data available on hydrological resources. Consequently, there has been no assessment of climate change impacts on these systems at the national level.[80] Climate change-induced lack or excess of water represent a grave threat to the country.

Droughts in the summer months responsible for the decrease in available water resources will trigger a reduction in agricultural yields, while flooding in winter and spring months causes infrastructure and livelihoods destruction. The BiH Council of Ministers stated that both climate-related drought and flood that affects the domestic water sector could potentially appear every five years.[81] Lower river flows will affect the already non-reliable water supply and could result in lower water quality caused by flow variations in some parts of the country (e.g., the capital Sarajevo).[82] Flooding threatens to pollute groundwater and drinking water resources with agricultural and industrial toxins flushed from land surfaces. The country, at the municipal and entity levels, has made limited investments in protection against flooding, particularly draining excess waters, which remains an unsolved critical strategic issue. Moreover, key indicators, such as the quality of potable water, have been deteriorating.[83]

For example, flooding has left serious economic consequences in BiH. Table 3

presents quarterly data for GDP of BiH in 2014. From the Table 3 it can be observed that in the second quarter (Q), GDP fell by sharply by 2.6 percent, seasonally adjusted data, chain linked at prices 2010 (real growth rate Q/Q-1). In the Q2 there were a negative impact on the fall in household consumption, exports, and partly on imports.

Table 3. GDP change by quarter and category, 2014

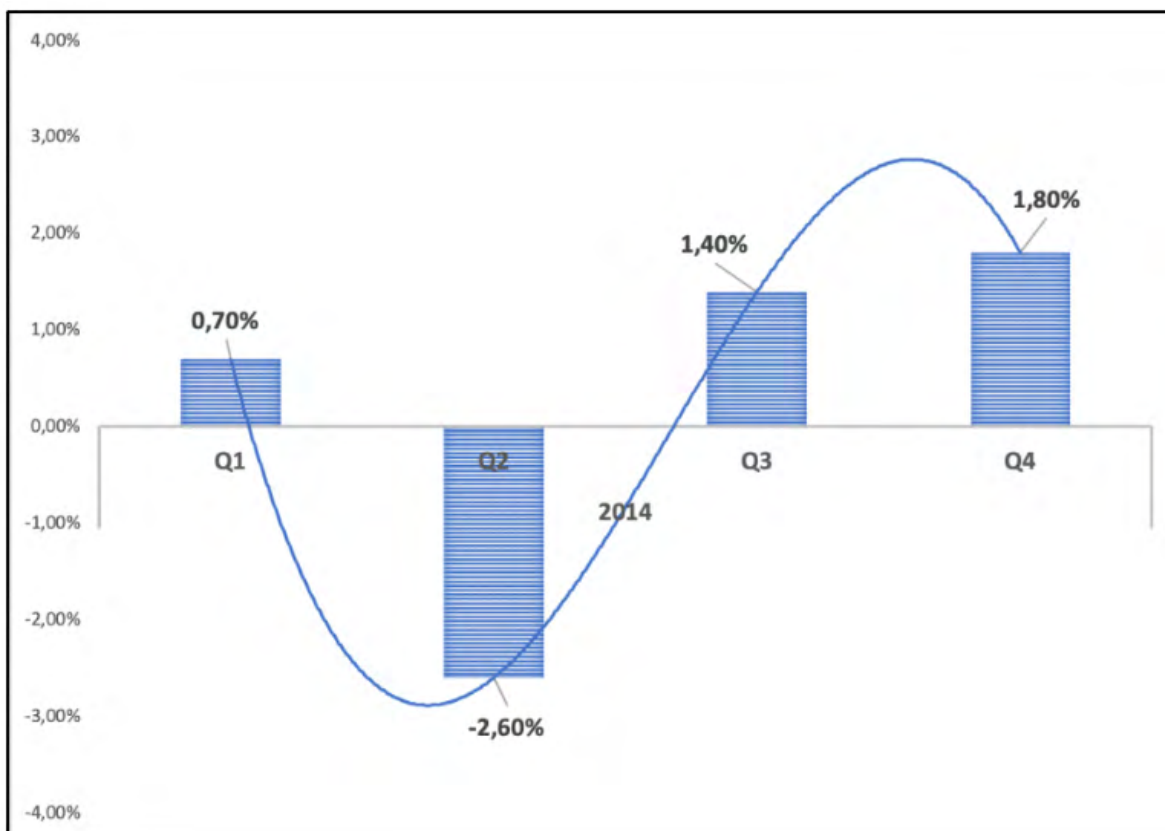
Period	Households	Government	Gross capital formation	Exports of goods and services	Import of goods and services	GDP	
2014	Q1	-0.20%	0.90%	8.60%	3.50%	2.20%	0.70%
	Q2	-0.70%	0.40%	1.10%	-4.40%	-0.20%	-2.60%
	Q3	0.20%	0.50%	-1.60%	5.00%	1.90%	1.40%
	Q4	1.60%	0.50%	6.30%	3.40%	1.00%	1.80%

[84]

Source: Agency for Statistics of Bosnia and Herzegovina, 2019.

In the Figure 3, quarterly GDP growth rates for 2014 are shown, indicating the impact of flooding on the economy through a sharp GDP decline and steady rise in Q3 and Q4.

Figure 3. GDP quarterly fluctuations, 2014

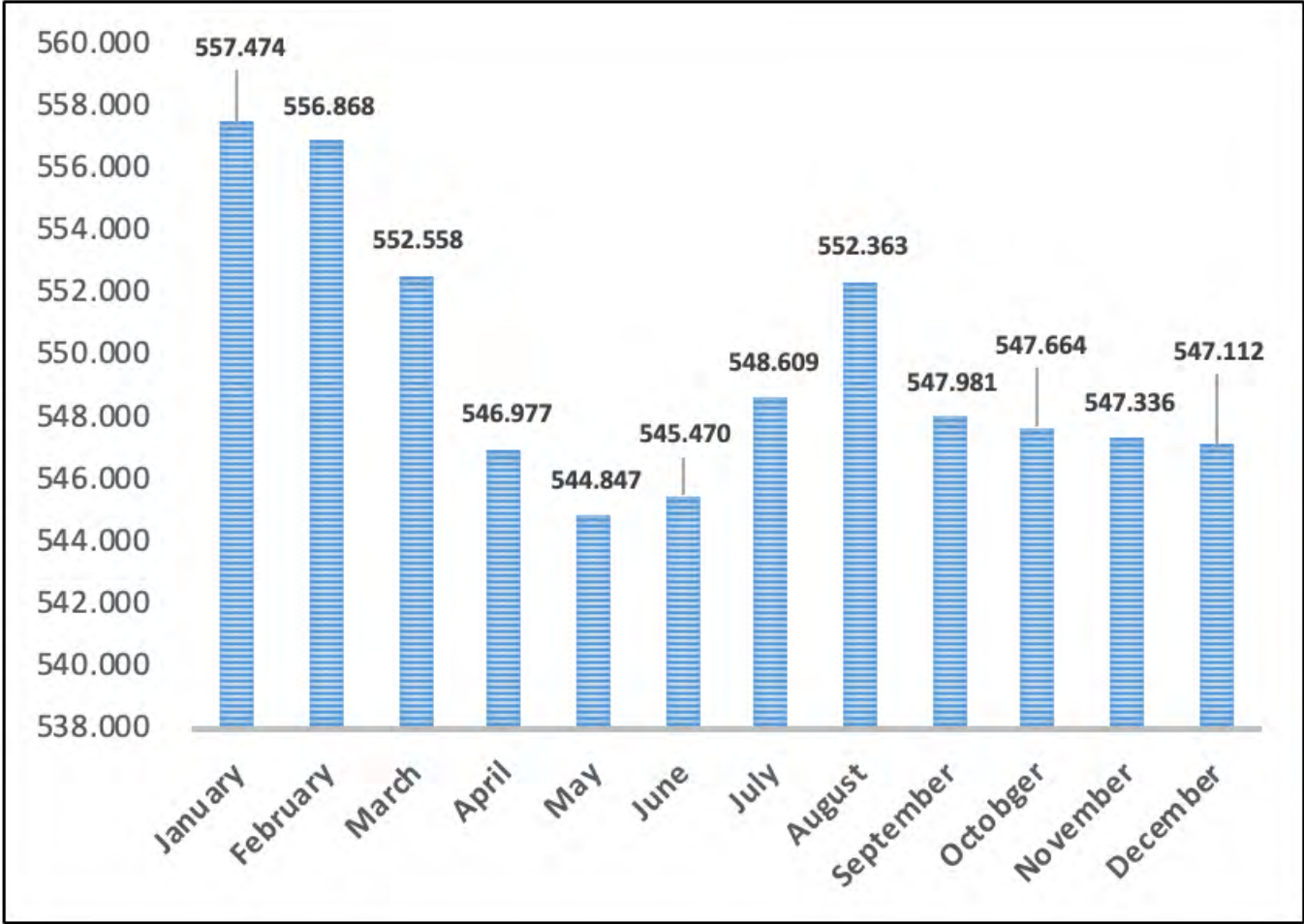


[85]

Source: Agency for Statistics of Bosnia and Herzegovina, 2019.

Another indicator of the negative economic impact of flooding on BiH's economy is the increase in unemployment through job losses. In the period until May 2014, unemployment was reduced by about 12,500 persons, and due to the flooding, in the period May–August, there was an increase of unemployment by about 7,000 persons. Subsequently, until the end of the year, there was no significant fall in unemployment. Data are presented in Figure 4.

Figure 4. Unemployment trends in BiH, 2014



Source: Agency for Statistics of Bosnia and Herzegovina, 2019. ^[86]

Energy

Electricity is a vital component of the BiH's economy as it enables manufacturing, industrial, and service sectors to operate, and also serves as the third most crucial export commodity. BiH generates electricity mainly through coal and hydroelectric power plants, and to a significantly lesser extent through oil, natural gas and renewables. While hydroelectric generation has remained stable in terms of its

percentage contribution to electricity generation since the end of the war, reliance on coal has increased substantially.

In 1996, coal only generated about 20.9 percent (2,148 GWh) of electricity, where hydro sources generated about 70.5 percent (5,156 GWh).[87] However, by 2017 this generation mix was close to the scenario, with coal generating about 75 percent (12,339 GWh) of electricity hydro-sources contributing about 24 percent (3,987 GWh) (all other sources amounting to less than 1 percent).[88] Electricity generation has increasingly favored coal fueled energy production in the past two and a half decades, an approach that has resulted in higher GHG emissions. In the submitted Nationally Determined Contribution (NDC) to the UNFCCC, BiH clearly stated the plan to develop new mini hydro powerplants to enable the country to reduce GHG and increase its percent generation of electricity from renewable hydro-sources.

Climate change is expected to increase energy production risks, particularly as hydroelectric generation experiences declines in river water flow. During the prolonged drought of 2012, overall electricity production was reduced by 25 percent and the levelized cost of energy of hydro generated electricity increased substantially compared to that from coal. The result was an increase in the percent of electricity generated from coal as a cost and water-resource saving measure. Despite the country's plans to develop new hydroelectric dams to offset emissions from coal climate change will in fact exacerbate the economic conditions that favor coal. This implies that the country will increasingly find the conditions for meeting its NDC challenging. Furthermore, a decrease in hydroelectric output would also have economic consequences for Bosnian utility companies. The Second National Communication of BiH under the UNFCCC estimated that a decrease between 5-10 percent in water flow could cause financial losses of US\$60 million for all three Bosnian public electric utility companies.[89] Flooding such as the 2014 floods that reduced the total electricity supply by 25 percent (because hydropower plants needed to slash their production capacities due to excessive water flows) demonstrates how climate-induced natural disasters can have a broader impact on national energy security.[90]

This puts the BiH energy security at risk concerning local consumption and electricity intended for export. Electricity is the third most crucial export commodity with sales worth US\$329 million in 2019.[91],[92]

Any disturbance in the generation of electricity via hydropower is substituted by utilizing coal-based power. In the long run, this is problematic as it increases GHG emissions and negatively impacts population health since it increases the number of particulate matter in the air, which directly affects the brain, lungs, heart and cardiovascular system. Also, recent increases in coal-fired power electricity generation as a response to climate change's impacts its favorability since, as a Contracting Party of the Energy Community Treaty, BiH has the obligation of reducing emissions from thermal power plants. FBiH in 2018 and RS in 2019 adopted amendments to the "Rulebook on Emission Limit Values for Large Combustion Plants".[93]

Public health

Climate change has both physical and mental health consequences for affected populations and therefore is a threat to public health.[94] High temperatures during the summer are particularly dangerous for the elderly and people with cardiovascular diseases, while in the winter, smog can adversely affect children and individuals with heart and respiratory conditions. Reduction in river water levels can increase the potential for water-borne diseases and food poisoning. At present, there is no monitoring system nor has there been an assessment conducted for the monitoring of epidemics and diseases correlated with climate change parameters.[95] Nevertheless, we can gauge the impact of climate change on health by looking at the 2014 flooding and constant issue of air pollution during the winter months in BiH. The total estimated damage to the health sector infrastructure after the 2014 floods was US\$55 million.[96] Furthermore, the damage suffered by the total or partial destruction of public health facilities and subsequent reduced resources for the sector decreased the quality and access to health services for the population living in the flood-affected areas.[97]

Extensive use of coal and firewood for heating, and diesel vehicles for transportation in urban areas is the main cause of air pollution during the winter months. IQAir, Swiss

and American based company specializing in air pollution monitoring, ranked Sarajevo as fourteenth most polluted capital city in the world in 2018.[98] Within this context, city of Tuzla has the worst air quality in the Western Balkans. Tuzla hosts one of the biggest coal-based power in the region, which in combination with the heavy car traffic, industries and the domestic use of coal for heating, make the city's pollution 6.5 times higher than (WHO) standards. A study by the Center for Ecology and Energy Tuzla estimates that coal-burning could have a significantly negative impact on Tuzla's population, including 131,000 lost working days.[99]

The Health and Environmental Alliance estimated that public health costs in BiH from polluted air linked to coal-fired power plants were US\$3.6 billion per annum.[100] The WHO estimates that the economic cost of deaths from air pollution as a percentage of GDP was at 21.5 percent in 2010 for BiH.[101] The UN estimated that 44,000 years of life are lost each year in BiH due to air pollution.[102] For example, the Ugljevik thermal power plant with sulfur dioxide emissions of 154,380 tons per year is one of the most polluting on the European continent.[103] Nonetheless, it is important to mention that Ugljevik thermal power plant is currently undergoing a flue-gas desulfurization facility installation, headed by the Japanese company Mitsubishi Hitachi Power Systems, which when completed, will significantly decrease its sulfur dioxide emissions.[104]

Tourism

In 2016 the direct contribution of tourism to GDP in BiH was 2.5 percent and it provided 3 percent of employment. However, tourism is one of the fastest growing sectors in the economy and is expected to double its contribution to GDP by 2025. [105] Due to unreliable snow and decreases in snowfall, Olympic winter sports ski resorts in central Bosnia will likely be impacted while heat waves and water scarcity in the summer months may reduce the number of tourists to the urban hubs of Sarajevo, Banja Luka and Mostar. In addition, the eco-tourism sector in the mountainous areas may be threatened due to the destruction of forests caused by wildfires.

Other relevant risks

Climate change is a result of anthropogenic GHG emission concentrations building up in the atmosphere. Human activity has become the dominant influence on the environment and climate, in what is known as the age of the Anthropocene. Risk in the Anthropocene is systematic. In 2020 the world was hit by the COVID-19 pandemic. While it is extremely hard to determine if the COVID-19 pandemic has any direct connection to the climate change, the nature of its shock effect on the economy mirrors a possible climate shock scenario. Within this context, the COVID-19 event can help us to better understand future potential climate change shocks in BiH. The systemic nature of the pandemic event triggered a multitude of downstream impacts that paralyzed the global economy and societies. Similarly, sudden drought or flooding events threatens to create similar impact events across critical sectors of the economy.

The COVID-19 impact on the economy of BiH was, like in other European countries, crippling. Most of the associated problems started in mid-March 2020 when economic activity stopped. Around this time the unemployment rate increased, quarterly GDP shrunk, and public revenues sharply fell. In a recently conducted study, macroeconomic simulations showed that BiH will face a 2020 GDP decline that ranges from 3.97 percent to 9.53 percent.[106] In a recent analysis, the worst-case scenario foresees the rise in the number of unemployed to 96,767 by the end of 2020.[107] Furthermore, the analysis emphasizes current negative macroeconomic trends in BiH (e.g., instability of pension systems, economic slowdown to 2.8 percent in 2019, and migratory trends with estimated 50,000 people annually leaving BiH annually) which makes the country very vulnerable to the current crisis. Strongest impact is expected in the healthcare and unemployment benefits sector. Specific financial burden pertains to government intervention aimed at stabilizing the economy; an estimate of US\$1.08 billion will be required to for this purpose.[108]

Concluding remarks

Climate models developed for the GEF projects by the World Bank predict a 2–4°C increase in average annual temperatures until 2100 in BiH.[109] The increase will likely have severe repercussions for the socio-economic situation of the country and will require a fundamental restructuring of the agriculture, water, energy, health and tourism sectors. The agricultural sector, employing a fifth of the population, and the energy sector, producing the third most important export commodity, are the most vulnerable in terms of decreasing the sensitivity of GDP loss to climate change.

Government institutions are aware of the risk associated with climate change, but due to institutional complexity, limited funding, poor regulation ability and lack of capacity and knowledge to identify climate change adaptation and mitigation measures, BiH remains heavily exposed to climate risks. The country is a member of the UNFCCC, has ratified the Paris Agreement and is implementing a strategy for a greener economy until 2025 according to EU standards, but the tangible examples in practice do not follow these political promises. Likewise, inhabitants of BiH are aware of the risk climate change represents, but this fact is overshadowed by everyday socio-economic hardships that are reflected in the desire to improve the overall standard

of living. Improved integration of climate change risk mitigation in BiH institutions will require an integrated, cross-cutting approach to overcome BiH's administrative complexity.

Climate change needs better visibility. At the state level, it has only been addressed in the "Climate Change Adaptation and Low Emission Development Strategy" report. However, without an action plan that outlines the total cost and funding sources, this document does not have any considerable effect.[110] Brcko District has no official documents that mention climate change. In FBiH, the issue is indirectly covered minimally within the Law on Energy Efficiency. RS has, to a limited extent, addressed the issue in the "Rulebook on the Method of Design, Content and Forming Spatial Planning" document. Climate change must become a question of vital national interest, and this should radiate across the state, entity and district-level institutions. The current climate change-related policy gap might become more prominent if and when BiH opens "Chapter 27: Environment" within the EU Accession process. The EU Accession process will set demands for more radical changes in the legal setting and policy framework as well as action on the ground regarding the

implementation of mitigation and adaptation projects. Initiating joint EU and BiH large-scale projects in the fields of energy efficiency, waste management, renewable energy and reduction of air pollution could be a part of the solution.

BiH needs to work on mobilizing internal and external financial resources. Alongside the multilateral organizations' funding, these resources will be crucial for financing various mitigation and adaptation initiatives that would reduce carbon intensity and fossil fuels dependence of the economy and build capacity to better respond to future floods and droughts. Key facilitators might include coordination of the private and the public sector, appropriate funding models, and advocacy, policy and legislative support. BiH and its entities need to develop a more transparent, investor-friendly legal and regulatory framework to increase FDI in untapped renewable energy resources.

Moreover, excluding large-scale hydro, renewable energy potential is underused. Today less than 1 percent of electricity supply originates from non-large-scale hydro renewables.[111] The UN Development Programme, optimistically estimated technical potential for installed renewable electricity capacity to be 600 MW biomass, 48,700 MW solar, 2,000 MW wind and 600 MW

small-scale hydro.[112] If in the future, some of the estimated technical potential could be developed in cost-competitive projects, BiH could significantly increase its share of electricity generated from renewable energy sources. This must be followed by an upgrade of the power grid's potential to absorb power from intermittent sources.

Investing in coal production is not worthwhile from an economic or public health perspective. Investing in renewable energy sources is a plausible solution. In addition to external financing sources for investing in renewable energy and improving energy efficiency, there are two additional options for investing from domestic sources and own funds, without borrowing. Part of the investment in renewable energy sources and the improvement of energy efficiency can be achieved by directing the collected excise taxes on fuel and tobacco for this purpose. According to Indirect Taxation Authority BiH data, US\$801 million was collected based on all excise duties.[113] From this amount, US\$668 million relates to excise duties on tobacco and fuel. These funds are directed to the variety of budget spending, and not purposely in healthcare system or energy efficiency.

In the period 2009–2019, US\$4.46 billion was collected from tobacco excise taxes, that went to budget spending. By investing this money in renewable energy sources, a complete transformation of the electricity production segment towards renewable sources could be done. The investment would have positive economic effects, where less money would be spent annually on the treatment of pollution-related diseases. Also, part of the excise duties collected on fuel, which is US\$162 million a year, which are also channeled into budget spending, could be directed towards improving energy efficiency and reducing pollution generated by cars.

Relevant actors from public and private domains need to develop a range of new skills and competencies necessary for effective implementation of climate change adaptation and mitigation strategies. This encompasses conducting various needs assessment exercises accompanied by capacity-building programs. BiH must develop the scientific framework for climate risk management to overcome knowledge gaps currently existing on the ground. The reduction in knowledge gaps will improve planning and provide an evidence base for future activities that will be established on scientific facts. BiH would initially need to identify both domestic and diaspora-based

climate change experts then connect them to one another. In this way, the country could gain leverage on the human resources of its vast diaspora; through for example UN's Diaspora for Development project.

Extensive use of fossil fuels, especially coal, for the energy supply (e.g., thermal plants and industry) and energy use (e.g., households) sectors could be addressed by introducing combined heat and power technologies in district heating, which heavily depends on cost-competitiveness based on population density.[114] This would reduce the coal consumption by households, hence helping to mitigate the winter smog issue. Coal-fired power plants are a very important segment in domestic electricity supply and development politics, currently generating approximately 62 percent of the total electric supply.[115]

Political leaders across BiH are prone to supporting not just modernization of the existing coal-fired power plants, but also their further expansion.[116],[117] Besides future environmental and air pollution issues, orientating future national energy development by heavily relying on coal presents several problems. First, over the last

couple of years, the coal power sector has seen a sharp decline in investment trends, not only due to environmental reasons but due to economic viability as well.[118] However, there is another aspect that makes investing in the coal-fired power plants a risky prospect: BiH potential future acceptance into the EU.

According to the electricity map database in 2018 BiH's gCO₂eq/kWh was oscillating between 660–860 gCO₂eq/kWh depending on the month.[119] At the same time the EU's annual average, which has been in constant decline for the last several decades, was 340 gCO₂eq/kWh in 2013; ranging from 16 gCO₂eq/kWh in Sweden to 770 gCO₂eq/kWh in Poland.[120] If BiH becomes EU member state in the near future and retains same electricity carbon intensity averaging 720 kg/MWh in 2013, the country might face serious problems in exporting its electricity to the EU, given that it strives to accomplish its 2050 long-term strategy for prosperous, modern, competitive and climate-neutral economy.[121],[122]

Finally, climate change has a multifaceted nature that stretches across disciplines and sectors. To improve its preparedness, a multisectoral and interdisciplinary approach to this issue is required, sharing knowledge and information, as well as an integration of planning, monitoring and evaluation.

At present, there is a very strong non-state-level modus operandi, which prevents more efficient inter-entity and state-to-entity cooperation.

These recommendations are not exhaustive but are grounded on consistent facilitators and barriers identified across information included in this document, which is a desk analysis supported by several interviews with relevant experts. They form critical starting points in leveraging the approaches to climate change risk mitigation in BiH.

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Endnotes

- [1] World Bank Group. "Rebalancing Bosnia and Herzegovina: A Systematic Country Diagnostic." (Washington, D.C., 2015). <https://openknowledge.worldbank.org/handle/10986/23120>.
- [2] Agency for Statistics of Bosnia and Herzegovina. "Labour Force Survey 2018." (Sarajevo, 2018). http://bhas.gov.ba/data/Publikacije/Bilteni/2018/LAB_00_2018_Y1_0_BS.pdf.
- [3] World Bank Group. "Data: Bosnia and Herzegovina." (2020). <https://data.worldbank.org/country/bosnia-and-herzegovina>.
- [4] Agency for Statistics of Bosnia and Herzegovina. "Labour Force Survey 2019." (Sarajevo, 2019). http://bhas.gov.ba/data/Publikacije/Bilteni/2019/LAB_00_2019_TB_0_BS.pdf.
- [5] British Broadcasting Corporation. "Bosnia-Herzegovina country profile." (October 8, 2018). <https://www.bbc.com/news/world-europe-17211415>.
- [6] Agency for Statistics of Bosnia and Herzegovina. "Demography 2016." (Sarajevo, 2016). http://www.bhas.ba/tematskibilteni/DEM_00_2016_TB_0_BS.pdf.
- [7] World Bank Group. "Bosnia and Herzegovina Country Context." (2020). <http://www.worldbank.org/en/country/bosniaandherzegovina/overview>.
- [8] International Monetary Fund. "Bosnia and Herzegovina Gross domestic product, current prices 2017." (Washington, D.C., 2017). <http://www.imf.org/external/pubs/ft/weo/2017/02/weodata/weorept.aspx?pr.x=67&pr.y=11&sy=2017&ey=2019&scsm=1&ssd=1&sort=country&ds=.&br=1&c=963s=NGDPD%2CPPPGDP%2CNGDPDPC%2CPPPPC&grp=0&a=#notes>.
- [9] Agency for Statistics of Bosnia and Herzegovina. "Census 2013 – Ethnic and National Affiliation." (Sarajevo, 2013). <http://www.popis.gov.ba/popis2013/knjige.php?id=2>.
- [10] Central Intelligence Agency. "Factbook: Bosnia and Herzegovina." (2020). <https://www.cia.gov/library/publications/the-world-factbook/geos/bk.html>.
- [11] Massachusetts Institute of Technology. "The Observatory of Economic Complexity: Bosnia and Herzegovina profile." (2020). <https://atlas.media.mit.edu/en/profile/country/bih/>.
- [12] World Bank Group. "Economy Profile of Bosnia and Herzegovina." (Washington D.C., 2020). <https://www.doingbusiness.org/content/dam/doingBusiness/country/b/bosnia-and-herzegovina/BIH.pdf>.
- [13] United States Department of Commerce's International Trade Administration. "Bosnia and Herzegovina Foreign Direct Investment and Foreign Portfolio Investment Statistics." (2020). <https://www.export.gov/article?id=Bosnia-foreign-direct-investment-statistics>.
- [14] World Bank Group. "Western Balkans Labor Market Trends 2018." (Vienna, 2018). https://www.seejobsgateway.net/sites/job_gateway/file/Western%20Balkans%20Labor%20Market%20Trends%202018.pdf.
- [15] United Nations. "Human Development Indicators: Bosnia and Herzegovina." (2020). <http://hdr.undp.org/en/countries/profiles/BIH>.
- [16] World Bank Group. "Rebalancing Bosnia and Herzegovina: A Systematic Country Diagnostic."
- [17] Vracic, Alida. "The Way Back: Brain Drain and Prosperity in the Western Balkans." (Brussels, 2018). https://www.ecfr.eu/publications/summary/the_way_back_brain_drain_and_prosperity_in_the_western_balkans#.

- [18] European Commission. "Bosnia and Herzegovina 2018 Report." (Brussels, 2018). <https://ec.europa.eu/neighbourhood-enlargement/sites/near/files/20180417-bosnia-and-herzegovina-report.pdf>.
- [19] World Bank Group. "Data: Bosnia and Herzegovina."
- [20] State Electricity Regulatory Commission of Bosnia and Herzegovina. "Annual Report 2018 (in Bosnian)." (Tuzla, 2018). <https://www.derk.ba/DocumentsPDFs/DERK-lzvjestaj-o-radu-2018-b.pdf>.
- [21] Bosnia and Herzegovina Ministry of Foreign Trade and Economic Relations. "Analysis of foreign trade of Bosnia and Herzegovina in 2017 (in Serbian)." (Sarajevo, 2017). http://www.mvteo.gov.ba/data/Home/Документи/Међународни%20документи/Analiza_2017.pdf.
- [22] Glavonjic, Branko D. et al. "Wood Fuels Consumption in Households in Bosnia and Herzegovina." *Thermal Science* 21, no. 5 (2017): 1881-92. <http://thermalscience.vinca.rs/pdfs/papers-2017/TSCI170102034G.pdf>.
- [23] International Energy Agency. "Bosnia and Herzegovina." (2020). <https://www.iea.org/countries/bosnia-and-herzegovina>.
- [24] Organization for Security and Co-operation in Europe. "Security of Energy Supply in Bosnia and Herzegovina in 2010." (Vilnius, 2010). <https://www.osce.org/eea/71268>.
- [25] Council of Ministers of Bosnia and Herzegovina. "Second National Communication of Bosnia and Herzegovina under the UNFCCC." (Sarajevo, 2013). <https://unfccc.int/resource/docs/natc/bihnc2.pdf>.
- [26] United Nations. "MY World: Bosnia and Herzegovina results." (2015). <http://data.myworld2015.org/?country=Bosnia%20and%20Herzegovina>.
- [27] European Bank for Reconstruction and Development. "Life in Transition Survey (LITS) II." (London, 2011). <https://www.ebrd.com/cs/Satellite?c=Content&cid=1395236498263&pagename=EBRD%2FContent%2FContentLayout>.
- [28] European Bank for Reconstruction and Development. "GrCF - Banja Luka District Heating." (October 24, 2017). <https://www.ebrd.com/work-with-us/projects/psd/grcf-banja-luka-district-heating.html>.
- [29] European Bank for Reconstruction and Development. "EBRD secures greener energy for Bosnian city of Zenica." (March 15, 2019). <https://www.ebrd.com/news/2019/ebrd-secures-greener-energy-for-bosnian-city-of-zenica.html>.
- [30] Sarajevo Canton Government. "Sarajevo Green Cantonal Action Plan." (Sarajevo, 2019). https://mpz.ks.gov.ba/sites/mpz.ks.gov.ba/files/zeleni_kantonalni_akcioni_plan_gcap-prezentacija.pdf.
- [31] Trbic, Goran et al. "Limits to Adaptation on Climate Change in Bosnia and Herzegovina: Insights and Experiences." In: Leal Filho W., Nalau J. (eds), *Limits to Climate Change Adaptation*. Climate Change Management. (Berlin: Springer, 2018). https://link.springer.com/chapter/10.1007/978-3-319-64599-5_14.
- [32] Grantham Research Institute on Climate Change and the Environment. "Country profile: Bosnia and Herzegovina." (2020). <http://www.lse.ac.uk/GranthamInstitute/country-profiles/bosnia-and-herzegovina/>.
- [33] Energy Community. "Implementation: Bosnia and Herzegovina." (2020). https://www.energy-community.org/implementation/Bosnia_Herzegovina.html.
- [34] SDG Index and Dashboards. "Country profile: Bosnia and Herzegovina." (2020). <https://dashboards.sdgindex.org/#/BIH>.
- [35] University of Notre Dame. "ND-GAIN Country Index." (2020). <https://gain.nd.edu/our-work/country-index/>.
- [36] United Nations. "Climate Change Adaptation and Low Emission Development Strategy for Bosnia and Herzegovina." (Sarajevo, 2014). http://www.ba.undp.org/content/bosnia_and_herzegovina/en/home/library/environment_energy/climate-change-adaptation-and-low-emission-development-strategy-.html.

- [37] United Nations Development Programme, United Nations Environment Programme and Global Environment Facility. "National Adaptation Plans in focus: Lessons from Bosnia and Herzegovina." (2018). http://globalsupportprogramme.org/sites/default/files/resources/naps_in_focus_lessons_from_bosnia_and_herzegovina.pdf.
- [38] Vukmir, Goran (Head of Office at Banja Luka at United Nations Development Programme Bosnia and Herzegovina). Interview by A. Causevic. Skype call. Munich, August 2, 2019.
- [39] United Nations Development Programme, United Nations Environment Programme and Global Environment Facility. "National Adaptation Plans in focus: Lessons from Bosnia and Herzegovina."
- [40] Official Gazette of the Federation of Bosnia and Herzegovina. "Ordinance on the method of calculation and payment, and the deadlines for calculating and paying the allowances for air pollutants (in Bosnian and Croatian)." (2018). <http://fzofbih.org.ba/userfiles/file/Broj-79.pdf>.
- [41] Government of Republika Srpska. "Law on Environmental Protection Fund (in Serbian)." 2018. <http://www.vladars.net/sr-SP-Cyrl/Vlada/Ministarstva/mgr/PAO/Documents/zakon%20o%20fondu.pdf>.
- [42] Global Environment Facility. "Country-At-A-Glance: Bosnia and Herzegovina." (2019). <http://www.thegef.org/country/bosnia-herzegovina>.
- [43] Green Climate Fund. "Scaling-up Investment in Low-Carbon Public Buildings Project." (October 26, 2017). <https://www.greenclimate.fund/-/scaling-up-investment-in-low-carbon-public-buildings>.
- [44] United Nations. "Climate Change Adaptation and Low Emission Development Strategy for Bosnia and Herzegovina."
- [45] European Academy Bolzano. "Regional State-of-the-Art Analysis covering SEE area." (Bolzano, 2014). [http://www.locsee.eu/uploads/documents/reports/FINAL%20version%20Regional_State-of-the-Art-Report%20\(Synthesis%20report\).pdf](http://www.locsee.eu/uploads/documents/reports/FINAL%20version%20Regional_State-of-the-Art-Report%20(Synthesis%20report).pdf).
- [46] Embassy of Sweden in Bosnia and Herzegovina. "High-level SDG Business Conference." (2019). <https://www.swedenabroad.se/en/embassies/bosnia-and-herzegovina-sarajevo/current/news/high-level-sdg-business-conference/>.
- [47] Klix. "First ever SDGsin Business Award Ceremony in Bosnia and Herzegovina (in Bosnian)." (June 13, 2019). <https://www.klix.ba/biznis/prvi-put-proglaseni-bh-biznis-lideri-odrzivog-razvoja/190613027>.
- [48] United Nations. "Climate Change Adaptation and Low Emission Development Strategy for Bosnia and Herzegovina."
- [49] Ibid.
- [50] Council of Ministers of Bosnia and Herzegovina. "Second National Communication of Bosnia and Herzegovina under the UNFCCC."
- [51] Ibid.
- [52] United Nations, European Union and World Bank Group. "Bosnia and Herzegovina Floods 2014: Recover Assessment Need." (Sarajevo, 2014). http://www.ba.undp.org/content/dam/bosnia_and_herzegovina/docs/Response%20to%20Floods/RNA.pdf.
- [53] Radio Free Europe. "Extreme Cold, Heavy Snow Killing Dozens In Balkans, Eastern Europe." (January 12, 2017) <https://www.rferl.org/a/extreme-cold-heavy-snow-killing-dozens-balkans-eastern-europe-greece-migrants-serbia/28227143.html>
- [54] Burke, Marshall, Solomon M. Hsiang, and Edward Miguel. "Global non-linear effect of temperature on economic production." *Nature* 525 (November 15, 2015): 235-39. <https://www.nature.com/articles/nature15725>.

- [55] Stanford University. "Economic Impact of Climate Change on the World: Bosnia and Herzegovina Country Profile." (2015). <https://web.stanford.edu/~mburke/climate/map.php>.
- [56] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina. "Plant Production." (February 5, 2018). <http://www.mvteo.gov.ba/Content/Read/poljiprivreda-i-ruralni-razvoj-biljna-proizvodnja?lang=en>.
- [57] Food and Agriculture Organization. "Food and agriculture data." (2020). <http://www.fao.org/faostat/en/#home>.
- [58] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina. "Plant Production."
- [59] Ibid.
- [60] World Bank Group. "Bosnia and Herzegovina - Agriculture and Rural Development Project." (2016). <http://documents.worldbank.org/curated/en/519381482852102471/Bosnia-and-Herzegovina-Agriculture-and-Rural-Development-Project>.
- [61] Ibid.
- [62] Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina. "Plant Production."
- [63] Food and Agriculture Organization. "Comprehensive analysis of Disaster Risk Reduction and Management System for agriculture in Bosnia and Herzegovina." (2020). <http://www.fao.org/publications/en/>.
- [64] World Bank Group. "Bosnia and Herzegovina - Agriculture and Rural Development Project."
- [65] Zurovec, Ognjen, Pål Olav Vedeld, and Bishal Kumar Sitaula. "Agricultural Sector of Bosnia and Herzegovina and Climate Change—Challenges and Opportunities." *Agriculture* 5, no. 2 (2015): 245-66. <https://doi.org/10.3390/agriculture5020245>.
- [66] Ibid.
- [67] Ibid.
- [68] World Bank Group. "Bosnia and Herzegovina - Agriculture and Rural Development Project."
- [69] Hodzic, Sabina, Mihajlo Markovic, and Hamid Custovic. "Drought conditions and management strategies in Bosnia and Herzegovina." (Sarajevo, 2012). http://www.ais.unwater.org/ais/pluginfile.php/548/mod_page/content/72/Bosnia_Herzegovina_CountryReport.pdf.
- [70] Ibid.
- [71] United Nations, European Union and World Bank Group. "Bosnia and Herzegovina Floods 2014: Recover Assessment Need."
- [72] Global Facility for Disaster Reduction and Recovery. "Flood and Earthquake profile: Bosnia and Herzegovina." (2015). <http://pubdocs.worldbank.org/en/513001483041833038/bih.pdf>.
- [73] Zurovec, Ognjen, Pål Olav Vedeld, and Bishal Kumar Sitaula. "Agricultural Sector of Bosnia and Herzegovina and Climate Change—Challenges and Opportunities."
- [74] Ibid.
- [75] Ibid.
- [76] Ibid.
- [77] Food and Agriculture Organization. "Food and agriculture data."
- [78] World Bank Group. "Bosnia and Herzegovina - Agriculture and Rural Development Project."
- [79] International Energy Agency. "Bosnia and Herzegovina."
- [80] Ibid.
- [81] United Nations. "Climate Change Adaptation and Low Emission Development Strategy for Bosnia and Herzegovina."

- [82] Trbic, Goran et al. "Limits to Adaptation on Climate Change in Bosnia and Herzegovina: Insights and Experiences."
- [83] International Energy Agency. "Bosnia and Herzegovina."
- [84] Agency for Statistics of Bosnia and Herzegovina. "GDP by Expenditure Approach, Quarterly Data (in Croatian)." (Sarajevo, 2019). http://bhas.gov.ba/data/Publikacije/Saopštenja/2019/NAC_04_2019_Q1_0_HR.pdf.
- [85] Ibid.
- [86] Ibid.
- [87] International Energy Agency. "Bosnia and Herzegovina."
- [88] Ibid.
- [89] Council of Ministers of Bosnia and Herzegovina. "Second National Communication of Bosnia and Herzegovina under the UNFCCC."
- [90] Hodzic, Sabina, Mihajlo Markovic, and Hamid Custovic. "Drought conditions and management strategies in Bosnia and Herzegovina."
- [91] Agency for Statistics of Bosnia and Herzegovina. "Economic Statistics." (Sarajevo, 2020). http://bhas.gov.ba/data/Publikacije/Saopštenja/2020/ETR_01_2019_12_0_HR.pdf.
- [92] Massachusetts Institute of Technology. "The Observatory of Economic Complexity: Bosnia and Herzegovina profile."
- [93] Kulic, Fahrudin (Senior Engineer, USAID Energy Investment Activity). Interview by A. Causevic. Skype call. Stockholm, June 13, 2019.
- [94] Watts, Nick et al. "The Lancet Countdown on health and climate change: from 25 years of inaction to a global transformation for public health." *The Lancet* 391, no. 10120 (February 2018): 581-630. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(17\)32464-9/abstract?code=lancet-site](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(17)32464-9/abstract?code=lancet-site).
- [95] United Nations. "Climate Change Adaptation and Low Emission Development Strategy for Bosnia and Herzegovina."
- [96] United Nations, European Union and World Bank Group. "Bosnia and Herzegovina Floods 2014: Recover Assessment Need."
- [97] Ibid.
- [98] IQAir. "The 2018 World Air Quality Report." (Goldach, 2018). <https://www.airvisual.com/world-most-polluted-cities/world-air-quality-report-2018-en.pdf>.
- [99] Carlone, Marco, and Simone Benazzo. "Trading profit for health: exploring Bosnia's toxic relationship with coal." Euronews, (June 12, 2019). <https://www.euronews.com/2019/12/06/trading-profit-for-health-exploring-bosnia-s-toxic-relationship-with-coal>.
- [100] Health and Environment Alliance. "Coal's unpaid health bill in Bosnia & Herzegovina estimated at €3.1 billion." (Brussels, 2018). https://www.env-health.org/IMG/pdf/160314_pr_wb_bosnia_final_.pdf.
- [101] World Health Organization. "Annex: Economic cost of deaths from air pollution (outdoor and indoor) per country, as a percentage of GDP WHO European Region, 2010." (Geneva, 2010). http://www.euro.who.int/__data/assets/pdf_file/0008/276956/PR_Economics-Annex_en.pdf?ua=1.
- [102] The United Nations Environment Programme. "Coming up for clean air in Bosnia and Herzegovina." (January 2, 2018). <https://www.unenvironment.org/news-and-stories/story/coming-clean-air-bosnia-and-herzegovina>.
- [103] Health and Environment Alliance. "The Unpaid Health Bill: How coal power plants in the Western Balkans make us sick." (Brussels, 2018). https://www.env-health.org/IMG/pdf/factsheet_eu_and_western_balkan_en_lr.pdf.

[104] Kulic, interview.

[105] World Travel and Tourism Council. "The Economic Impact of Travel and Tourism 2017: Bosnia and Herzegovina." (London, 2017). <https://www.wttc.org/-/media/files/reports/economic-impact-research/countries-2017/bosniaherzegovina2017.pdf>.

[106] Cavalic, Admir, Faruk Hadzic, and Damir Becirovic. "COVID-19 Analysis - Economic Consequences for Bosnia and Herzegovina, Measures and Solutions." (Sarajevo, 2020). <https://westbalkan.fnst.org/content/covid-19-analysis>.

[107] Ibid.

[108] Ibid.

[109] United Nations Development Programme. "Technology transfer for climate resilient flood management in Vrbas River Basin." (2015). <https://www.adaptation-undp.org/projects/sccf-bosnia>.

[110] Vukmir, interview.

[111] State Electricity Regulatory Commission of Bosnia and Herzegovina. "Annual Report 2018 (in Bosnian)."

[112] United Nations Development Programme. "Renewable Energy Snapshot: Bosnia and Herzegovina." (2014). <http://www.undp.org/content/dam/rbec/docs/Bosnia%20&%20Herzegovina.pdf>.

[113] Hadzic, Faruk. "FBiH and RS Budgets Analysis 2016–2018 (in Bosnian)." (Zenica, 2019). <https://bit.ly/2YCdQOq>.

[114] Ploskic, Adnan (Senior Researcher, KTH Royal Institute of Technology). Interview by A. Causevic. Skype call. Stockholm, August 4, 2020.

[115] State Electricity Regulatory Commission of Bosnia and Herzegovina. "Annual Report 2018 (in Bosnian)."

[116] Bankwatch Network. "Tuzla 7 lignite power plant, Bosnia and Herzegovina." (2019). <https://bankwatch.org/project/tuzla-7-lignite-power-plant-bosnia-and-herzegovina-2>.

[117] Bankwatch Network. "Stanari lignite power plant, Bosnia and Herzegovina." (2019). <https://bankwatch.org/project/stanari-lignite-power-plant-bosnia-and-herzegovina>.

[118] Bloomberg New Energy Finance. "New Energy Outlook 2018." (New York, 2018). <https://about.bnef.com/new-energy-outlook/>.



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